TEAM ADVISOR RESOURCE GUIDE

Dear Team Advisor,

On behalf of the U.S. Army Educational Outreach Program (AEOP), I want to welcome you to eCYBERMISSION. I am thrilled that you are taking the first step to provide this science, technology, engineering and mathematics (STEM) opportunity to your students. I know that you and your students will find the program to be a challenging and rewarding experience. Across the nation, teachers are looking for innovative ways to engage students in STEM disciplines and build 21st century skills. We believe this competition is an exciting way to meet these challenges and help your students understand and embrace the real-world applications of STEM.

In 2012, the U.S. Army eCYBERMISSION program reached out to teachers across the nation who served in the capacity of Team Advisors (TA) to come together and develop an enhanced Team Advisor Resource Guide. The group represents a diverse group of educators from across the country, all of whom have actively participated in eCYBERMISSION with students in classrooms and afterschool programs. Over a four-month period, The TAs in the Roundtable used their unique experiences to generate this resource guide. It is easy to use and can be applied to a wide variety of student settings throughout the nation.

This Team Advisor Resource Guide contains:

- Administrative Information
- Rules for Participation
- Sample Lesson Plans (6th, 7th, 8th and 9th grades)
- Best Practices
- Public Relations and Community Involvement
- Additional Resources

The goal in creating this resource guide is to provide Team Advisors first hand, classroom-based advice to walk them through each task associated with completing Mission Folders. The resource guide will also provide sample lesson plans segmented by grade level to assist in teaching the fundamentals of STEM in a dynamic fashion. Student enrichment through eCYBERMISSION meets various aspects of the National Science Standards and has the structure in place to help students develop integral academic skills while using STEM to solve problems.

I hope that this guide will not only provide you with the necessary tools to easily infuse this program into your current curriculum, but provide an avenue to authentically engage your students in STEM studies.

Louie R. Lopez
U.S. AEOP eCYBERMISSION Program Manager

National Science Teachers Association

1840 Wilson Boulevard • Arlington, VA 22201-3092
703-243-7100 • Fax. 703-243-7177 • *www.nsta.org*

Executive Director
703-312-9254
703-243-0407

Dear Team Advisor:

On behalf of the National Science Teachers Association (NSTA), I would like to welcome you and your students to the U.S. Army's eCYBERMISSION competition. I hope you share in our enthusiasm and excitement about this program and the opportunity it presents for you and your students.

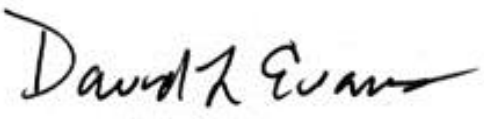
Many kinds of learning experiences, including science competitions like eCYBERMISSION, can contribute significantly to a student's education. This program helps students connect what they have learned in the classroom to real-world applications, which enhances student engagement and provides examples of how their learning is linked to future career options.

Teachers and mentors, like you, are the primary agents for effecting meaningful change in science, technology, engineering, and math (STEM) education and play a vital role in cultivating an interest in science in our nation's youth. As a former educator, I know that there are multiple demands and responsibilities placed on teachers and mentors each day and that participating in extracurricular programs and competitions can be arduous. To that end, we greatly appreciate your decision to participate in the eCYBERMISSION program as it will, indeed, make a difference in the lives of your students.

NSTA is thrilled to be working with the United States Army to promote high-quality learning opportunities and experiences that foster interest in innovation and build students' knowledge in the STEM disciplines. Our involvement and support of this program underscores NSTA's continued commitment to elevating the quality of STEM education in the U.S.

We look forward to following you and your students' progress and experience throughout the competition and wish you the best of luck.

Best regards,



David L. Evans, Ph.D.
Executive Director, National Science Teachers Association

Table of Contents

TEAM ADVISOR ROUNDTABLE BIOS

The eCYBERMISSION Program carefully selected 10 Team Advisors from throughout the country to participate in the Team Advisor Roundtable. Over a course of four months, these individuals met both in person and virtually to create this robust resource guide to assist you in implementing the program in your classroom.

Barbara Morrow: *Sixth-Grade Focus.* Barbara Morrow currently teaches middle school science at Providence Day School in Charlotte, N.C. (since 2000). From 1997-2000, she taught middle school science and served as the Science Department Chair at Albemarle Road Middle School in Charlotte, N.C. Earning a Bachelor of Science in Biology from Salem College in 1995, she completed internships at the Bowman Gray School of Medicine and RJ Reynolds Tobacco Company in Winston Salem, N.C. Mrs. Morrow presently coaches eCYBERMISSION, Science Olympiad, Science Quiz Bowl, and SIEMENS competitions and has been a national assessment writer since 2007.

Mary Nielsen: *Sixth-Grade Focus.* Mary Nielsen received a Bachelor's in Arts in Elementary Education and a Master's of Science in Educational Administration from Fort Hays State University in Hays, Kan. She has spent 28 years in education and strives to provide professional leadership in a school environment where there is a desire to help all students develop positive learning habits and skills that will lead them toward a life of independent discovery. Ms. Nielsen has served as an eCYBERMISSION Team Advisor for the past two years, along with coaching both the Science Olympiad and an afterschool robotics program.

Frank Curcio: *Seventh-Grade Focus.* Frank Curcio retired from government service in July 2006 after 25 successful years and has come full circle back to education, as he was previously a high school physics teacher. Currently, Mr. Curcio teaches "Introduction to Applied Physics" and "Physical Science" at Sanford Math, Science & Technology Magnet Middle School in Sanford, Fla. He has been active in eCYBERMISSION since the program's inception and has served as a Team Advisor to more than 550 students.

Holly Erickson: *Seventh-Grade Focus.* Holly Erickson is a founding member of and seventh grade math educator at the STEM Center Middle School in West Fargo, N.D. She earned her Bachelor's in Elementary Education and English Language Learners with a focus on math and teaching Middle Level. She coaches eCYBERMISSION, BEST (Boosting Engineering Science and Technology) Robotics, and TARC (Team America Rocketry Challenge) Teams for seventh through 10th grade.

Migdalia Sanabria: *Seventh-Grade Focus.* Migdalia Sanabria is a Nationally Board Certified Science Teacher. She is a seventh-grade Science Educator at the Queens School of Inquiry, a sixth through twelfth grade college preparatory school in Flushing, N.Y. She earned her Bachelors in Science and obtained her Master's Degree in Science Education. In 2012, one of her eCYBERMISSION Teams was selected as the First-Place State Winners for New York. She has been a Team Advisor for the eCYBERMISSION Program for the past five years.

Jennifer Roberts: *Eighth-Grade Focus.* Jennifer Lionetti Roberts is an eighth grade Gifted and English for Speakers of Other Languages endorsed Science educator at Coral Springs Middle School in Coral Springs, Fla. She completed pre-professional studies while earning her Bachelors of Science degree in Food Science and Human Nutrition from the University of Florida. Jennifer has been an educator for 13 years and part of eCYBERMISSION since 2002 with six Winning Teams. She enjoys spending her free time with her husband Steven, who is a Veterinarian, and her 4-year-old daughter Madison.

Miken Harnish: *Eighth-Grade Focus.* Miken Harnish is an eighth-grade science teacher and instructional coach at Wheatland Middle School in Wheatland, Wyo. She has a Bachelor's of Science in Science Education for grades seven through 12 and a Masters of Business Administration. She is on the Wyoming State Science Standards Committee and has been involved with the Wyoming State Science Assessment Committees for the past six years. At Wheatland Middle School, Miken is the science fair coordinator, LEGO robotics coach, and the eCYBERMISSION Team Advisor. In addition to sharing her love of science with students for the past 14 years, Miken has also been a community leader for Girl Scouts, Cub Scouts and 4-H.

JoAnne Brown: *Ninth-Grade Focus.* JoAnne Brown has been a science educator in Salt Lake City, Utah, for the past 14 years. She received her Master's in Teaching from the Evergreen State College in Olympia, Wash., and has since received endorsements in Biology, Integrated Science and Gifted Education. She was President of the Utah Science Teachers Association and is a leader in science education in her state. She has been recognized as her school district's Teacher of the Year, and has been instrumental in helping her students and school receive more than $200,000 in grants, scholarships and awards over the past few years.

Tim Meadows: *Ninth-Grade Focus.* Tim Meadows served in the U.S. Army for 21 years and is still serving as the Army Instructor for the Army Junior Reserve Officer Training Corps (JROTC) at Crosby High School in Crosby, Texas. Tim has been teaching at Crosby High School and Crosby Middle School for the past eight years. He has a Bachelor's of Science degree in Multidisciplinary Studies and is currently working on his Masters. He coaches the seventh through ninth grade eCYBERMISSION Teams, JROTC Orienteering Team, Teen Community Emergency Response Team (CERT) and is very active in the community, with more than 100 hours of service to the community each year.

Stephanie Hsu: *Ninth-Grade Focus.* Stephanie Hsu received her Bachelor of Science degree in Chemistry from the University of Florida. She has taught in Manatee County School District in Florida for the past 10 years, and has taught Physical Science and Biology at Braden River High School for the past five years. She is the *Bradenton Herald* Golden Herald Awards coordinator at Braden River High, and has integrated eCYBERMISSION into her classroom curriculum for the past two years.

ADMINISTRATIVE INFORMATION

1. Competition Timeline

Early August 2017	Student & TA registration **opens** Ambassador registration **opens** CyberGuide registration **opens** Virtual Judge registration **opens**
November 8, 2017	Early registration ends (deadline to receive free STEM kit)
December 13, 2017	Student & TA registration **ends**
February 28, 2018	CyberGuides' registration **ends**
February 28, 2018	CyberGuides' **last day** online
February 28, 2018	Virtual Judge registration **ends**
February 28, 2018	Final day to **submit** Mission Folders
March 14, 2018	Virtual Judging **begins**
March 30, 2018	Virtual Judging **ends**
April 9, 2018	Potential State Winners and Regional Finalists contacted for validation
April 13, 2018	Potential winners' validation forms due
April 16 - 20, 2018	Equipment testing for Regional Judging video conference
April 23-27, 2018	Regional Judging
Early May 2018	State Winners, Regional Winners, and National Finalists Announced
Late June 2018	**National Judging & Educational Event**

Notes regarding the timeline**:**

1. Potential winner validation includes review of the team make-up and Mission Folder contents. Quick adjustments will need to be made if any State Winning Teams must be disqualified. Actions that could lead to disqualification:
    a. Students on one team are from different grades or states
    b. Students or their parents do not have a Social Security Number for savings bonds
    c. Team Advisor is unable to certify the start date of research as on or after April 1, 2017.
    d. Any competition rules are found to be violated.
2. Regional Finalists will be determined by overall score from Virtual Judging. The top three scores in each grade in each region will advance to the regional judging.
3. Regional Judges will be provided a copy of the team's Mission Folder electronically for advance reviews.

4. The Regional Judging Panel will be conducted via an online video conference with each Regional Finalist Team:
    a. Team presentation to Regional Judges (4 minutes)
    b. Regional Panel Q&A (3 minutes)
5. All Regional Judging will take place during the week of April 23, 2018.

2. Submit Your Mission Folder

Use the checklist below to determine if your team is ready to submit their Mission Folder:
Has your team:

- ☐ Selected a Mission Challenge?
- ☐ Determined which method to use (scientific inquiry using scientific practices or engineering design process)?
- ☐ Answered all questions in the Mission Folder?
- ☐ Checked the written entry for spelling or grammatical errors?
- ☐ Checked that your tables, charts, maps, and graphs are accurate?
- ☐ Provided the Mission Folder to a Team Advisor, parent, or another adult for review?
- ☐ Attached supplemental materials for the Virtual Judges to score (encouraged)?
- ☐ Attached the supplemental materials in an acceptable file types? Failure to do so could result in the inability of a Virtual Judge to view the attached file.

Acceptable File Types	
No more than 30 files attached, or maximum allowable size, 10 MB	
Microsoft Word: .doc, .docx	Adobe Acrobat: .pdf
Microsoft PowerPoint: .ppt, .pptx	Flash Files: .swf
Microsoft Excel: .xls, .xlsx	Image Files: .gif, .jpg
Microsoft Publisher: .pub	Web design files: .htm, .html, .css

- ☐ Had the Team Advisor electronically sign the Mission Folder and verify the project start date?
- ☐ Completed and attached any Survey Approval Forms or IRB Approval Forms (see Competition Rules for details) to your Mission Folder?
- ☐ Completed the Mission Folder before the February 28, 2018 submission deadline?

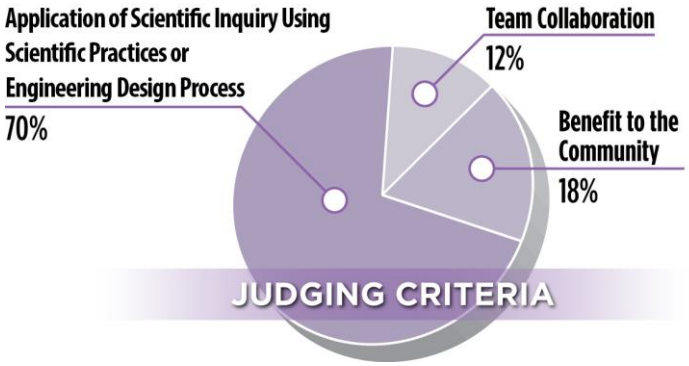
Once you have completed each of these steps, your team's Mission Folder is complete and ready for submission and judging!

3. Judging

After submission, each Mission Folders is assigned to five randomly selected Virtual Judges. These individuals are STEM experts and work as chemists, biologists, engineers, nutritionists, physicists, and in numerous other STEM fields. Virtual Judges are located throughout the nation and are subject to an extensive eCYBERMISSION training process before scoring the Mission Folders.

Mission Folder Scoring Criteria

The Virtual Judges assign scores based on three basic criteria: Application of Scientific Inquiry using Scientific Practices or Engineering Design Process; Benefit to the Community; and Team Collaboration.



Application of Scientific Inquiry using Scientific Practices or Engineering Design Process (70 percent)

- Effective use of scientific practices and problem solving strategies
- Extensive research and reputable sources
- Logical conclusions based on data collected
- Appropriate use of scientific terms, equipment, materials and mathematic equations
- Effective use of technology as part of the solution

Benefit to the Community (18 percent)

- Selected problem deals with a challenging community issue
- Proposed solution could have a positive impact on the whole community, or a segment of a population in the community
- Proposed solution has the potential to be implemented
- Direct demonstration of the benefit of the team's proposed solution on the community

Team Collaboration (12 percent)

- Evidence that the team worked together
- Effective use of a broad range of team member skills
- Involvement of community members as resources

Overall presentation is organized, clear and free from grammatical and spelling errors

Judging Comments

In addition to providing your Mission Folder scores, eCYBERMISSION encourages Virtual Judges to provide encouraging and constructive comments after they have completed reviewing each team's Mission Folder. The Virtual Judges typically provide feedback in the following areas:

- Quality of the Mission Folders
- Competent understanding and use of the scientific inquiry using scientific practices or engineering design process
- Value and impact on the community
- Amount of research conducted and proper references
- Quality and quantity of attachments
- Proper spelling and grammar.

Below are some featured comments from past, high-scoring Mission Folders:

- **"[The] Project was unique and [the] submission was an example of a well thought-out, organized and documented project that demonstrated a benefit to the community."**
- **"Excellent job with your pre-experiment research and in presenting your bibliography! Also, good job on identifying potential areas for future research."**
- **"You measured the knowledge base of an important segment of your community, then you presented information to that segment, and then you measured the knowledge base again to see if it changed as hypothesized. Real science!"**
- **"This team came up with a fresh, original idea to research and work on. Their commitment and work showed in a Mission Folder they can be proud of."**

Mission Folder Scorecards

Mission Folders receive grades following one of two scorecards; the Scientific Mission Folder Scorecard, which aligns with all teams that submitted Mission Folders based on scientific inquiry using scientific practices; and the Engineering Mission Folder Scorecard, based on principals used in the engineering design process. Both are weighted identically to ensure fairness and unbiased scoring, as is evidenced below.

The Scoring Rubrics for both the Scientific Mission Folder and the Engineering Mission Folder are available online. Please reference the Advisor Resource section on the eCYBERMISSION website (http://www.ecybermission.com/AdvisorResources) for those scoring rubrics.

Variation in Scorecards

There are slight variations in the scorecards for Scientific Inquiry using Scientific Practices and Engineering Design Process techniques. These differences are a direct result of the need to accurately capture the work done by teams focusing on engineering. While engineering students typically do not learn the engineering design process before entering secondary school eCYBERMISSION recognizes the need to expose interested students to this concept earlier in their education.

While the scorecards vary slightly, the points for each section of the "Use of the Engineering Design Process" and "Use of Scientific Inquiry Using Scientific Practices" phases are equal to ensure that judging is fair and impartial.

Mission Folder Scorecard Sections	Scientific Mission Folder	Engineering Mission Folder
Problem Statement	75	75
Hypothesis	45	-
Experimental Design	100	45
Build Prototype	-	100
Test Prototype	-	75
Data Collection and Analysis	75	-
Drawing Conclusions	55	55
"Use of" Subtotal	**350**	**350**

4. Awards and Incentives

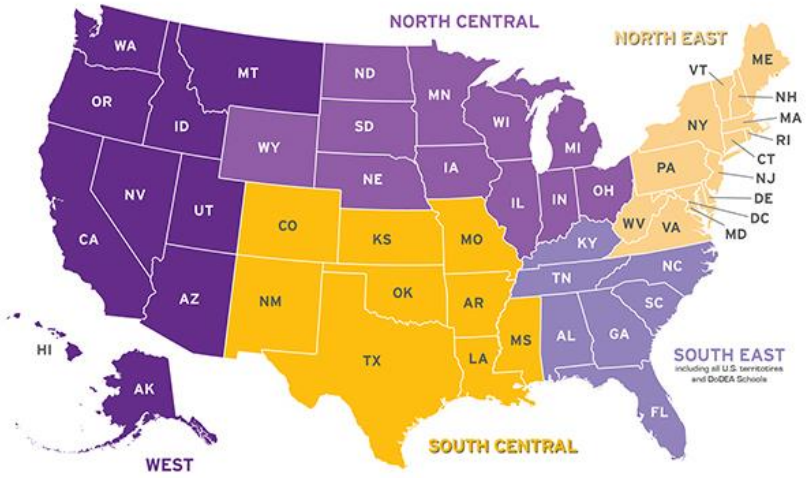
eCYBERMISSION seeks to award teams who perform at an exemplary level in order to create an opportunity for students to continue their love of research and knowledge into their college careers.

2017-2018 Award Structure

State Awards	
First-Place State Winners* **	$1,000 U.S. Savings Bonds (matured value) per student or equivalent
Second-Place State Winners**	$500 U.S. Savings Bonds (matured value) per student or equivalent
Regional Awards	
All Regional Finalists	$1,000 U.S. Savings Bonds (matured value) per student.
First-Place Regional Winners**	$2,000 U.S. Savings Bonds (matured value) per student, or equivalent, and an all-expense paid trip to the Washington Metropolitan Area to compete for the First-Place National Award
National Awards	
First-Place National Winners	$5,000 U.S. Savings Bonds (matured value) per student or equivalent

*Non-U.S. based Department of Defense Education Activity School entries will be considered as one state (i.e., Armed Forces Europe and Armed Forces Pacific). U.S. Territories and Commonwealths will be considered as one state (i.e., American Samoa, U.S. Virgin Islands, Guam and Puerto Rico)
**In order to be eligible for an eCYBERMISSION Award, the Mission Folder must have received a composite score of at least 300 during the Virtual Judging process.

The following map displays eCYBERMISSION's regional divisions:



RULES FOR PARTICIPATION

For more information on the rules of participation, please view the official Competition Rules.

SAMPLE LESSON PLANS

1. Grade 6

1.1 TEAMWORK

Title: Sixth Grade Teamwork Lesson Plan

Goal/Purpose:

1.) To instill/model effective teamwork among groups when faced with a scientific or engineering challenge.
2.) To enhance communication among team members and guide students into self-determining roles.

Objectives:

1.) Students will list the characteristics of an effective team and team leader.
2.) Students will discuss the various skills, strengths, and roles of team member.
3.) Students that will work together toward a common goal that will benefit the community.

Standards:

Next Generation Science Standards:

Practice 6: Constructing Explanations and Designing Solutions

• Apply scientific ideas, and/or use an explanation for real-world phenomena, examples, or events.
• Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.
• Undertake a design project, engaging in the design cycle to construct and/or implement a solution that meets specific design criteria and constraints.
• Apply scientific ideas of principles to design, construct, and/or test a design of an object, tool, process, or system.
• Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.

Common Core State Standards for English Language Arts

Speaking and Listening Standards (Grade 6)

Domain: Presentation of Knowledge and Ideas

Standard 4. Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation.

Domain: Comprehension and Collaboration

Standard 1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.

Time:	Materials:
Six class periods, 45 minutes each.	(Enough to build two replicas of the same device, model or sculpture): - K'NEX - Paper plates - Polystyrene cups - Straws - LEGO's - Tape - Coffee stirrers - Wire - Nuts/bolts/washers - Magnets - Clay - Ruler - Walkie talkies - Ziploc bags/Small boxes (for group materials)

Instructional Procedures:

Teacher Preparation (20 minutes)

1.) Arrange students in groups of three to four based on teacher knowledge of each student.

- *Initial student grouping can be difficult. If students choose the groups themselves, there is often a student left out.*

2.) Build five different devices, models or sculptures out of simple materials.

- *Building the device, model or sculpture is often best when they are made of the same materials.*

3.) Create five different stations, each with a different device, model or sculpture at each station. DO NOT allow students to see stations ahead of time.

4.) Compile the materials needed to build a replica of the device, model, or sculpture into a separate storage container (Ziploc® bag, small box, etc.).

Day 1

1. First five minutes: Ask students to get into their assigned group and fill out the characteristics of an effective team. (This is a pre-assessment).
2. With no explanation of what students will be doing, give students 30 seconds to determine a team "leader." This leadership role will change as students rotate through the stations each day.
3. Provide student leaders (only) the instructions for their station on a card or printout.
4. Next 30 minutes: All students are to assemble the device, model or sculpture based on the different instructions at each station.
5. Last 10 minutes: Ask students to disassemble their materials and place them back into the container. (Allow five minutes for this).
6. Last 10 minutes: Have students fill out the student sheet. (Students will do this during the last five minutes of each remaining class period until the student sheet is completed).

Day 2-5

1. Have students begin with a new station

Teacher Notes:

Advanced/Gifted Students:

Have student leaders make a video recording summarizing their experience as a leader. Combine all group member responses into one video clip. Have students take a digital photo of their final product and the device, model or sculpture.

ESE/Special Needs Students:

Instead of writing procedural steps, allow students to take digital photos of each step as their procedure.

Reinforcement/Extension:

1.) Teachers should pre-select and change groups each day.

2.) After all stations are completed teachers should give students a problem to solve. (This could be an experiment or a design challenge).

each day.

2. Repeat day one, steps 1-6 each day. With each day, students must choose a different leader, and each student should participate as a leader at least once during the entire week.

Day 6

1. First 10 minutes: Have student leaders for each day get into groups.
2. Next 10 minutes: Allow them to discuss any issues they had in achieving their goals.
3. For the remaining portion of the class period, have students discuss each member's strengths, and the potential role they could fulfill on a team.

Assessment:

1.) Probe students for understanding of what an "effective" team is and the dynamics of successful teamwork.
2.) Worksheet 1 and 2
3.) Qualitative assessment on how teams worked together, and which teams needed teacher help.

Resources:

http://www.ehow.com/info_12121901_fun-games-play-walkie-talkies.html

Worksheet 1: Student Team Leader Station Instructions

Team Leader Instructions

In the given time, your group must build an exact replica of the ____ (device, model or sculpture) at your station.

Station 1

Instructions:

Your team members may not see what they are building ahead of time. Give your team members the materials in the bag (or box) and one of the walkie talkies. You will then go into the hallway (or anywhere out of view and approved by your teacher). Take the completed ____ (device, model or sculpture) with you. You will use the walkie talkie to communicate instructions on how your team should build the ____ (device, model or sculpture).

Total Time (for you and your group): _____

In the given time, your group must build an exact replica of the ____ (device, model or sculpture) at your station.

Station 2

Instructions:

You and your team members are not allowed to communicate with your voices or in writing.

Total Time (for you and your group): _____

In the given time, your group must build an exact replica of the ____ (device, model or sculpture) at your station.

Station 3

Instructions:

Give your team members the materials in the bag (or box). All members of your group (yourself included) must place their dominant hand behind their backs. This hand must remain there throughout the class period. Switching hands at any time is not allowed.

Total Time (for you and your group): _____

In the given time, your group must build an exact replica of the ____ (device, model or sculpture) at your station.

Station 4

Instructions:

Your team members may not see what they are building ahead of time. You will go into the hallway (or anywhere out of view approved by your teacher). In ten minutes, write a procedure (using only words and no pictures) of how to build the ____ (device, model or sculpture). You may not communicate to your team in any other way. Give your team members the materials in the bag (or box).

Total Time For You: _____ Total Time For Your Group: _____

In the given time, your group must build an exact replica of the ____ (device, model or sculpture) at your station.

Station 5

Instructions:

Your team members may not see what they are building ahead of time. You will go into the hallway (or anywhere out of view approved by your teacher). In 10 minutes, draw pictures/symbols of how to build the ____ device, model or sculpture). You may not use words or communicate to your team in any other way. Give your team members the materials in the bag (or box).

Total Time For You: _____ Total Time For Your Group: _____

BEFORE the activity…

What are the characteristics of an effective team?

1.

2.

3.

Station 1

BEFORE the activity…

What are the characteristics of an effective leader?

1.

2.

3.

What worked well:

1.

2.

3.

What did not work well:

1.

2.

3.

What worked well:

Station 2

1.

2.

3.

What did not work well:

1.

2.

3.

Station 3

What worked well:

1.

2.

3.

What did not work well:

1.

2.

3.

Station 4

What worked well:

1.

2.

3.

What did not work well:

1.

2.

3.

Station 5

What worked well:

1.

2.

3.

What did not work well:

1.

2.

3.

AFTER the activity…

What are the characteristics of an effective team?

1.

2.

3.

AFTER the activity…

What are the characteristics of an effective leader?

1.

2.

3.

1.2 UNDERSTANDING AND SELECTING A MISSION CHALLENGE

Title: Sixth Grade Understanding and Selecting a Mission Challenge Lesson Plan

Goal/Purpose:

1.) To help students understand and select Mission Challenges.
2.) To help students see the vast majority of problems they could investigate within their Mission Challenge.

Objectives:

1.) Students will generate a list of local and world problems and identify the Mission Challenge category in which the problem best belongs.
2.) Student will use the Internet to research three community problems.
3.) Students will use their research to select an appropriate Mission Challenge.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
• Ask questions that require sufficient and appropriate empirical evidence to answer.
• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Common Core State Standards English Language Arts

Reading Standards for informational Text (Grade 6)

Domain: Key Ideas and Details

Standard 1. Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Domain: Integration of Knowledge and Ideas

Standard 8. Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.

Writing Standards (Grade 6)

Domain: Text Types and Purposes

Standard 1. Write arguments to support claims with clear reasons and relevant evidence.
a.) Introduce claim(s) and organize the reasons and evidence clearly.
b.) Support claim(s) with clear reasons and relevant evidence using credible sources and demonstrating an understanding of the topic or text.

	Speaking and Listening Standards (Grade 6) **Domain: Comprehension and Collaboration** **Standard 1.** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade level topics, texts, and issues, building on others' ideas and expressing their own clearly. **b.)** Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed. **c.)** Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text or issue under discussion. **d.)** Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing.
Time: Five class periods, 45 minutes each.	**Materials:** Butcher-block paper (post-it) Red & Blue Markers (one per group) Copies of Student Sheets 1, 2, 3, and the article "Water Crisis in the Nepal Himalayas" Access to Internet

Instructional Procedures:

Day 1:

1. First 20 minutes: Have students get into their pre-determined groups.
2. On the Student Sheet (attached), ask students to create a concept map about as many different "problems" in the community as they can think of. Have students use one color for problems occurring locally and one color for problems occurring globally. Students should record only problems that can be solved using science or engineering.
3. Ask students to copy their concept map onto the butcher block paper. Once all groups are finished, hang the concept maps in the classroom.
4. Minutes 20-40: After all groups have had a chance to view the concept maps of all groups, each group should agree upon and select 10 problems to list on Student Sheet 2. Students should divide the problems amongst themselves and research those problems on the Internet.

Day 2:

1. First 30 Minutes: Give each student a copy of Student Sheet 2. Ask them to fill out the top left box "What I Know about Water."
2. Give each student a copy of the article "Water Crisis in the Nepal Himalayas." (Students could either read this individually or aloud depending on the nature of the class.)
3. Once they have read the article, have students finish the other three boxes on Student Sheet 2.
4. Last 15 minutes: In their pre-determined groups, have students return to the 10 problems they chose to research on Day 1. Have students begin to brainstorm possible solutions to the problems listed (this may continue into Day 3).

Day 3

1. Have students finish the "10 Problems" chart. Students should identify the eCYBERMISSION Mission Challenge for

Teacher Notes:

Advanced/Gifted Students:

Have students find their own articles about the water crisis in both the U.S. and abroad. Students can share their articles with the rest of the class.

ESE/Special Needs Students:

Have students highlight 20 terms in the article they think are relevant. Make sure the students understand the meaning of the terms they have highlighted. Have students form a paragraph using these terms.

Reinforcement/Extension:

Find another article pertaining to the world's water crisis.

Have students determine other areas of the world experiencing similar water shortages.

each problem.

2. Have each group select three of the problems in their table they would like to investigate seriously as their eCYBERMISSION project.

Day 4:

1. Using the Internet, have students begin to research what has already been done on their three selected problems.

Day 5:

1. Share Day: Have students get into their pre-determined groups and share the information they found about the three problems their group chose. Have students start to form a plan, or assign more in-depth research to the problems. Hopefully students will determine their idea for the Mission Challenge.

Assessment:

1.) Completion of Student Sheets 1, 2, and 3
2.) Probing for Understanding of the Mission Categories
3.) Teacher could provide students with a list of the eCYBERMISSION categories and generate a list of local and global problems. Students should identify the category in which each problem belongs.

Resources:

http://www2.fiu.edu/~sukopm/seminar/Suresh.pdf

Worksheet 1: Concept Map

Key:

Blue= Local Problem

Worksheet 2: 10 "Problems" My Group Is Interested in Researching

1.Alternative Sources of Energy 2. Environment 3. Food, Health & Fitness 4. Forces & Motion

5. National Security & Safety 6. Robotics 7. Technology

Problem	Is this a local problem or a global problem?	Who will be responsible for conducting Internet research about this problem?	Possible solution to this problem	eCYBERMISSION Mission Challenge
1.				
2.				
3.				
4.				
5.				

6.				
7.				
8.				
9.				

Reference Article:

WATER CRISIS IN THE NEPAL HIMALAYAS - A CASE OF TOO MUCH, YET TOO LITTLE

Dr. Suresh Das Shrestha,
Tribhuvan University, Kathmandu, Nepal

Himalayan peaks with the legendary 'eight thousanders' are referred to as water towers of South Asia. They are the sources of all the three of south Asia's major river systems, the Indus, the Ganges and the Brahmaputra, and Nepal lies in the middle of it. The five river basins of Nepal, all important tributaries of River Ganges, contribute 71 % of the annual flow during the dry season and 40% in the monsoon which sees 80% of the total rainfall. The total renewable water resources including the groundwater adds up to 210.2 billion km3 /year, which makes Nepal one of the Asian countries with the highest level of water resources.

The reality however is quite different. In spite of all the above resource, Nepal faces acute shortage of water and remains one of the poorest countries in the world. For many Nepalese who live in the hills, the water flowing in the large valleys below is out of reach. Families in the mountains have to do with less than 5 liters per capita per day as compared to 700 liters used by an average person in USA. Only half of all farm land is irrigated and more than a third of the population has difficulties in obtaining water. In Monsoon however, widespread landslides and flooding take heavy tolls on human lives and the infrastructure. Only 10% of the country's groundwater potential is utilized and so far only 253 MW of hydropower has been generated which is 0.3% of the total potential.

The uncontrolled dumping of wastes into flowing streams has turned the Himalayan waters into giant sewers. It is said that 80% of the country's illness is due to contaminated water. Every year many children die from the water-borne diseases like dysentery, hepatitis, and even cholera, which are very common throughout the country. In recent years, another menace has been added to the list of the water pollutants -- Arsenic. Five of the southern districts in the plains bordering India have shown large concentration of arsenic in shallow groundwater, the only source of water supply for some 10 million people. Water in many wells exceeds the regional standard of 50 ppb but the problem is more acute in Nawalparasi. Most have no choice except to use the contaminated water. Though it is believed the

symptoms of arsenic starts to show after some 8 to 10 years, random cases of Arsenicosis can be now observed in some villagers. Though it is believed that the cause is natural in origin, why and how arsenic is transferred from the soil to water is still debated and little understood.

There is no simple single solution for all the problems mentioned above. The obvious solution for the water shortage would be to store and treat the river water, but building dams in the world's youngest and most fragile hills, which are known to sit in the seismically active zone, is not easy. Steep gradients of the streams and siltation problems make the job even more challenging. Also the economic, social and environmental cost makes them unattractive. Although the biggest demand for Himalayan water comes from agriculture, large scale irrigation projects in the mountains are impractical because there are only small pockets of cultivable land. Moreover large rivers flow at the bottom of the mountains while the farms are perched higher on the terraces carved out of the slopes.

http://www2.fiu.edu/~sukopm/seminar/Suresh.pdf

Worksheet 3: Two, Four Corners Sheets

Three Things I Know About Water: 1. 2. 3.	Three Things I Learned From the Article: 1. 2. 3.
Three Things That Could Help the Water Situation in the Nepal Himalayas: 1.	Summary of Article: (in five sentences)

2. 3.	

Worksheet 4: Solutions

Problem	What has already been done to “fix” this problem? Attach any articles you found about the solution.
1.	
2.	

3.	

1.3 DEVELOPING A PROBLEM STATEMENT

Title: Sixth Grade Developing a Problem Statement Lesson Plan

Goal/Purpose:

1.) To encourage students to work on meaningful, relevant problems.
2.) To develop "both problem solving strategies and disciplinary knowledge base and skills by placing students in the active role of problem solvers confronted with an ill-structured problem that mirrors real-world problems" (Finkle & Torp, 1995).

Objectives:

1.) Students will determine whether a problem exists, and if so, identify the solution.
2.) Students will identify information needed to understand a problem.
3.) Students will develop a meaningful problem statement in their scientific experiment.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
• Ask questions that require sufficient and appropriate empirical evidence to answer.
• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Common Core State Standards for English Language Arts

Writing Standards (Grade 6)

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.

Speaking and Listening Standards (Grade 6)

Domain: Comprehension and Collaboration

Standard 1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade level topics, texts, and issues, building on others' ideas and expressing their own clearly.

Reading Standards for Literacy in Science and Technical Subjects (Grade 6)

Standard 7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions

<table>
<tr><td></td><td>that allow for multiple avenues of exploration.</td></tr>
<tr><td>Time:
Two class periods, 45 minutes each.</td><td>Materials:
Student Sheet 1
Access to Internet
Digital recording device (iPad, phone, or camera- if available)</td></tr>
<tr><td>Instructional Procedures:
1.) Have students get into pre-determined groups.
2.) Give each student a copy of Student Sheet 1 and read the introduction together.
3.) Have students work together for the rest of the period to answer the questions in the table as a group.
4.) Have students report/present their group’s problem statement.

Assessment:
1.) Probing for understanding. Students will feel ownership of their problem statement if they have little help from their teacher in developing it.
2.) Well-developed problem statement.
3.) Teacher can give students several examples of both well-structured and ill-structured problems and have students write problem statements from each example.</td><td rowspan="2">Teacher Notes:

<u>Advanced/Gifted Students:</u>
Have students create both a well-structured problem and an ill-structured problem. Have them then switch papers with someone else and develop problem statements for each problem.

<u>ESE/Special Needs Students:</u>
Have students bring in digital photos of a problem they have seen. Have them make a 20-second infomercial about the problem and how they could solve it.

Reinforcement/Extension:
Give each group a different situation on a card and have groups rotate the cards among the groups.

Students discuss group problem statements for eCYBERMISSION Project at end of each class period.</td></tr>
<tr><td>Resources:
http://istudy.psu.edu
http://www.cotf.edu/ete/teacher/teacherout.html</td></tr>
</table>

STUDENT SHEET 1: PROBLEM STATEMENT[1]

INTRODUCTION

One of the most common difficulties when solving a problem scientifically is that we don't always identify the real problem. Sometimes, we head down the wrong path and solve only a part of the problem, or we find we are not tackling the original problem we first began to investigate.

Here is an example:

"Guests on the upper floors of a hotel complain that the elevators are slow."

Most people would determine the problem to be that the elevators are slow, and they would try to determine a way to make them faster while keeping the guests safe.

Can you guess what the hotel did to solve it?

Hotel management concluded the real problem was that guests were thinking only about waiting for the elevators. They decided to install mirrors beside the elevator to take people's minds off the wait. Customer complaints ended after the mirrors were installed.

Rather than trying to make the elevators faster right away, the hotel management determined there was a different problem all together.

Scientific problems can be classified into **well-structured** and **ill-structured** problems. Some problems are simple and well defined. There are a set number of possible solutions -- and solutions are either 100% right or 100% wrong. An example of a well-structured problem is a typical mathematical (2 + 2 =?) question. This question has a definite "correct" answer.

The second type of problem is an ill-structured problem. These problems may have many possible answers because they are complex and ill defined. What is "best" today may not be "best" tomorrow. Ill-structured problems, because they are more difficult to "solve," require the development of higher order thinking skills.

Now it's your turn.

[1] Adapted and quoted from http://istudy.psu.edu

DIRECTIONS: With your group, read the following problem and determine a possible solution. Determine if the problem is well structured or ill structured. Then, write a well-developed problem statement.

PROBLEM: The population of your community is growing. Your water supply will not support many new people. What do you do?

QUESTIONS	ANSWERS
What do we know? Answer all of the following questions in the column to the right (or in your scientific journal). 1. Whose problem is it? 2. Why is it a problem? 3. How do people involved in the problem feel about it? (Stick with the facts—no opinions here).	
What do we need to know? Answer all of the following questions in the column to the right (or in your scientific journal). 1. What would happen if the problem went unsolved? 2. Could anything undesirable happen if the problem were solved? 3. What has been done to solve this problem so far?	
What should we do? Answer all of the following questions in the column to the right (or in your scientific journal). - What is the ideal outcome? - What will happen when the problem is solved? - If the problem is solved, are more people satisfied?	

Is this problem well-structured or ill-structured?	
My group's problem statement for this problem:	

1.4 CONDUCTING RESEARCH

Title: Sixth Grade Conducting Research Lesson Plan

Goal/Purpose:

1.) To help the student understand the importance of accurate information on the Internet.

2.) To help students determine the validity and reliability of Internet information.

3.) To help the students use information found on the Internet to incorporate into scientific research.

Objective:

Students will identify reputable Internet websites through the use of who, what, where and why questions.

Standards:

Next Generation Science Standards:

Practice 7: Engaging in Argument from Evidence

• Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.

• Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.

Common Core State Standards for English Language Arts

Writing Standards (Grade 6)

Domain: Text Types and Purposes

Standard 1. Write arguments to support claims with clear reasons and relevant evidence.

a. Introduce claim(s) and organize the reasons and evidence clearly.

b. Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.

Reading Standards for Literacy in Science and Technical Subjects (Grade 6-8)

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Standard 9. Draw evidence from informational

	texts to support analysis reflection, and research.
Time: One to two class periods, 45 minutes each.	**Materials:** Copies of pre-assessment Copies of Website Worksheet Access to Internet
Instructional Procedures: 1.) Have students get into pre-determined groups. 2.) Issue each student a copy of Student Sheet 1 and have groups do the pre-assessments together. 3.) Then, have groups split up so students are working individually on the Website Worksheet. Each student will need access to the Internet to complete the worksheet. 4.) Once all students have completed the table, solicit responses to each website investigated in the table. 5.) At the end of the lesson, show students the shortcut for finding reliable websites. "search terms" site:.org "search terms" site:.edu "search terms" site:.gov **Assessment:** 1.) Probing for understanding 2.) Student responses to Student Sheet 1 3.) Give students a small list of Web addresses and have them individually determine the **Who, What, Where, and Why** using the table in Website Worksheet.	**Teacher Notes:** *Advanced/Gifted Students:* Have students make a list of 10 topics to research. Tell students to find 10 reliable websites and 10 non-reliable resources. *ESE/Special Needs Students:* Have students complete the Internet activity using websites with topics with which they are more familiar. Then, have students expand into more broad topics. **Reinforcement/Extension:** 1.) Have students work in pairs to create another list of researchable web addresses. 2.) Have students exchange their lists with other groups. 3.) Students could have a five-minute share session at the end of each class period to discuss the research their group is working on for their eCYBERMISSION Project. 4.) Teacher can keep a running list of important research tips that students can add to as their projects continue. This list can be kept on a piece of butcher block paper.
Resources: http://dept.sccd.ctc.edu/tlc/resources/teach.html	

If your friend comes up to you and tells you a story, how do you determine whether or not it is true?

If you find an incredible story on the Internet, how do you determine if what you have read is true?

ACTIVITY:

Before your get onto the Internet, can you tell which of these websites are real and which are not what they seem?

a. http://www.improb.com/airchives/classical/cat/cat.html
b. http://www.d-b.net/dti/
c. http://ajobonline.com/
d. http://www.dhmo.org
e. http://www.stanford.edu/group/King/
f. "type martin luther king .org as URL with no spaces"
g. http://www.whitehouse.net/
h. http://www.whitehouse.gov
i. http://62.116.31.68/index00.htm
j. http://sunny.crk.umn.edu/courses/MISC/MCG/

How did your group determine which sites are real and which are not what they seem?

Why does it matter where you get your information on the Internet?

When questioning reputable Internet websites, it is important to find out: "**Who** owns it?" (or who created the site) - "**What** type of site is it?" - "**Where** can you find more information?" and "**Why** was the site created?"

Now, using the Internet, determine Who, What, Where, and Why.

Website Worksheet

Website(s)	**Who** owns it?	**What** type of site is it?	**Where** can you find more information?	**Why** was the site created?
http://cats-life.com/				
http://www.tigerhomes.org/wild-cats/wc-wild-cat-alphabetical.cfm				
http://www.cabq.gov/biopark/zoo/news/learn-about-local-wild-cats-at-lunchtime-talk-at-zoo				
http://wildfeline.tripod.com/				
http://www.snr.arizona.edu/files/shared/UA_Wild_Cat_4-30_Exhibit_Flyer.pdf				

1.5 STATE A HYPOTHESIS

Title: Sixth Grade State a Hypothesis Lesson Plan

Goal/Purpose:

1.) Given a real-life situation, students will think about community problems and scientific solutions to problems.
2.) To learn to write hypothesis using available data to make the best educated prediction.

Objectives:

1.) Students will brainstorm problems in the community and possible ways science could help.
2.) Students will identify a problem in the community and formulate probing, scientific questions regarding the problem.
3.) Students will use probing questions to formulate a hypothesis using the format:

"If_____(I do this)___, then___(this)_____will happen."

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

Common Core State Standards for English Language Arts

Writing Standards (Grade 6)

Domain: Text Types and Purposes

Standard 1. Write arguments to support claims with clear reasons and relevant evidence.

a. Introduce claim(s) and organize the reasons and evidence clearly.

b. Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short research projects to answer a question, drawing on several sources and refocusing the inquiry when appropriate.

Speaking and Listening Standards (Grade 6)

Domain: Comprehension and Collaboration

Standard 1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on grade level topics, texts, and issues, building on others' ideas and expressing their own clearly.

a. Come to discussions prepared having read or studied required material; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.

b. Follow rules for collegial discussions, set specific goals and deadlines, and define individual roles as needed.

c. Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.

	d. Review the key ideas expressed and demonstrate understanding of multiple perspectives through reflection and paraphrasing. **Writing Standards for Literacy in History/Social Studies, Science, and Technical (Grade 6-8)** **Domain: Research to Build and Present Knowledge** **Standard 7**. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. **Standard 9.** Draw evidence from informational texts to support analysis reflection, and research.
Time: Two, 60-minute class period.	**Materials:** Science Lab Notebook Newspapers, scientific journals, and other current event media Poster with the following written on it - Hypothesis Checklist: 1. Does the hypothesis relate to information presented in the original problem statement? 2. Does the hypothesis include the independent and dependent variables? 3. Can the hypothesis be tested through experimentation? 4. Engineering Hypothesis: Have you set your design criteria? Internet access would be helpful for day 2, when the students are further researching their problem.
Instructional Procedures: Day 1 1. Present a community problem to the class. Teams find an everyday problem in your local newspaper, science journals and/or, in classroom materials you are currently using with your students. 2. Ask questions related to the problem. 3. An important scientific practice is asking a question about something you observe: How, What, When, Who, Which, Why, or Where? 4. Explain to the students that after answering the "how and six W questions," it is time to make an educated predication (hypothesis).	**Teacher Notes:** *Advanced/Gifted Students:* Have students research actual scientific research articles (from reputable sources). After reading the abstract for these articles, have students write their own hypothesis for the article. *ESE/Special Needs Students:* Provide students with cause and effect diagrams. Ask them to write hypotheses as "If_____(I do this)___, then___(this)_____will happen." Pair students together and probe for understanding.

Have students help you write a hypothesis statement for the problem using the if/then format. Remind students that a hypothesis can be tested and will have an independent variable (the variable you change during the experiment) and a dependent variable (the variable you measure). Changes in the dependent variable depend on changes in the independent variable. Example: If I give a plant fertilizer every week (independent variable), then it will grow bigger (dependent variable) than a plant that does not receive fertilizer.

5. Check the hypothesis meets the criteria printed on the Hypothesis Checklist poster. Let students know that it can be difficult to write a hypothesis if they do not know enough about the problem. If they are struggling, they may need to do more research first.

Day 2

1. Now that you have modeled the process, have students sit in their eCYBERMISSION Teams. Students should use newspapers and other journals to find a community problem they are interesting in solving.
2. Teams answer the "how and six W questions."
3. Teams write a hypothesis statement for the problem.

Problem statements should address the following:

Physical Science: Process skills related to the understanding of physical science including properties, changes of properties of matter, motion and forces, and transfer of energy.

Life Science: Understand the structure and function in living systems, reproduction and heredity regulation and behavior, populations and ecosystem, diversity and adaptations of organisms.

Earth and Space: Explore and develop an understanding of the structure of the Earth's system, Earth's history and the Earth in the solar system.

Health and Nutrition: Develop an understanding of issues of personal health, populations, resources and environment, and natural

Reinforcement/Extension:

When the students have had an opportunity to practice writing their "If____, then ____" statements they will meet with their eCYBERMISSION Team and log into the eCYBERMISSION Mission Folder to record a hypothesis related to their chosen topic of study.

hazards.
Engineering: Develop an understanding of how we can design, create or modify things around us.

Assessment:

1.) Informal through class discussion.
2.) Assess the format, logic and testability of the hypothesis statement

Resources:

How To Conduct Research:
www.experiment-resources.com
Examples of Standard Based Instruction:
http://www.exemplars.com/education-materials/free-samples/science-6-8
Science and Engineering Practices in the K-12 Classroom:
http://www.nsta.org/about/standardsupdate/resources/201112_Framework-Bybee.pdf
The National Science Digital Library:
http://nsdl.org

1.6 CONDUCT AN EXPERIMENT

Title: Sixth Grade Conduct an Experiment Lesson Plan

Goal/Purpose:

Based on a mutual interest in an eCYBERMISSION theme, groups of three or four students will follow the steps of the scientific inquiry or engineering design process to conduct an experiment.

Objectives:

1.) Students will write procedural steps to address their hypothesis statement.
2.) Students will decide what data to gather and what tools they need to gather the data.
3.) Students will determine how to measure and record the data.
4.) Students will decide how much data they need to produce reliable measurements.
5.) Students will plan experimental or field research procedures, identifying relevant independent and dependent variables.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

Practice 3: Planning and Carrying Out Investigations

• Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

• Evaluate the accuracy of various methods for collecting data.

Time:

Varies due to the nature of the study. (At least 3 days.)

Materials:

Access to the Internet
Science notebook
Materials specific to eCYBERMISSION projects
Small balls such as a golf ball, super ball, ping pong ball , …
Plastic Cup
Ruler
Yard Sticks
Tape (duct tape works best)

Instructional Procedures:

From previous lessons students should already have accomplished the following objectives:

1.) Students will brainstorm problems in the community and possible ways science could help.
2.) Students will identify a problem in the community and formulate probing scientific questions regarding the problem.
3.) Students will use probing questions to formulate a hypothesis.

Review the steps of a good experiment through

Teacher Notes:

1.) Inquiry: Questions guide experiments. "What's in this world?" and "How does it work? Encourage questions.
2.) Hands-on Activities: Students learn by doing. Put objects, organisms and systems in their hands.
3.) Multisensory observations should include all five senses if possible.
4.) Collaboration is essential to the field of science. Students are encouraged to work with their eCYBERMISSION Team to ensure all

modeling a simple experiment, such as:

1. Create a ramp for a ball to roll down (taping two yard sticks together leaving a gap for the ball to roll in works well.)
2. Place a plastic cup at the end of the ramp that can fit a golf ball.
3. Have a ruler set up to measure the distance the ball moves the cup once it rolls down the ramp.
4. Have students gather around as you roll the golf ball down the ramp into the cup. Measure the distance the cup moved.
5. Ask the students "What is the dependent variable?" (Answer: the distance the cup moves)
6. Have the students identify all the independent variables – the length of the ramp, the height of the ramp, how hard you push the ball, the type of cup used, the floor under the cup, and the weight of the ball.
7. Ask students to pick one independent variable they would like to manipulate. Example –the slope of the ramp. Once an independent variable has been identified for testing, have students explain how they will control for the other independent variables.
8. At this point you could continue the experiment as a demonstration or you could provide groups of students the materials needed to run their own experiment. It is good to let students pick the independent variable they would like to change and not make every group do the same variable.
9. Once the independent variable has been identified for each group, have them write a hypothesis statement in their science journal. For example, "if you increase the slope of the ramp, the ball will travel further. Or "if the ball is heavier, it will push the cup further."
10. Review the steps to a scientific experiment. There are many slideshows on the internet.

- Steps recommended for the development of a presentation to students to generate scientific experiments.
  Conduct an Experiment.
  - Research your topic. Find out how it works.

members contribute to the management, data collection, data analysis and reporting of test results.
5.) Reflective Thinking/Writing: Possible indicators would include -- focus discussions in collaborative groups, whole class discussions, wrap-up session at the end of each meeting time, Word Webs, graphic organizers to collect and organize data, and response sheets that access knowledge base.

Advanced/Gifted Students:

Students will take on the leadership role for the group project and will ensure the continued progress of the eCYBERMISSION research project.

ESE/Special Needs Students:

Always check for understanding and team cooperation between all team members.
Rotate team membership roles throughout the research project so that all members have equal chance to develop their own personal scientific research skills.

Reinforcement/Extension:

During the experiments, walk around to each of the groups and listen to their ideas and problem solving techniques.

After the activity is over, have teams discuss the outcomes of their group's experiment.

Throughout the eCYBERMISSION Program, continue to encourage teamwork, collaboration, integrity and open communication.

- Define the problem. Narrow down your research into one easily testable problem.
- Write a hypothesis. This should be in the following form: If_____, then_____.
- Experimentation. Identify your independent variable (this is what you change in order to provide a result). Determine controlled variable (these are the things that never change). The dependent variable is what you are measuring. Example: How much mold is on the orange, or how much water will a towel hold?
- Results: Let the whole world know what you have found out at the end of your experiment. Show your data, report your findings. Graphs and tables should be included if possible.
- Discussion/Conclusions. Discuss how the results of your experiment answer the hypothesis.

11. Have students use scientific inquiry using the scientific practices to conduct their experiment. Use Student Worksheet 1 to guide them through the experiment.
12. Have students meet in eCYBERMISSION teams to write the steps to their experiment based on their community problem and hypothesis.

Assessment:

Teacher observation during the research, problem, hypothesis, experimental and results phases of the science experiment.

While students are working on their experiments, they should record progress daily in their eCYBERMISSION Mission Folders.

Use Team participation rubrics to monitor teamwork, collaboration and open communication.

Resources:

http://www.corestandards.org/
How To Conduct Research:
www.experiment-resources.com
Examples of Standard Based Instruction:
http://www.exemplars.com/education-materials/free-samples/science-6-8
Kathy Schrock's Guide to Everything:

http://www.schrockguide.net/ Assessment Tools and Rubrics for Science Projects: http://www.schrockguide.net Science and Engineering Practices in the K-12 Classroom: http://www.nsta.org/about/standardsupdate/resources/201112_Framework-Bybee.pdf The National Science Digital Library: http://nsdl.org	

Student Worksheet 1: Science Experiment Guidelines

Source: http://sciencespot.net/Media/indinvest.pdf

Independent Investigation

Name _____

Question

What do you want to find out?

Hypothesis

What do you think will happen?

Procedure

Design your experiment! Write the steps for your experiment in the space below. (Include any safety rules.) Remember to control all independent variables you do not want to test!

Data

Create a table, chart, or graph to record your data. Include enough data to prove or disprove your hypothesis.

Conclusion/Analysis

What did you find out? Did your results support your hypothesis? Are your results reliable?

1.7 DATA COLLECTION AND ANALYSIS

Title: Sixth Grade Data Collection and Analysis Lesson Plan

Goal/Purpose:

To analyze the results of the chosen research topic and share the information with the world through computer generated diagrams and graphs.

Objectives:

1.) Students will collect and display data, calculate central tendencies and present their findings in an appropriate format for computer transmission.
2.) Students will calculate the mean, median, mode and range of data.
3.) Students will be able to identify outliers in a data set.
4.) Students will choose an appropriate chart, table or graph to display a given set of data.

Standards:

Next Generation Science Standards:

Practice 4: Analyzing and Interpreting

• Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
• Distinguish between causal and correlational relationships in data.
• Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trails).
• Analyze and interpret data to determine similarities and differences in findings.
• Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Practice 5: Using Mathematics and Computational Thinking

• Use mathematical representations to describe and/or support scientific conclusions and design solutions.
• Apply mathematical concepts and/or processes (e.g., ratio, rate, percent, basic operations, simple algebra) to scientific and engineering questions and problems.
• Use digital tools and/or mathematical concepts and arguments to test and compare proposed solutions to an engineering design problem.

Practice 8. Obtaining, Evaluating, and Communicating Information

• Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.

Common Core State Standards for Mathematics (Grade 6)

Domain: Summarize and describe distributions.

4. Display numerical data in plots on a number line, including dot plots, histograms, and box plots.
5. Summarize numerical data sets in relation to their context, such as by:
a. Reporting the number of observations.
b. Describing the nature of the attribute under investigation, including how it was measured and its

	units of measurement. c. Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. d. Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered. **Common Core State Standards for English Languages Arts** **Writing Standards (Grade 6)** **Standard 1.** Write arguments to support claims with clear reasons and relevant evidence. **a.** Introduce claim(s) and organize the reasons and evidence clearly. **b.** Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text.
Time: Approximately three, 45-minute class periods.	**Materials:** Discovery Math: Statistics and Data Analysis video (accessible via United Streaming through school subscription or for purchase) Data Sets for Central Tendencies Worksheet Example of bar graphs, circle graph, line plot, stem and leaf plot, box-and-whisker plot, scatter plot and histogram (Students can collect these from various sources.) Newspapers magazines, or brochures that contain data representations Computers Calculators
Instructional Procedures: 1.) Display the terms mean, median, mode and range. Ask students to identify the terms, referring to examples presented in the video or from printed materials. 2.) Display the following data set: 69,44,87,75,32,85,65,75,72,68, and 76. Model how to find the mean, median, mode and range (mean = 68, median = 72, mode = 75, and range = 55). 3.) Distribute copies of the Data Sets for	**Teacher Notes:** *Advanced/Gifted Students:* With students' math teacher, plan a cross-curricular lesson on types of graphs and statistics (mean, median, mode, range). Ask students to develop spreadsheets using statistics about their favorite sports teams (e.g., batting averages, yards gained in football, goals attempted/made). Another meaningful activity could be to have students conduct a survey

Central Tendencies Worksheet.
4.) Have students calculate the mean, median, mode and range of each data set. (Use calculators as needed.)
5.) Review the graphs and tables presented in the video. Display each type of graph and table and discuss their characteristics and uses.

a) Bar graph – a type of graph in which the lengths of bars are used to represent and compare data in categories.
b) Circle graph – a type of graph that displays data as sections of a circle. The entire circle represents all the data.
c) Line plot – a graph that shows one value changing over time in relation to another value.
d) Stem and leaf plot – a display that shows how data is distributed. Each data value is separated into a leaf (the last digit) and the stem (the remaining digits).
e) Box-and-whisker plot – a display that divides a data set into four parts using the lower extreme, lower quartile, median, upper quartile, and upper extreme.
f) Scatter plot – an effective way to represent relationships between paired quantities.
g) Histogram – a type of graph that displays data from a frequency table. The height of the bars represents the frequency for the interval.

6.) Working with a partner, the students will determine the best way to display a set of data. Distribute copies of Data Sets for graphing to each pair. Use your local math series, or core curriculum for examples.

7) Students must display the data by choosing the most appropriate graph or table.
8.) When all graphs and tables are complete ask each pair to share their work with the class.
9.) Students should be able to explain why they chose the particular graph or table to that produces data to be analyzed.

ESE/Special Needs:

Provide students with a game format to learn and reinforce the ideas of data: mean, median, mode and range.

http://www.bbc.co.uk/bitesize/ks2/maths/data/mode_median_mean_range/play/

Reinforcement/Enrichment:

Ask students to get into eCYBERMISSION Teams and come up with a list of five reasons why statistics and graphs are important in communicating data. Have students share a set of data they collected and have other groups graph it. This can be done until all groups have analyzed all other group's data.

display the data.
10.) Ask students to identify examples of data misrepresentation from the video. They should share and explain their examples, describing why the data was misleading.
11.) Student collected examples of various data presentations should be reviewed by the class to identify data that may be presented in a misleading way.
12.) Have students select a more appropriate way to display the data. They should prepare a new presentation and explain to the class how they developed it.
13.) Have students work in small groups to collect and display data.

1. Have each group identify a topic they would like to study (e.g., what pets classmates own, favorite school subjects or a community statistic).
2. Have students create a plan for collecting data. They can conduct a poll, create surveys, or gather information from newspaper, magazine, or Internet sources. Allow time for students to collect data. They should record their data in an organized way.
3. Have students identify an appropriate and clear way to display the data. They must be able to justify their choice of data displays.
4. Have students calculate the mean, mode, median and range of their data set. They should also identify any outliers. If there are outliers, they should discuss and explain how the outliers affected the central tendencies and range.
5. Have each group present their data to the class. They should discuss the following:
    a. What was the topic?
    b. How did they collect the data?
    c. How did they represent the data? Why is this the best method of representation?
    d. What are the central tendencies? Were there any outliers and what

affect did the outliers have on the central tendencies?

e. What conclusions can they make based on the data?

Assessment:

Student quiz on graphing: Have students determine not only the proper graph to be used when given a set of data, but to also have all components of a graph identified and carried out (title, x and y axes labeled with units in parentheses, axes evenly spaced numerically, and a ruler used [when doing line and bar graphs]).

Resources:

Discovery Math: Statistics and Data Analysis – Video Segments:
http://www.discoveryeducation.com/?returnURL=player%2Ediscoveryeducation%2Ecom%2Findex%2Ecfm%3FguidAssetId%3D6da26e1f-5672-41f4-8528-06a6c0fce6fd

Central Tendencies Data Sets				
DATA	MEAN	MEDIAN	MODE	RANGE
26, 58, 45, 85, 12, 63, 15, 78, 25, 14, 16, 85, 96, 92, 85, 14, 53, 63, 49, 65, 75, 23, 20, 50, 45, 60, 75				
8, 6, 4, 9, 2, 8, 8, 3, 9, 6, 7, 5, 8, 2, 8,				
152, 563, 485, 698, 256, 458, 756, 259				
485, 758, 632, 125, 563, 865, 496, 852, 125, 758, 634, 129, 746, 758				
1,456, 7,259, 4,563, 1,589, 2,015, 4,065, 1,456, 3,548, 2,456, 2,34				
689, 159, 357, 156, 325, 147, 258, 369, 456, 123, 789, 654, 321, 852, 951, 159				
12, 15, 17, 16, 19, 18, 14, 25, 26, 27, 20, 35, 45, 85, 46, 16, 45, 20, 80, 53, 45				
46, 20, 40, 90, 80, 258, 31, 45, 12, 45, 86, 20, 47, 20, 63				
15, 25, 45, 65, 95				

1.8 DRAWING CONCLUSIONS

Title: Sixth Grade Drawing Conclusions Lesson Plan

Goal/Purpose:

1.) To understand the difference between an inference and a conclusion.

2.) To develop conclusions based on reading passages and data analysis.

Objectives:

1.) Students will distinguish between an inference and a conclusion.
2.) Students will draw conclusions from scientific data.
3.) Student will draw conclusions from their own data collected in an eCYBERMISSION project.

Standards:

Next Generation Science Standards:

Practice 4: Analyzing and Interpreting

• Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
• Distinguish between causal and correlational relationships in data.
• Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trails).
• Analyze and interpret data to determine similarities and differences in findings.
• Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Practice 6: Constructing Explanations and Designing Solutions

• Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
• Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.

Common Core State Standards for English Languages Arts

Reading Standards (Grade 6)

Domain: Key Ideas and Details

1. Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Domain: Integration of Knowledge and Ideas

Standard 8. Trace and evaluate the argument and specific claims in a text, and distinguish claims supported by reasons and evidence from claims that are not.

Time:
One, 60 minutes class. (This could be done in two 45 minute periods with the eCYBERMISSION teams meeting on day 2.)

Materials:
Student sheets 1 and 2

Instructional Procedures:
1.) In student notebook, have students define "inference" and "conclusion." Have students share ideas. Present students with the definition on worksheet 1. Discuss the differences between the two words.
2.) Distribute copies of Worksheets One and Two to each student. When students have finished the worksheets, ask students to describe how they made an inference and drew conclusions. Discuss the need for these skills in science.
3.) Project the data table from Teacher Resource sheet on the front broad. **Only show the first section.** Have students answer the questions that follow the first two rows.
5.) Show the rest of the data and answer the questions pertaining to the second part of the table.
6.) Have students get in their eCYBERMISSION groups to discuss the data they have collected for their eCYBERMISSION project. They should analyze the data to see if they can draw conclusions yet or if they need to collect more or better data.

Assessment:
Grade each student's answers on Worksheets 1 and 2.
Informal assessment based on class discussion.

Resources:
http://flang1.kendall.mdc.edu/cpt/R06/index.htm
http://www.irsc.edu/uploadedFiles/Students/AcademicSupportCenter/WritingLab/Making-Inferences.pdf
http://ete.cet.edu/gcc/?/resourcecenter/slideshow/4/59

Teacher Notes:

Advanced/Gifted Students:
1.) Have students complete a Venn Diagram of inferences and conclusions.
2.) Have students write their own paragraphs with scenarios for others to make inferences and draw conclusions.

ESE/Special Needs Students:
1.) Have students draw pictures for their classmates. Then have classmates make inferences and conclusions based on the drawings.
2.) Pair ESE students with non-ESE students and have them work together on the worksheets.

Reinforcement/Extension:
Have students analyze each other's data and draw conclusions once the group's eCYBERMISSION Data Collection is complete.

Worksheet 1: Drawing Conclusions[2]

Inference: an idea suggested by the facts or details in a passage

Conclusion: a decision about what may happen or about the result an event may have

Making Inferences/Drawing Conclusions

NOTE: Making an inference and drawing a conclusion are very similar skills. Each requires the reader to fill in the blanks left out by the author. An author may not include information for several reasons: they may think you already know it, it may not seem important to them or they may want you to find the result.

How to make an inference or draw a conclusion:

1) Observe all the facts, arguments, and information given by the author.
2) Consider what you already know from your own experiences.
3) When faced with multiple-choice questions, determine whether each option is true or false based on the information in the passage.

Example 1:

> "The woman waited nervously in line. When the counter was empty, she carefully unloaded her items from her cart. Lines creased her forehead as if to show the calculations ringing up in her head. Finally, the cashier began ringing up the items as the woman clutched her purse".
>
> **Inference/Conclusion:** The woman may not have enough money to cover the cost of her groceries.

A. Think about the facts of the passage and what may result from them.
B. Think about causes and effects. The writer may only provide a list of effects, so you have to figure out the cause.

Example 2:

> "The child stood on the sidewalk clenching her ice cream cone. Beads of sweat collected on her little nose as she furiously licked at the ice cream dripping down her hand.
>
> "Try saying "If ...then…" If the girl is sweating, then it may be warm outside.

[2] Adapted from: Inferences/Conclusions Dec. 2008, G: ASC Eng/Read

PRACTICE ACTIVITIES

Turner almost wished he hadn't listened to the radio. He went to the closet and grabbed his umbrella. He would feel silly carrying it to the bus stop on such a sunny morning.

1. Which probably happened?

a) Turner realized that he had an unnatural fear of falling radio parts.

b) Turner had promised himself to do something silly that morning.

c) Turner had heard a weather forecast that predicted rain.

d) Turner planned to trade his umbrella for a bus ride.

"Larry, as your boss, I must say that it's been very interesting working with you," Miss Valdez said. "However, it seems that our company's needs and your performance style are not well matched. Therefore, it makes me very sad to have to ask you to resign your position effective today."

2. What was Miss Valdez telling Larry?

I. She would feel really bad if he decided to quit.

II. He was being fired.

III. He was getting a raise in pay.

IV. She really enjoyed having him in the office.

"Bill and Jessica were almost done taking turns choosing players for their teams. It was Jessica's turn to choose, and only Kurt was left. Jessica said, "Kurt."

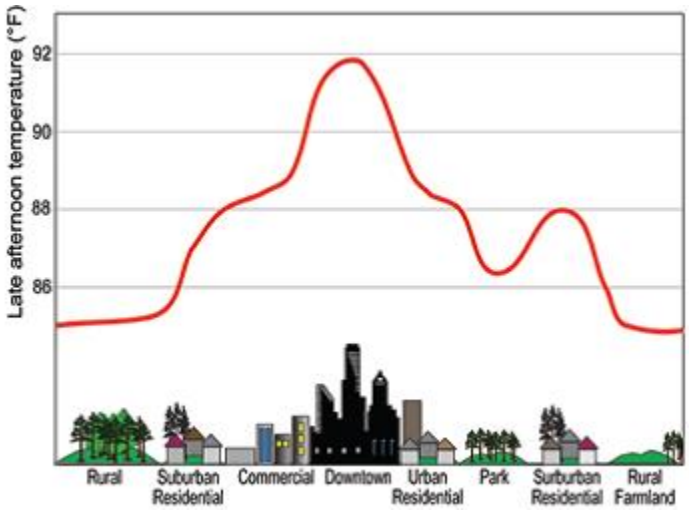
3. We can infer that

- Kurt is not a very good player.
- Jessica was pleased to have Kurt on her team.
- Kurt was the best player on either team.
- Jessica was inconsiderate of Kurt's feelings.

Worksheet 2: Drawing Conclusions

DIRECTIONS: Analyze the following graphs and write a conclusion based on the data.

1.

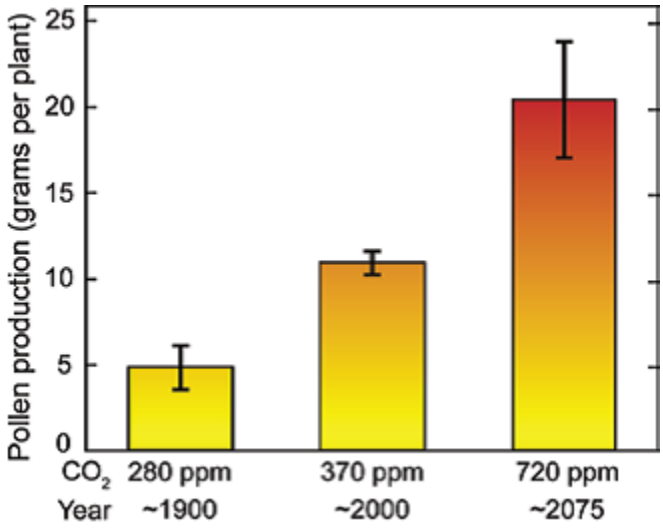


http://ete.cet.edu/gcc/?/resourcecenter/slideshow/4/59

My conclusion:

_____
_____
_____

2.

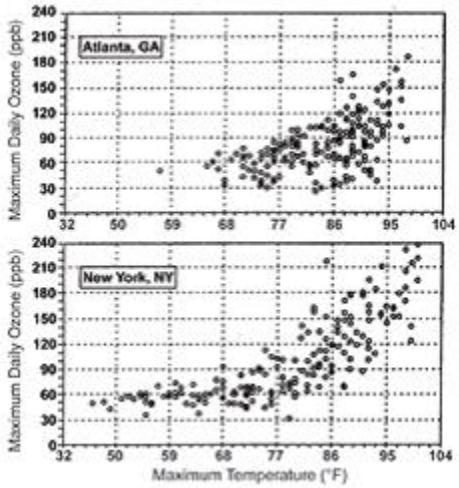


http://ete.cet.edu/gcc/?/resourcecenter/slideshow/4/59

My conclusion:

_____
_____
_____

3.

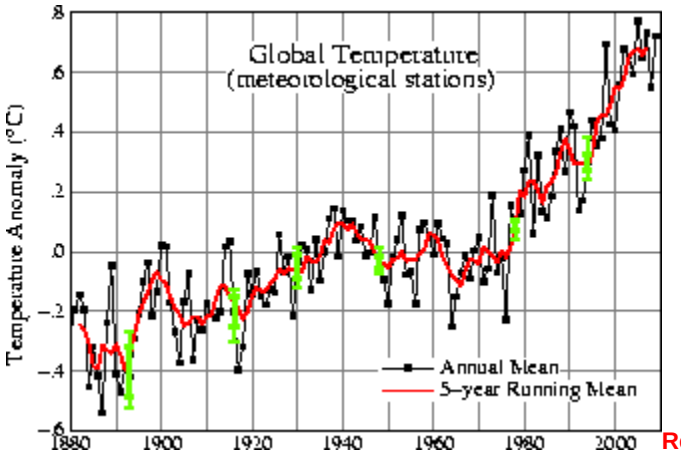


http://ete.cet.edu/gcc/?/resourcecenter/slideshow/4/59

My conclusion:

_____
_____
_____

Global Mean Surface Temperature Changes—1880-present



Red line—5-year running averages
Black line—annual (yearly) averages (Normal seasonal fluctuations cause the variability seen on the graph.)

http://data.giss.nasa.gov/gistemp/graphs/

My conclusion:

_____
_____
_____

First Period Math Class

Date	Math Test Scores Student Name: Jake	Math Test Scores Student Name: Maggie
9/04	36%	93%
9/07	49%	97%

What can you conclude about these students based on the above data?

Can you make any conclusion about boys versus girls? Why or Why not?

Can you make a fair conclusion about Jake and Maggie?

Date	Math Test Scores Student Name: Jake	Math Test Scores Student Name: Maggie
9/16	92%	80%
9/28	96%	91%
10/19	93%	94%
11/12	100%	86%
11/27	94%	95%

With this additional data, what can you now conclude about Jake and Maggie?

What may have caused Jake to have done so poorly at the being of the year and then become an A student?

The first two tests had been a review of the skills learned in 5th grade. The rest of the tests were based on new material the teacher taught during class. What might you infer about Jake and Maggie based on this information? Is there a way to prove your inference?

What would you need to do to make a conclusion about boys and girls abilities in math?

Extension Question: One student who looked at the data said “Jake has problems with his long term memory.” Another student argued “No way, Jake just hadn’t gotten used to waking up for school and was just tired the first few weeks of school.” Can they make these conclusions? Are they based on facts or opinions? How could they test their ideas?

1.9 BENEFIT TO THE COMMUNITY

Title: Sixth Grade Benefit to the Community Lesson Plan

Goal/Purpose:

1.) Determine community benefits to scientific problems.
2.) Understand the differences and similarities between local and global benefits.

Objectives:

1.) Students will determine the benefits to the community of their eCYBERMISSION research.
2.) Students will classify benefits to the community as being either local or global

Standards:

Next Generation Science Standards:

Practice 7: Engaging in Argument from Evidence

• Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.
• Construct, use and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation an explanation or a model for a phenomenon or a solution to a problem.
• Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.

Practice 8: Obtaining, Evaluating, and Communicating Information

• Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).
• Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.
• Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts.
• Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.

Common Core State Standards for English Language Arts

Writing Standards (Grade 6)

Domain: Text Types and Purposes

Standard 1. Write arguments to support claims with clear reasons and relevant evidence.

	a. Introduce claim(s) and organize the reasons and evidence clearly. **b.** Support claim(s) with clear reasons and relevant evidence, using credible sources and demonstrating an understanding of the topic or text. **c.** Use words, phrases, and clauses to clarify the relationships among claim(s) and reasons. **d.** Provide a concluding statement or section that follows from the argument presented.
Time: Two, 45-minute class periods.	**Materials:** Copies of Student Sheets Internet access
Instructional Procedures: Day 1: 1. Students will respond to the following three questions in their science notebook. Allow about 5 minutes for each question. a. What makes a scientific investigation/invention valuable? b. When scientists solve a problem, who benefits? c. What is the difference between a local problem and a global problem? 2. After giving students time to respond, solicit student responses and lead class discussion about who benefits from scientific investigations. Ask students to provide examples of scientific research that has benefited either humans or other organisms. 3. Issue copies of Student Sheet 1 to each student. Have students complete Part 1 of Student Sheet 1 either in groups or individually. 4. Conduct a class discussion about where students decided to place each scientific problem in the Venn Diagram. Day 2: 1. Using the Internet, have students determine who would benefit from a scientific investigation to counter each problem listed in the table. Ask students to	**Teacher Notes:** *Advanced/Gifted Students:* Have students develop a list of three local groups and three global communities that would benefit from scientific investigations. *ESE/Special Needs Students:* Have students find images of three local communities and three global communities that would benefit from scientific investigations. **Reinforcement/Extension:** 1.) Have students present their problems they tried to solve in their eCYBERMISSION project. 2.) Allow other groups to help them identify the community benefits.

be as specific as they can.

2. Conduct a class discussion about how they determined who benefits from each scientific investigation.

Assessment:

1.) Informally assess student responses during class discussions.
2.) Grade Student Sheets for understanding (not for a grade).

Resources:

http://pubs.ext.vt.edu/426/426-722/426-722.html;
http://www.aces.edu/fourh/docs/programs/nree/Non-Renewable_Sources_of_Energy_1.pdf ;
http://www.ipm.iastate.edu/ipm/icm/1998/2-16-1998/crwconsist.html ;
http://fiesta.bren.ucsb.edu/~chiapas2/Water%20Management_files/Greywater%20Wetlands-1.pdf ;
http://athenaeum.libs.uga.edu/bitstream/handle/10724/9521/d-angelo_gino_j_200705_phd.pdf?sequence=1; ;
http://students.arch.utah.edu/courses/Arch4011/Recycling%20Facts1.pdf;
http://forest.mtu.edu/pcforestry/resources/studentprojects/boliv34.htm;
http://www.ce.gatech.edu/node/5961;
http://www.stonybrook.edu/police/safety/reactions-not-distractions.shtml

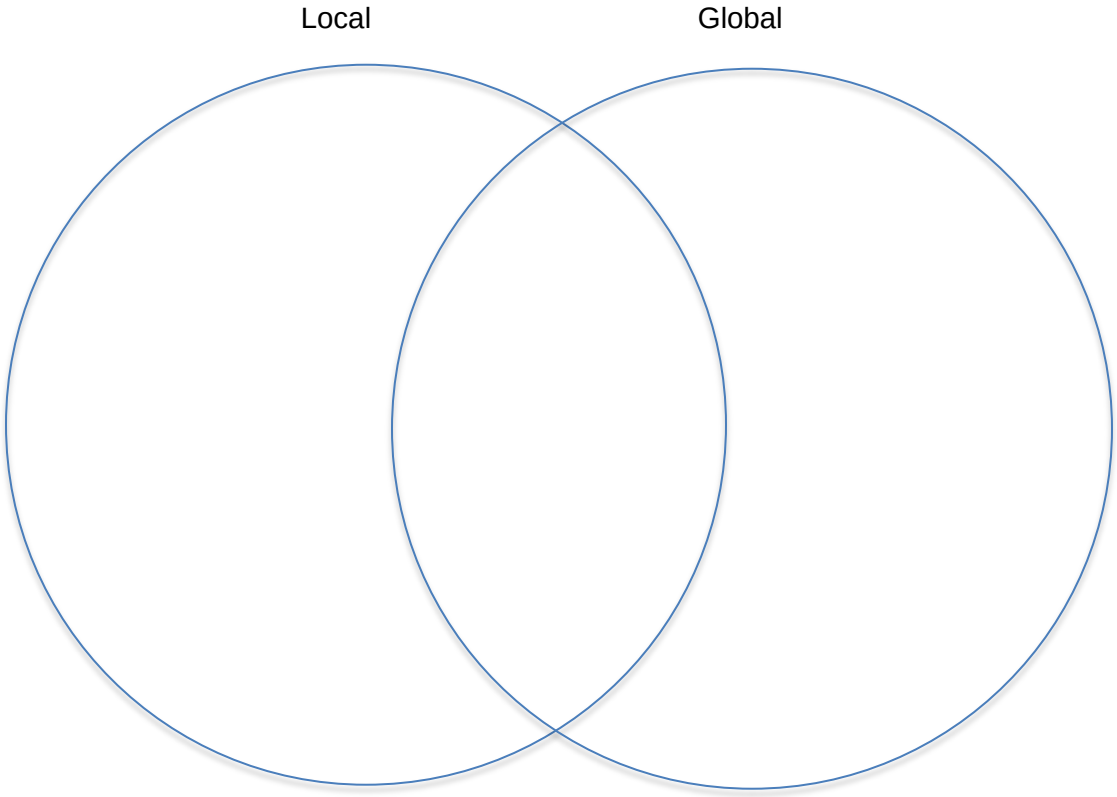
Student Sheet 1: Benefit to the Community

Solutions to scientific problems (simple and complex) benefit communities in some way (either locally or globally).

PART 1 DIRECTIONS: Place the letter (left column) that corresponds to the specific Scientific Problem Statement from the following chart into the appropriate circle of the Venn Diagram. Do not write anything in the right column until Part 2.

	Scientific Problem Statement	Who Benefits? Why?	Rating 1-10
A	Water runoff after storms shows high levels of pollutants in homes that are downstream.		
B	Coal and oil (made from dead plant and animal matter) are sources of energy that are quickly being depleted.		
C	Rice and grains grown near the Niger River are rapidly disappearing due to climate changes.		
D	Corn rootworm insecticides have been shown not to be as effective in reducing corn crop infestations.		
E	A greywater biofiltration system removes a significant amount of pollutants before they flow into the groundwater, river, or natural wetland.		
F	Deer-vehicle collisions are a common occurrence, resulting in human injury and death, damage to vehicles, and waste of deer as a wildlife resource.		
G	Aluminum [in landfills] takes 200-500 years to fully degrade in a landfill.		
H	An unfortunate consequence of the steep Andean terrain is a severe problem with soil erosion.		
I	Placing water in plastic bottles in direct sunlight for several hours takes advantage of UVA radiation's ability to kill pathogenic bacteria.		
J	Response times when driving distracted slow drastically.		

Venn Diagram:



PART 2 DIRECTIONS: In the "Who Benefits? Why?" column of the table (above the Venn Diagram), determine who would benefit if the problem in the left-hand column were investigated scientifically. Be specific in determining who benefits.

After completing, rate each "problem" (1-10) in terms of importance to you with 10 being the least important and 1 being the most important. Write your ratings in the "Rating" column. Discuss your ratings with your class.

How did **you** determine which communities would benefit from investigating each problem?

_____

_____

2. Grade 7

2.1 TEAMWORK

Title: Seventh Grade Teamwork Lesson Plan	
Goal/Purpose: To learn how to work in groups. **Objectives:** 1.) Students will work together to define teamwork. 2.) Students will develop three or four positive guidelines for working in a group.	**Standards:** **Common Core State Standards for English Language Arts** **Writing Standards (Grade 7)** **Domain: Text Types and Purposes** **Standard 2.** Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. **a.** Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information, using strategies such as definition, classification, comparison/contrast, and cause/effect; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension. **Speaking and Listening Standards (Grade 7)** **Domain: Comprehension and Collaboration** **Standard 1.** Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on *grade 7 topics, texts, and issues,* building on others' ideas and expressing their own clearly. **b.** Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed. **c.** Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed. **d.** Acknowledge new information expressed by others and, when warranted, modify their own views.
Time: One, 45 minute lesson	**Materials:** Markers Bristol Boards or poster paper Dry erase boards and markers (one for each team). Paper can be substituted if boards are not available. Sports or other team focused Journals or

	Magazines Newspapers
Instructional Procedures: 1.) Have students sit in groups of 4 to 6. Explain that they will play two versions of "Minute to Win It". In the first version there is no talking aloud. Any team that speaks is disqualified. In the second version they will be able to speak to their team members. Version 1 – Students are to pass the dry erase board counter clockwise around to each member of their team. No member can be skipped. Each person must put the name of a professional baseball team on the list. No repeats are allowed. They have one minute. Absolute silence! The team with the most names wins (names can be misspelled but must be real teams.) After version 1, teams clean their board and get ready for version 2. Version 2 – Students will follow the same procedure however this time they may talk to each other. Each person must write their own answer and no one may be skipped. The topic this time is the name of professional football teams. Teams have a "Minute to Win It! 2.) Ask the class "What do all of these teams have in common?" 3.) Ask the class "What does it mean to be a team?" They should reflect on how successful they were when they were allowed to help and communicate with each other. Help them arrive at the conclusion that for a team to be successful they must work together toward a common goal. 4.) Briefly review what it means to succeed and have goals. **Group Activity:** 1.) Put students in groups (three-four students/group) with a piece of Bristol paper and markers. 2.) Explain that the Bristol paper will be hung in the classroom and each team will create their own teamwork poster, so students should use scrap paper for brainstorming. 3.) Teams should have a brainstorming session	**Teacher Notes:** *Advanced/Gifted Students:* Allow students to think "outside the box" in such a way that would allow them to be within the parameters of the activity, but achieve a better result (*i.e.*, combining information from two groups, using other materials not supplied). *ESE/Special Needs Students*: Give students an opportunity to rebuild their boards with fresh materials if they are unsuccessful on the first try. **Reinforcement/Extension:** 1.) Review what it means to succeed and have goals in a team. 2.) After the activity is over, discuss the outcomes of their group's board. Students will naturally want to talk about their board's strengths and weaknesses. 3.) Discuss the teamwork process of eCYBERMISSION with the students, and explain how they will need to use the skills that they used to create their boards to complete their eCYBERMISSION Projects.

(10 min.) where they can decide on words, sentences and pictures that represent teamwork.
4.) Team should spend the remainder of the class creating their TEAM posters.
5.) For closure, they will present their posters to the class and discuss how they worked together to create the poster.

The boards will be placed on a wall in the room. They are colorful and look great when parents or administrators come into the room!

Assessment:

Assess how well they worked as a team to create the poster

Resources:

For additional assistance, please access the article "Twelve Tips for Team Building: How to Build Successful Work Teams." (http://humanresources.about.com/od/involvementteams/a/twelve_tip_team.htm) Although the article focuses on business environments in the workforce, the goals are the same in order to establish an efficient team. It is a great way to get students working together. Use different color markers and Bristol board. They look great in the classroom.

Other Resources:
http://www.corestandards.org
http://floridastandards.org

2.2 UNDERSTANDING AND SELECTING A MISSION CHALLENGE

Title: Seventh Grade Understanding and Selecting a Mission Challenge Lesson Plan

Goal/Purpose:

To help guide students when choosing a Mission Challenge for eCYBERMISSION.

Objectives:

1.) Students will be able to define each Mission Challenge.
2.) Students will be able to determine ways they can make a difference in their state or throughout the world with the completion of their eCYBERMISSION project.
3.) Students will be able to select a Mission Challenge.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
• Ask questions that require sufficient and appropriate empirical evidence to answer.
• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Common Core State Standards for English Language Arts

Speaking and Listening Standard (Grade 7)

Domain: Comprehension and Collaboration

Standard 1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on *grade 7 topics, texts, and issues,* building on others' ideas and expressing their own clearly.
b. Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed.
c. Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed.
d. Acknowledge new information expressed by others and, when warranted, modify their own views.

Time:

Three class periods, 65 minutes each. However, each period should be at least 10 days apart.

Materials:

Laptops-electronic devices
Resource Worksheets
Writing utensils
Post it notes
Poster board
Markers

Instructional Procedures:

1.) Go to eCYBERMISSION Website and make a list of all current Mission Challenges.
2.) Put these on large index cards and place them in areas around the room. For example—the list for this year includes:

- Alternative Sources of Energy
- Environment
- Food, Health & Fitness
- Forces & Motion
- National Security & Safety
- Robotics
- Technology.

Group Activity

Lesson One:

1.) Have students fill out the information for the pre-assessment (Worksheet 7-1) on Mission Challenges (10 minutes).
2.) Collect the pre-assessments.
3.) Read aloud some of the answers to determine what they currently know about the Mission Challenges (5 minutes).
4.) Ask students to turn and discuss with their neighbor "Ways scientists and engineers have impacted the world" (5 minutes). Ask students to share their ideas with the class. Start making a list of ways scientists have impacted the world, and later have students add how they can impact the world/state.
5.) Look at the following site: http://www.un.org/Pubs/CyberSchoolBus/mdgs/flash/index.asp. Read through the home page together out loud.
7.) Divide students into eight groups. Give each group one of the Eight Millennium Goals to research.
8.) The student groups will be asked to give a

Teacher Notes:

Mission Challenges might be different year to year so adjust plan to fit your needs.

Reinforcement/Extension:

For above reinforcement or re-teaching-You may show a scenario from this site if you really want to make this over the top. Both of these sites help kids see how others have made a difference using certain mission folders.

1.) Review the 100 people, http://www.100people.org website together.
2.) The site is heavily game focused in solving world issues and could be useful with your more challenging students.
3.) The game is not up and active, but kids can see what it once was.
4.) The designer of the games hopes that a Game Designer will win the Noble Peace Prize one day.
5.) See video here: http://www.youtube.com/watch?v=dE1DuBesGYM http://archive.superstructgame.net/
6.) Post this in a hallway when completed so students can use it as a reference over the next few days.

three-four minute presentation about what the goal is and how this might connect back to the Mission Challenges.
9.) Pass out Worksheet 7-3. Explain to students they are going to be engineers/scientists the next few days. They will need to figure out the next best way to make a difference in the world. They are to write down problems they encounter in their day-to-day life. Show the example of the human robot: http://today.msnbc.msn.com/id/41641984/ns/today-today_health/t/robot-avatar-allows-sick-boy-go-school/

The goal is to have students leaving feeling empowered and ready to impact the world.

Lesson Two:

1.) Go over Worksheet 7-2. Put students in groups of two to discuss the problems they came up with and have them write in how they fit into the Mission Challenges in Worksheet 7-3.
2.) After 10 minutes have them merge into groups of four (two groups of two combine). Now they should all share their "problems list" and where they fit with the Mission Challenges in Worksheet 7-3.
3.) Take out the Mission Folder Index Cards. Have the groups write down ideas that fit into these Mission Challenges. (If one to one computers are available, it might be best to have the groups do this on a wiki discussion board or using http://www.socrative.com/).
4.) Pass out the Post Assessment—Worksheet 7-4

Lesson Three:

1.) Teachers label rooms or sections of room with Mission Challenges.
2.) Students organize according to their Mission Challenges into the corresponding labeled area of the room to fine tune ideas and form groups.
3.) Students interview for mission teams, if needed.
4.) A CEO is determined for each mission team - the student who has developed the most ideas for this group will be the CEO.
5.) Others will interview with this person to see if they are selected to be in that group.

Assessment: 1.) Completion of Resource Worksheets 2.) Probing for Understanding of the eCYBERMISSION Mission Challenges 3.) Students should be able to identify to which Mission Challenge a world problem/issue belongs.	
Resources: http://www.un.org/Pubs/CyberSchoolBus/mdgs/flash/index.asp http://www.100people.org/ http://archive.superstructgame.net/ Resource Worksheets 7-1-7-4	

Resource Worksheet 7-1: Mission Challenge Pre-Assessment

DIRECTIONS: Please write down what you know about the following words or where you have encountered them and what they mean to you. You may have heard them from a teacher, parent, in the news, etc. Write and describe whatever you think/know about the topic. You will have approximately 10 minutes to complete this task so please work efficiently.

- Alternative Sources of Energy

- Environment

- Food, Health & Fitness

- Forces & Motion

- National Security & Safety

- Robotics

- Technology

Resource Worksheet 7-2: Mission Challenge Brainstorm Problems

DIRECTIONS: Over the next 15 days, document any problems you encounter in your daily life. These encounters can take place in your day-to-day actions, news, family member conversations, etc. These problems might be as simple as family members misplacing their belongings or as complex as wanting to find a way to make sure a loved one does not go missing. The only MUST is to be truthful and look at the world with an engineering/scientific eye. How could you make life better, different, or improved from its current condition? Best of luck on your first mission!

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

16.

17.

18.

19.

20.

Resource Worksheet 7-3: Brainstorm Mission Challenges

DIRECTIONS: With a partner take out the completed Handout B titled 'Brainstorm Problems.' Together look at the lists you both created and document how these problems might fit into each Mission Folder. You will meet with another group of two in 15 minutes, so please use your time wisely.

- Alternative Sources of Energy

- Environment

- Food, Health & Fitness

- Forces & Motion

- National Security & Safety

- Robotics

- Technology

Resource Worksheet 7-4: Post Assessment

DIRECTIONS: Please write down what you know about the following words and what they mean to you or places you have encountered these words. At this time you may also write down ideas/problems you thought of that may fit under these different mission folders. Good luck!

A. Alternative Sources of Energy

B. Environment

C. Food, Health & Fitness

D. Forces & Motion

E. National Security & Safety

F. Robotics

G. Technology

2.3 DEVELOPING A PROBLEM STATEMENT

Title: Seventh Grade Developing a Problem Statement Lesson Plan

Goal/Purpose:

1.) To help students learn how to ask probing questions about the texts they read, the features of the phenomena they observe, and the conclusions they draw from their models or scientific investigations.
2.) To use research and observation to refine questions.
3.) To understand what constitutes a good investigation.

Objectives:

1.) Students will brainstorm problems in the community and possible ways science could help.
2.) Students will identify a problem in the community and formulate probing scientific questions regarding the problem.
3.) Students will research the problem and use the information to refine the questions.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
• Ask questions that require sufficient and appropriate empirical evidence to answer.
• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Time:

Approximately Three, 60 minute lessons

Materials:

Paper and pencil
Computer
Internet Access
Library
eCYBER Guides
Newspapers

Instructional Procedures:

1.) Ask students to think of one word that states the most essential part of science. Allow students to share their word.

2.) Write on the board "Questions". Explain that questions are an essential part of science.

3.) Ask students to turn to their neighbor and discuss why questions are so essential. Students share ideas with the class.

Note: When discussing scientific questions you may want to discuss that all science starts with a question. Scientists ask questions about the natural world. They question material objects and energy changes through direct observation or with scientific tools. The objects may be either living or nonliving things. The energy changes may be easy to observe, such as the sound of thunder overhead, or more difficult, such as the light coming from a distant star. What makes a question scientific is that it can only be answered by observations or evidence.

4.) Scientists ask questions every day about the world around them. Do you ask questions about things going on in your community? What are some of the questions you have? Are there problems in your community you would like to solve? Brainstorm with your eCYBERMISSION Team. Can Science and/or Engineering solve any of these problems? List the questions.

5.) Try to eliminate questions that cannot be answered by gathering evidence and have students rephrase the question so they could gather evidence.

6.) Word questions in a way that allows them to be answered by an investigation or experiment. Here are some good ways to begin scientific questions:

"What is the relationship between . . ."
"What factors cause . . ."
"What is the effect of . . ."

7.) Break broad questions into questions that can be investigated one at a time.

8.) Be sure that the question identifies a relationship or factor you can investigate.

Group Activity:

1.) In eCYBERMISSION, teams have students create a problem statement for their project. The statements will be collected and used as a pre-assessment.

2.) Students read online Mission Folders from previous Winning Teams and write down good things they notice

Teacher Notes:

Advanced/Gifted Students

1.) What problem in your community did your team try to solve?
2.) Why is this problem important to your community?
3.) List at least 10 resources you used to complete your research (e.g. websites, professional journals, periodicals, subject matter experts).
4.) Describe what you learned in your research in a paper.

ESE/Special Needs Students

1.) Have a list of scientific and non-scientific questions. Have students sort into correct piles. Students can pick one question out of the list of scientific questions for further investigation.

Reinforcement/Extension:

1.) Prior to the activity, go over the seven Challenges. Use the Mission Challenge pictures from the eCYBERMISSION Website to trigger discussion/questions about each one.

2.) Use extinction techniques to discourage student groups from frequently asking for the Team Advisor's direct help on creating their problem statement. Use the "Ask Three, Then Me" rule to encourage students to find solutions to their own questions.

3.) Students can post their Problem Statement around the classroom to generate a class discussion or gallery walk in order to refine their problem statements further by soliciting input from their peers.

4.) Choose one of the scientific questions developed and tell what kind of evidence you would need to answer the question. How do you think a researcher could collect that evidence?

especially about the types of questions that were utilized and how they were formatted.
3.) Make a big class list of the questions that were noticed.
4.) Compare this list to the kinds of questions the class came up with. Discuss the properties of a good science question.
5.) Students should review their original problem statement to determine if they are addressing a good science question.
6.) Rewrite problem statements and turn in as a post assessment.

Assessment:

For each of the 10 questions below, write yes if the topic can be investigated scientifically. Write no if it cannot be investigated scientifically. For each yes answer, re-write the topic in the form of a scientific question.

a) Some people work better in the morning, and other people work better in the afternoon.
b) Taking something that belongs to another person is wrong.
c) Snakes travel in pairs.
d) Animals behave in strange ways before an earthquake.
e) People who don't recycle should have to pay fines.
f) Basketball is a better sport than soccer.
g) You will remember what you read best if you read it just before you sleep.
h) Maria's kind of bike is faster than Rob's kind of bike.
i) Each year when the weather gets cold, birds fly to warmer regions.
j) Trucks use more gasoline than cars.

Resources:

http://www.corestandards.org
http://floridastandards.org
http://www.wikihow.com/Write-a-Problem-Statement
http://suite101.com/article/scientific-inquiry-as-a-process-for-learning-a147274
http://school.discoveryeducation.com/sciencefaircentral/Getting-Started/Validate-Topic.html
http://www.district196.org/rhs/library/formulatequestion.htm

2.4 CONDUCTING RESEARCH

Title: Seventh Grade Conducting Research Lesson Plan

Goal/Purpose:

To help students understand why it is helpful to follow a process (steps) when researching.

Objectives:

1.) Students will name the steps for conducting research.
2.) Students will re-read the problem statement to see if researching terms and questions fit the topic.
3.) Students will find 10 credible sources for research topic.

Standards:

Common Core State Standards for English Languages Arts

Reading Standards for Informational Text (Grade 7)

Domain: Integration of Knowledge and Ideas

Standard 8. Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.

Standard 9. Analyze how two or more authors writing about the same topic shape their presentations of key information by emphasizing different evidence or advancing different interpretations of facts.

Writing Standards (Grade 7)

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

Standard 8. Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

Standard 9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

b. Apply *grade 7 Reading standards* to literary nonfiction (e.g. “Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims”).

Speaking and Listening Standards (Grade 7)

Domain: Comprehension and Collaboration

Standard 1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners

	on *grade 7 topics, texts, and issues,* building on others' ideas and expressing their own clearly. **a.** Come to discussions prepared having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion. **b.** Follow rules for collegial discussions, track progress toward specific goals and deadlines, and define individual roles as needed. **c.** Pose questions that elicit elaboration and respond to others' questions and comments with relevant observations and ideas that bring the discussion back on topic as needed. **d.** Acknowledge new information expressed by others and, when warranted, modify their own views. **Reading Standards for Literacy in Science and Technical Subjects (Grade 6-8)** **Domain: Integration of Knowledge and Ideas** **Standard 8.** Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
Time: Two, 90-minute class periods. (This lesson can be modified to be taught in three, 60-minute classes)	**Materials:** Resource Worksheets 7-5 through 7-7 Access to the Internet to play video
Instructional Procedures: Day 1 1.) Give pre-assessment. 2.) After the pre-assessment, show the video: http://www.ideo.com/work/aquaduct/. 3.) When video is over, talk with students about the aquaduct bike and ask them how they think the developers made this bike and came up with the video. Some questions to ask: a) What was the problem they were trying to solve? b) What are some of the obstacles they needed to overcome in designing the bike? c) What steps do you think they took before designing the aqua bike? d) What are some of the different things they needed to research/think about in order to make this work? 4.) Have students get out paper and write down what	**Teacher Notes:** 1.) See Resource Worksheet 7-5 for the Pre and Post Test for this lesson. This handout currently contains the questions to ask the class as well as a link to a website that can be used to ask the questions to the class. The question answers can be whatever you need them to be. 2.) While going over questions have students open a Google doc and type up student responses, so they can revisit this while they research for eCYBERMISSION. 3.) If Google Docs does not work, type the student responses in Microsoft Word and hand them out so students will have something to revisit while they research. 4.) Student research could take longer than the two class days.

they think the steps are for research.
5.) After two minutes share with a partner.
6.) After two more minutes share with a group of two, making groups of four, and fine tune the list—be ready to share with the class.
7.) Start PowerPoint (available on eCM site) on the research steps—students take notes—refer to the aquaduct project while you work through PowerPoint. Ask and elicit questions for clarification on material.
8.) Pass out the following for homework: Resource Worksheet 7-6 to help guide students. Each student must find five sources for their eCYBERMISSION project for homework as they will need it for day 2.

Day 2
1.) Put kids in eCYBERMISSION Teams.
2.) Have students review criteria from credible sources provided in yesterday's PowerPoint.
3.) Team members should share sources with each other, and talk about which ones are good sources and which ones they might not use.
4.) Decide which ones they will use for their eCYBERMISSION project.
5.) Read and discuss resources to start to design your project. (Use Teacher Research Log to help organize group's progress.)
6.) To end the lesson, have eCYBERMISSION Teams share the benefit of researching using the guide we used. Also, share other ways groups might have approached this problem.
7.) Give post-Assessment.

Assessment:

Resource Worksheets 5-7.

Resources:

http://www.youtube.com/watch?v=nrG3dUldI_U&feature=related&safe=active
http://www.youtube.com/watch?v=27De6EnqUzg&feature=related&safe=active
http://www.youtube.com/watch?v=22CPQoLE4U0&feature=related&safe=active
http://www.ecybermission.com/AdvisorResources

Advanced/Gifted Students:
Have students help run the presentation.

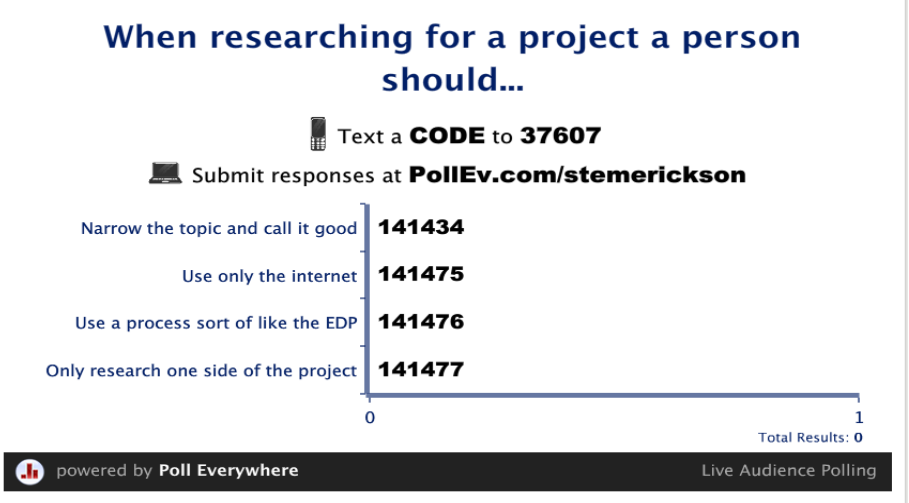
ESE/Special Needs Students:
Use screencast to capture the screen as you teach so kids can revisit the lesson if needed later.

Reinforcement/Extension:

Write a paragraph on why you think it is important for eCYBERMISSION to include research as one of their requirements. Should all competitions include this step? Why or why not?

Resource Worksheet 7-5: Conducting Research Lesson Plan Pre/Post Assessment

Directions: Pre/post-assessment questions: Give the quiz on paper or this polling site—if you use this site you can compare results for the two quizzes. (http://www.polleverywhere.com/)



(The site looks like this when a question comes up. It does have a free part to this site and kids can text in answers. Results are emailed to you.)

What steps do you use when researching at topic?

0

True or false: Any source, as long as you like it, is a valid source.

0

Researching is easy because....

0

When researching for a project a person should...

Resource Worksheet 7-6: Conducting Research Checklist Name: _____

Step 1 - What is my topic?

Step 2 - What are my Questions or Keywords?

Question 1: _____
Question 2: _____
Question 3: _____
Question 4: _____

Step 3 – What sources do I plan to search?

☐Books
☐Reference Books (Encyclopedia)
☐Internet Web Sites
☐Periodical Databases
☐Additional Source Required By Teacher

Step 4 – List my sources.

1) _____
2) _____
3) _____
4) _____

Step 5 - Where is my organized information?
(*Working bibliography and notes*)
Show your teacher _____ (Teacher's Initials)

Step 6 - Sign here when your project is finished. _____
What is the finished product? (paper, annotated bibliography…etc.)

Step 7 - Evaluate your project by answering the following questions:
How well did I follow the steps?

What do I think of my finished project?

Have two other groups look at your research and write their feedback for the above steps (You must have three sentences for each question).

Resource Worksheet 7-7: Research Log

Research Log
Teacher Checklist

Class_____

Students	Topic Chosen	Developed Questions	Selected Sources	Evaluated Sources	Recorded Information	Made Product	Evaluation Completed

2.5 STATE A HYPOTHESIS

<table>
<tr><td colspan="2">Title: Seventh Grade State a Hypothesis Lesson Plan</td></tr>
<tr><td>Goal/Purpose:
To learn the process of developing a hypothesis statement.

Objective:
Students will develop and test a hypothesis on one factor that affects how accurately people remember information.</td><td>Standards:
Next Generation Science Standards:
Practice 1: Asking Questions and Defining Problems.
• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Practice 3. Planning and Carrying Out Investigations
• Evaluate the accuracy of various methods for collecting data
.
Practice 4. Analyzing and Interpreting Data
• Analyze and interpret data to determine similarities and differences in findings.
• Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trails).</td></tr>
<tr><td>Time:
One, 40-minute class</td><td>Materials:
Stopwatch</td></tr>
</table>

Instructional Procedures:

1.) As a group, make two lists of six three-letter words on two sheets of notebook paper (one list per sheet). List A should contain nonsense words, like “zop,” “rud,” and “tig,” that have no meaning in ordinary English. List B should contain familiar but unrelated words like “cat,” “sea,” or “red.”

2.) Discuss with your group what you think will happen when people try to remember the words in each list. Write a hypothesis about which list will be easier to remember.

5.) Have students present List A to five people not in their group.

6.) Use the stopwatch and allow them to study the list for one minute then take the list away.

7.) Give students one minute to write down words they remember from List A. Record the number of words each person remembers in your data table.

8.) Calculate the mean (average) number of words remembered by all the people, and record that number in your data table.

9.) Present List B to the same five people. Control variables by having them study List B for the same length of time that they studied List A. After one minute, take the list away. Then give them one minute to write down words they remember from List B.

10.) Record the number of words each person remembers in your data table. Calculate the mean (average) number of words remembered by all the people, and record that number in your data table.

11.) In Conclusion, students should ask themselves if the data/results supports or refutes their hypothesis.

12.) Ask them if they think there is anything they should change about the experiment.

> Lead them to see that List B was always given to the test subjects after List A. How could that affect the results? How could they fix the experiment to control for this variable? Students should conclude that the results of their experiment could be questions because it could be suggested that people just get better at remember lists after they practice. In order to prove the hypothesis, “if words make sense to us (are in a familiar pattern…) they are easier to remember,” 50% of the time test subjects should be given List A first and 50% List B first. This would control for the variable “practice”.

12.) Instruct the students that they can develop ideas for a hypothesis by writing several questions about a topic

Teacher Notes:

1.) The mean, or average, of a set of data is the sum of all the values divided by the number of items. The median is the middle number when the data values are arranged in numerical order.

The mode is the value that occurs most often. What are the mean, median, and mode of this data set?

Data	18, 10, 14, 15, 17, 19, 21
Values	18, 12

Mean =
Median =
Mode =

2.) Every scientific experiment starts with a question and a testable possible answer to that question, called a hypothesis.

3.) Not all scientific questions can be answered with controlled experiments, but controlled experiments are one important tool that scientists use.

4.) Controlled experiments provide reliable results because variables are controlled, meaning that only one variable is purposely changed. All other variables must be controlled, or kept the same.

5.) The variable that is changed on purpose is called the independent variable. The dependent variable is the variable that changes in response to the independent variable. Other steps in a controlled experiment include collecting and interpreting data, drawing conclusions, and communicating.

Advanced/Gifted Students:

1.) Students should have opportunities to learn standard techniques for displaying, analyzing, and interpreting data. Such techniques include different types of graphs, the identification of outliers in the data set, and averaging to reduce the effects of measurement error.

2.) Students should also be asked to explain why these techniques are needed.

3.) Use handheld numbered blocks to demonstrate all above.

ESE/Special Needs Students:

of interest. Then they must narrow the question to one that can be investigated.
13.) Close the lesson by asking the following assessment questions. Students should turn in answers.

Assessment:

1.) Is a hypothesis always the correct answer to a scientific question? Explain.
2.) Write a hypothesis based on this question: "Will empty trucks use the same amount of gas as heavily loaded trucks?" Write the hypothesis as an "if/then" statement.
3.) True or false - ideas for hypotheses often result from identified problems or from questions that have been raised.

Resources:

www.experiment-resources.com
www.flinnsci.com
www.gpscience.com
www.gpscience.com/time

1.) Pair students in variety ability groups. Students with special needs could be assigned the job of time keeper or list counter.
2.) Provide students with calculators

Reinforcement/Extension:

Have students design their own hypothesis based on a simple, easy to research question (such as the one presented in class). Students may test their hypothesis at the end of class or for homework.

2.6 CONDUCT AN EXPERIMENT

Title: Seventh Grade Conducting an Experiment Lesson Plan

Goal/Purpose:

1.) To learn there are a variety of ways to conduct an experiment.
2.) To determine the most appropriate type of experiment to conduct based on the nature of the scientific problem being investigated.

Objectives:

1.) Students will select one of four types of experiments for their Mission Challenge.
2.) Students will analyze problems and determine the most beneficial type of experiment to use.

Standards:

Next Generation Science Standards:

Practice 3. Planning and Carrying Out Investigations

• Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
• Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
• Evaluate the accuracy of various methods for collecting data.

Practice 6. Constructing Explanations and Designing Solutions

• Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.
• Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.

Time:

Two, 45-minute class periods

Materials:

Resource Worksheet 7-8: Exit Slips
Excel spreadsheet of Students Problems
"Conducting an Experiment" PowerPoint

Instructional Procedures:

Day 1

1. Write the following four questions on the front board (Do not write the answer until step 2)
2. How does the size of a ball affect the amount of bounce back?
    a. (Answer: Controlled Experiment)
3. What is the maximum hunting distance of a mother eagle when she has eaglets in her nest? (Answer: Fieldwork)
4. Does exercising increase one's life span? (Answer: Secondary Research)
5. Can we design a car horn that will work

Teacher Notes:

1.) Be sure to print as many exit slips as needed for each student.
2.) If the teacher does not feel comfortable explaining variables, here is a student friendly and reliable Website to use as a revision before you teach the types of experiments students can conduct in eCYBERMISSION.http://nces.ed.gov/nceskids/help/user_guide/graph/variables.asp.

Advanced/Gifted Students:
Students can work in pairs to make up eight different types of experiments and identify which of the four different types is the best approach for conducting the

for people who are deaf?
   a. (Answer: Design/Invention)
6. Ask students how they would go about finding an answer to these questions. Write these answers on the front board. Explain to the students there are many ways of conducting an experiment but that today's lesson will focus on four common types of research.
7. Start the "Conducting an Experiment" PowerPoint presentation.
   Conduct a question and answer session.
   Resource Worksheet 7-8: Exit Slips.

Day 2:

1. Review day one by asking the following:
2. "If a student wanted to conduct an experiment about rocket launches in the past five years, which type of experiment should he/she choose?" Answer: Secondary Research
3. "If a student wished to research the affect sleep has on a student's ability to score a high grade on a test, what is the best type of experiment?" Answer: Controlled experiment
4. The students will then be divided into pairs. Each group will be given a list of students who are trying to conduct an experiment to investigate a scientific problem.
5. 20 Minutes: Each student is an expert at helping scientists conduct experiments. The scientists have given the students a problem. The students need to guide the scientists in selecting one of the four different types of experiments:
   Controlled Experiment
   Fieldwork
   Secondary Research
   Design/Invention
6. 10 Minute Review: Require all students to participate and if you feel an answer is incorrect, ask the student to explain how they would conduct the experiment and why they would use that type of experiment.

ESE/Special Needs Students:
1.) Break the students into groups of four. Provide each student with a copy of the "Conducting an Experiment" PowerPoint. Ask each student to only focus on one type of experiment. Give them time to research their desired type of experiment. Allow the group to present their findings to the small group and each student is responsible to identify the four types of experiments with student friendly notes.
2.) Students can then use the "Conducting an Experiment" Excel Spreadsheet to identify experiments and determine the type of experiment that is most reliable and accurate (from the four different types researched by the small group).

Reinforcement/Extension:

1.) Review variables with the students.
2.) The strategy of Exit Slips helps students reflect on and process new information, and offers teachers the opportunity to differentiate upcoming instruction based on these reflections, or to re-teach certain aspects of the lesson based on need.
3.) Some experiment types may vary due to the way the student might decide to conduct the investigation.

research.

Assessment:

Day1

1.) Students will need to complete an "Exit Slip" in the classroom (Resource Worksheet 7-8: Exit Slips). Use the prompt "What are the four types of experiments, and which one do you like the best and why?" Explain in detail.

Day 2

1.) Students will swap papers with their partners and correct each other's papers.
2.) Teacher needs to state that depending on the way the scientist decides to gather data will determine which type of experiment type they choose.
3.) Students will use the Resource Worksheet 7-8: Exit Slips "4,3,2,1" in order to write the following: four facts, three things about how the information is useful in science, two questions, and one thing it reminds them of (five minutes).

Resources:

"Conducting an Experiment" PowerPoint (http://www.ecybermission.com/AdvisorResources)

"Conducting an Experiment" Excel Spreadsheet

This is a great link for students who enjoy conducting secondary research. Enter your zip code to retrieve weather data like allergy forecast, allergy history, UV forecast, and cold and cough forecast. This website is excellent for students conducting a secondary research experiment in weather www.pollen.com.

Resource Worksheet 7-8: Exit Slips

Name _____ Date _____

Class _____ Teacher_____

Exit Slips "4,3,2,1"

Directions: You are to complete it after the lesson is complete. It is a reflection of what was taught in today's lesson.

Topic: _____

Write four facts you learned in today's lesson. **4**	_____ _____ _____ _____ _____ _____ _____

Write three things about how the information learned can be useful. **3**	_____ _____ _____ _____ _____
Write two questions you have about the lesson. **2**	_____ _____ _____ _____

Write one thing this lesson reminds you of. **1**	_____ _____ _____ _____

Student Worksheet

Name _____ Date _____

Class _____

Student Copy

Directions: Choose 1 out of the 4 types of experiment the scientist must choose:

Controlled, Fieldwork, Secondary Research, or Design/Invention

Problem

Type of Experiment

1) Which liquid has the highest pH value?
2) Which type of popcorn leaves the fewest amounts of kernels?
3) How does music affect your heartbeat?
4) Does the type of drink affect its freezing point?
5) How do different brands of paper towel affect its absorbency?
6) Does the air temperature affect the size of a balloon?
7) How will body temperature affect your mood?
8) How does adding glow-in-the-dark chemicals to a bubble mixture affect the lifespan of bubbles?
9) How does the temperature of food affect the way it tastes?
10) What will happen if you water plants with liquids other than water?
11) How does temperature affect the volume of rainfall in the month of April?
12) How does the mass of a paper ball affect the distance traveled?
13) Do the seasons affect the incidents of asthma attacks?
14) How does the temperature affect the number of

unpopped kernels in a bag of popcorn?

15) How does temperature effect the growth of a plant?

16) Do sneakers make you jump more accurately?

17) Do different brands of paper towels affect the amount of pennies it can hold?

18) How do different hand sanitizers affect the number of germs killed?

19) Which brand of paper towels will hold the most quantities of pennies after 10 drops of water are added?

20) How does temperature affect the allergy forecast in the months of September thru December?

2.7 DATA COLLECTION AND ANALYSIS

Title: Seventh Grade Data Collection and Analysis Lesson Plan

Goal/Purpose:

1.) To understand the process of data collection
2.) To create organized tables.
3.) To learn how to analyze data through the use of Microsoft Excel.

Objectives:

1.) Students will identify various ways to collect data for their experiment.
2.) Students will analyze data using Excel, write observations and make conclusions based on data.

Standards:

Next Generation Science Standards:

Practice 1. Asking Questions and Defining Problems.

• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Practice 3. Planning and Carrying Out Investigation

• Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
• Evaluate the accuracy of various methods for collecting data.

Practice 4: Analyzing and Interpreting

• Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
• Distinguish between causal and correlational relationships in data.
• Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trails).
• Analyze and interpret data to determine similarities and differences in findings.
• Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

	Common Core State Standards for Mathematics (Grade 7) **Domain: Statistics and Probability 7.SP** **Use random sampling to draw inferences about a population.** **Standard 1.** Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences. **Standard 2.** Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. **Draw informal comparative inferences about two populations.** **Standard 3.** Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. **Standard 4.** Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.
Time: Data Collection: Two, 45-minute classes Data Analysis: Three, 45-minute classes (If students are proficient in Excel, this could be condensed to two, 45 minute classes.)	**Materials:** Ball Projector Collecting Data PowerPoint Graph paper Laptops (One for every two students) Resource Worksheet 7-1 Excel Handout Resource Worksheet 7-2 Rubric for scoring students graph Resource Worksheet 7-3 writing observations Resource Worksheet 7-4 Writing conclusions
Instructional Procedures: Data Collection Day 1:	**Teacher Notes:** Data Collection: Review the PowerPoint

1.) Tell students that you know a girl who loves to watch pro soccer and a boy who doesn't like soccer at all. You have decided, based on your data, that girls like soccer more than boys. Ask students if this is a good and fair analysis of the data.
2.) After students point out how unfair your conclusion is, ask "what does biased mean?"
3.) Ask some of the students to share their thoughts.
4.) Provide "teacher explanation" of biased data.
5.) When a researcher collects data, the researcher must use as many people as they can. This is called the sample size. Refer back to your original soccer data. Ask how many students you should ask before you draw a conclusion. Help the students understand the larger the sample size the more reliable the data. The researcher should not favor an outcome. Ask students if it matters what types of people are asked about soccer (such as, asking the girls soccer team and the boys chess club.) Lead the class to conclude that if the sample size prefers one group over another, the data is biased. If the data is biased, it is not a good representation of the entire population.
6.) 20 Minutes: PowerPoint presentation about the different ways to collect data.

Data Collection Day 2:
1.) Tell the students: We will be collecting data about student birthdays.
2.) Ask the students to help you come up with the question that will lead to this data.
3.) Put the following table on the front board:

Months	# boys	# girls	Total

4.) Complete the month's section. Tell the students when they hear the month they were born in to raise their hands.
5.) After they have gathered the data review the importance of making the table before gathering data.
6.) Ask the students if there is an independent and dependent variable. If they are not sure remind students that a dependent variable is before showing it to the students.

Data Analysis:
1.) There are only eight names added to the data sheet in order to fit all the names in the graph.
2.) If you add more names to the data you must enlarge the graph and change the alignment of the x-axis (look at the excel spreadsheet in order to see how you can change the alignment).
3.) Students should have more than eight names to decrease error.
4.) If you do not have laptops, the students can generate a hand drawn graph but it might take two class periods.

Advanced/Gifted Students:
Students can design their own simple experiment, collect data, and graph using Excel.

ESE/Special Needs Students:
1.) The first day the students make the graph (be sure the y-axis has a scale, meaning it increases consistently by the same number).
2.) The second day they analyze their data

Reinforcement/Extension:

After completing this lesson, use the skills learned on collecting and analyzing data to help students gather data and summarize conclusion to see if the data supports or contradicts your hypothesis.

something that changes if the independent variable changes.
7.) Hold up a small ball (a tennis ball works well). Tell the students you want to measure how high the ball bounces back when you drop it. Drop the ball from knee height. Ask students if you could change anything to make the ball bounce back more. The students will tell you to bounce it from a higher height. Tell them that height is the thing you are changing (independent variable) and bounce back is what you wish to measure (dependent variable).
8.) Ask again if there is an independent and dependent variable in the birthday data. Ask if birthdays are dependent on if you are a boy or girl. The answer is no. This is data that is independent of each other so it would not make for a good research project. Of course, if someone believes your birthday is dependent on gender, they could collect data and find out if their hypothesis is correct.
9.) Have students brainstorm some data they could collect that has an independent and dependent variable.

<u>Day 3 Data Analysis:</u>
1.) Starter: What are the different ways you can organize data? Answer: Bar graphs, pie graphs, line graphs.
2.) Scientist must first organize their data in order to analyze it. The first step is making graphs of your data.
3.) Today you will learn how to use Microsoft Excel in order to assist you in organizing your data into graphs.
4.) Review the Rubric of scoring the graph (5 minutes).
5.) A scientist problem is: **How does gender affect the height of 12-year-old students?**

The data the collected is below:

Student Name	Gender	Height (inches)
Ana	F	43
Chris	M	56
Tina	F	41
Tom	M	30

Jen	F	65
Tito	M	58
Lisa	F	55
Fred	M	59

6.) Our job is to organize and analyze the data.

Data Analysis Day 1:
1.) Use Excel or graph paper to make the graph. This will allow you to assess the students that are having difficulties. See attached Rubric
2.) Use Resource Worksheet 7-1.
3) Use Resource Worksheet 7-2 Rubric of a graph.

Data Analysis Day 2:
1.) How to write detailed and descriptive observations of our data. Look at the data and write observations.
2.) Use Resource Worksheet 7-3.

Data Analysis Day 3:
1.) Look at the data and review the problem and hypothesis and write conclusions of the study.
2,) Make sure the students recognize the independent and dependent variable.
3.) Use Resource Worksheet 7-4.

Assessment:

1.) Data Collection: The teacher will ask the students to list two ways one can collect data and write a detailed explanation.
2.) Data Analysis: Students will make a bar graph with the axes labeled, an accurate scale to the y-axis and a chart title.

Resources:

Data Collection
Teachers can model how to collect data by performing “Drops of a Penny” Lab. Students can use the skills learned in this lesson in order to complete the penny lab. The link is attached below
http://sciencespot.net/Media/pennylab.pdf.

To strengthen collecting data and analysis skills go through this interactive website that graphs kids and their pets with the students, and then have the students collect their own data and analyze their findings.
http://www.beaconlearningcenter.com/WebLess

ons/Kidshavepets/default.htm#page1 Data Analysis: http://pblchecklist.4teachers.org/checklist.shtml Teachers can create a checklist that targets specific needs in writing, science, oral presentation and multimedia. http://math.pppst.com/dataanalysis.html great lesson on statistics http://www.graves.k12.ky.us/powerpoints/elementary/symjself.ppt#265,14 (please copy and paste the link) great PowerPoint about various graphs one can use.	

Resource Worksheet 7-1 Data Collection: How to Use Excel

Name _____ Date _____
Class _____ Teacher_____

AIM: How to use Microsoft Excel in order to help you organize your data into graphs.

Note: this handout is for PC users only.

QUESTION: How does gender affect the height of 12-year-old students?

TASK: Students will use this data, graph it, and write observations and conclusions about the data.

DATA:

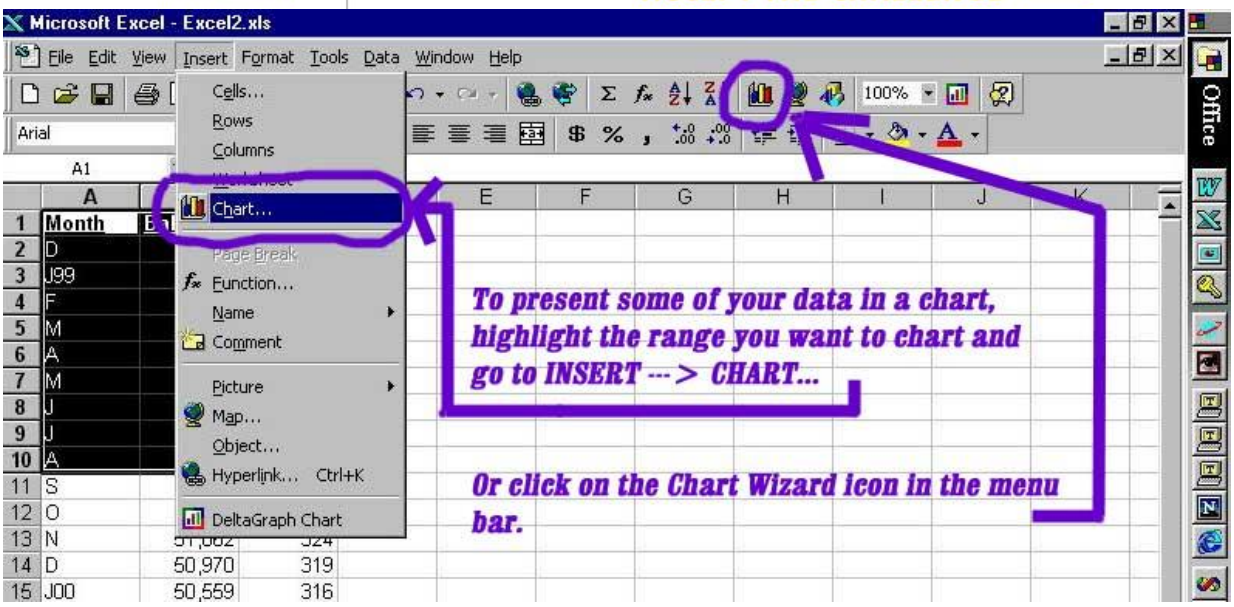
Student Name	Gender	Height (inches)
Ana	**F**	**43**
Chris	**M**	**56**
Tina	**F**	**41**
Tom	**M**	**30**
Jen	**F**	**65**
Tito	**M**	**58**
Lisa	**F**	**55**
Fred	**M**	**59**

1) Go to Start → Microsoft Office→ Microsoft Excel and open the file.

2) There should be a title for the data; and remember, the first row or column is always the X-axis (dependent variable) and the second row or column is the Y-axis (independent variable). The title that has any numerical data must have units as grams (g), inches (in.), time (sec.), etc. **Now ask the students to copy the data into the Excel spreadsheet.**

X-axis (gender)	Y-axis (Height) (inches)

3) Once you are done left click and drag to highlight the data only (it should be blue if you did it correctly), then go to→ Chart wizard, click once.



4) Select the appropriate graph you desire, and move the cursor to “Press and Hold to View Sample,” then left click and leave it pressed to see the graph. If it’s what you like, move the cursor to “next” and left click once.

5) You are now at Step 2 of 4, move the cursor to “next” and left click once.

6) Step 3 of 4 is where you can do all your editing of the graph; **Moving the Legend → go to the tab that says “Legend”**, and choose the desired location.

Show the values→ go to the tab that says “Data Labels” and left click on value.

Adding Title (to graph and axes) → “Title” complete the X-axis title, and the Y-axis title as this will help you write a title for the graph in the “Title” section.

7) Step 4 of 4, you want to left click on “As object in” → then left click “Finish.”

8) Accessories: **To change the color of the bar graph, drag the cursor inside the bar graph, double left click, choose the desired color (to add extra click on fill effect) then click OK. Play around and you will see a variety of things in this section.**

9) To change the orientation (alignment) of the words in the X-axis→ double left click on the words in the X-axis, go to the tab “Alignment” and see how many degrees you want to set up the text, or move your cursor to the text word→ left click and see how you want to move the text. When you are done click ok and you should see your changes. Note: this is great when not all the categories in the X-axis are visible.

This handout will be helpful for any desired graph.

Resource Worksheet 7-2: Rubric of Scoring Student Graphs

Name _____ Date _____

Class _____ Teacher _____

Name of the Graph _____

6	5	4	3	2	1
The graph demonstrates graphing proficiency. It has accurate graphed data, title for the X-axis, title for the Y-axis, scale for the Y-axis, key, and title for the graph.	The students' graph is accurate. Both axes have a title and there is a scale for the Y-axis. Or the student meets five out of the six requirements. The student is missing: title for the X-axis, graph is not accurate, title for the Y-axis, scale for the Y-axis, key, and title for the graph. **(circle all the missing requirements that apply to the student)**	The student accurately graphs all the data, labeled both the X & Y-axis, and there is a scale for the Y-axis. Or the student meets four out of the six requirements. The student is missing: title for the X-axis, graph is not accurate, title for the Y-axis, scale for the Y-axis, key, and title for the graph. **(circle all the missing requirements that apply to the student)**	There are three out of the six requirements on the graph. The graph is accurate, however the student might be missing: title for the X-axis, graph is not accurate, title for the Y-axis, scale for the Y-axis, key, and title for the graph. **(circle all the missing requirements that apply to the student)**	The student graphs the data accurately and labeled one of the axes. The student might be missing a scale for the Y-axis, title for the graph, key and another title for one of the axes. Or the student meets two out of the six requirements. The student is missing: title for the X-axis, graph is not accurate, title for the Y-axis, scale for the Y-axis, key, and title for the graph. **(circle all the missing requirements that apply to the student)**	The student only graphs the data. All five components of a graph are missing: The student might be missing title for the X-axis, title for the Y-axis, scale for the Y-axis, key, and title for the graph.

Resource Worksheet 7-3: Writing Observations of Data

AIM: How to write detailed and descriptive observations of our data.

In order to write great observations, students must write only what they see. They must also use the data as evidence to strengthen each observation of the data.

DIRECTIONS: Students use the time to write as much as they can about observations of their data. They can compare and contrast. At first you can scale it, in order for it not to be so overwhelming and ask for three observations and three conclusions. Then as you continue the school year, you can increase the specific number of observations and conclusion each student must write.

Here are a few sample observations your students might write about the data.

OBSERVATIONS

- Chris and Lisa are both 12 years old of similar height. Chris' height is 56 inches and Lisa's height is 55 inches.
- There are a total of four girls and four boys, the data is not biased.
- Jen has a height of 63 inches.
- Fred has a height of 59 inches.
- The average height for the females is _____.
- The average height for the males is _____.
- The median is _____.

Allow the students 30 minutes to write as much detailed observation as possible. Ask every student to share at least one observation not mentioned and correct the observation as needed. Be sure they use the data values as evidence of their statement.

ASSESSMENT: Ask every student to write a brief summary about what they learned in class. You will use this on Day 3 as a starter.

Resource Worksheet 7-4: Writing Conclusions of Data

AIM: How to write a detailed conclusion of our data.

STARTER: Read aloud some of the students prior comments about their learning outcome of writing observations.

TASK: For every observation, the student must also write a conclusion matching that observation. The numbers should be aligned so the students' first observation should also be their first conclusion.

In order to write great conclusions, you must summarize your findings, restate your hypothesis, state whether your hypothesis was correct or incorrect, and explain why you reached the outcome you did. Students can also state whether or not there is a direct relationship (as independent variable increases, the dependent variable also increases). Maybe there is an indirect relationship (as the independent variable increases, it causes the dependent variable to decrease or vice versa) if it applies.

DIRECTIONS: The students must have the observations of the 12 year olds and their height in order to complete the writing assignment. Allow 25 minutes for students to complete this task.

Below are some sample concluding statements your students might write.

CONCLUSION

1) Even though both Chris and Lisa are of different genders, they have very similar heights. This can possibly mean that gender might not have an effect on the height of a person.

2) The people that participated are evenly distributed and we have the same number of boys and girls.

3) Jen is the tallest female in the study. Her height was 63 inches.

4) Fred is the tallest male in the study. His height was 59 inches.

5) In this data there isn't a relationship between gender (independent variable) and height (dependent variable).

6) In my hypothesis I stated the females would be taller than boys; however, my data doesn't prove this to be true.

7) In order to get accurate data, I would need to increase the number of participants from eight to about 50 in order to get reliable data that represents the population of all 12 year olds.

REVIEW & ASSESSMENT: Allow 15 minutes for each student in the class to read their conclusion. Have each student read aloud a conclusion they wrote and assess accordingly. Ask other students to help clarify some challenging conclusions.

2.8 DRAWING CONCLUSIONS

Title: Seventh Grade Drawing Conclusions Lesson Plan

Goal/Purpose:

To learn how to draw conclusions based on a careful analysis of the data.

Objectives:

1.) Students will write a hypothesis statement.
2.) Students will analyze data and decide if their hypothesis is supported or not supported by the data.
3.) Students will use data to draw specific, data supported conclusions.

Standards:

Next Generation Science Standards:

Practice 1. Asking Questions and Defining Problems.

• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Practice 4: Analyzing and Interpreting

• Distinguish between causal and correlational relationships in data.
• Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trails).
• Analyze and interpret data to determine similarities and differences in findings.
• Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Common Core State Standards for English Languages Arts

Reading Standards for Informational Text (Grade 7)

Domain: **Integration of Knowledge and Ideas**
Standard 8. Trace and evaluate the argument and specific claims in a text, distinguishing claims that are supported by reasons and evidence from claims that are not.

Common Core State Reading Standards for Literacy in Science and Technical Subjects (Grade 6-8)

Domain: Integration of Knowledge and Ideas
Standard 7. Integrate quantitative or technical

	information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). **Domain: 8.** Distinguish among fact, opinion, and reasoned judgment in a text.
Time: One class period, 45-60 minutes.	**Materials:** Paper & Pencils Resource Worksheet 7-X Optional: Bring in a brand name paper towel as a visual to the "paper towel strength experiment"
Instructional Procedures: 1.) Review what it means to make a conclusion- "Suppose you find that your basketball is flat. You pump air into the basketball, but it goes flat again. You would probably conclude that there is a leak in the ball. We all make conclusions in everyday situations. In science, the word conclusion has a more limited meaning. Drawing a conclusion means making a statement summing up what you have learned from an experiment." 2.) Tell the students to imagine they and their lab partner have decided to experiment to see if the strength of Brand Y paper towels changes when they get wet. Your lab partner saw an advertisement that convinced her that Brand Y paper towels have the same strength no matter if they are wet or dry. 3.) For her to test her prediction she needs a hypothesis statement. What would be her hypothesis statement? Have students turn to their neighbor and decide on a good hypothesis. Elicit student responses. Answer: If a Brand Y paper towel is wet, then it will be just as strong as when it was dry. 4.) You don't think the advertisement is true. What would your hypothesis be? Have student turn and tell their neighbor. Elicit student's responses. Answer: If a Brand Y paper towel is wet, then it is weaker than a dry Brand Y paper towel. 5.) Put the following data (from a controlled experiment) on the front board. Give students a minute to analyze the data and draw a conclusion.	**Teacher Notes:** 1.) Review the hypothesis for the experiment. 2.) Examine the observations and measurements you made during the experiment. Analyze your data using graphs, tables, and charts. 3.) Decide whether you need to repeat the experiment. If possible, compare your work to the work of others. 4.) Write a conclusion that sums up the results of the experiment. 5.) Review your conclusion. Be certain that you have used only your experimental data to make your conclusion. You may have to review writing a hypothesis statement with the students. Recall that experiments begin with a hypothesis often written in the If… then…form. After the experiment is complete, the data is examined to see whether the hypothesis is correct or incorrect. Using the hypothesis and the data, you can write a conclusion that tells what you learned from the experiment. *ESE/Special Needs Students:* 1.) Have students draw pictures for their classmates. Then have classmates' makes inferences and conclusions based on the drawings. 2.) Pair ESE students with non-ESE students and have them work together on the RW. **Reinforcement/Extension:**

Brand Y Paper Towel Strength Investigation			
Dry Conditions		**Wet Conditions**	
Trial	Mass Held Before Tearing (g)	Trial	Mass Held Before Tearing (g)
1	86	1	57
2	89	2	51
3	86	3	57
4	88	4	52
5	86	5	53
AVG	87	AVG	54

6.) What conclusion would you write? Give students a minute to write a conclusion. The conclusion should look like one of the following:

Based on the results of a controlled experiment, wet Brand Y paper towels are not as strong as dry Brand Y paper towels.

Wet Brand Y paper towels are weaker than dry Brand Y paper towels.

7.) It is important to draw conclusions based only on the experimental data.

8.) Imagine that you drew the following conclusion from the experiment:

> Paper towels are weaker when they are wet than when they are dry.

9.) Discuss why this can or cannot be concluded.
Answer: You cannot reasonably draw this conclusion based on the data from your experiment because you did not test all brands of paper towels. Only conclusions about Brand Y paper towels can be drawn using your data.

10.) Students complete worksheet 7-X Drawing conclusions.

Assessment:

How well students were able to correctly complete Resource Worksheet 7-X.

1. Have students analyze each other's data and draw conclusions once their group's eCYBERMISSION Data Collection is complete.
2. Continue to reinforce the teamwork process of eCYBERMISSION with the students, and explain how they will need to continue communicating to complete their eCYBERMISSION Projects.

Resources: http://www.miniscience.com/SciProjIntro.asp http://www.corestandards.org http://www.experiment-resources.com/conduct-science-experiments.html	

Resource Worksheet 7-X: Drawing Conclusions

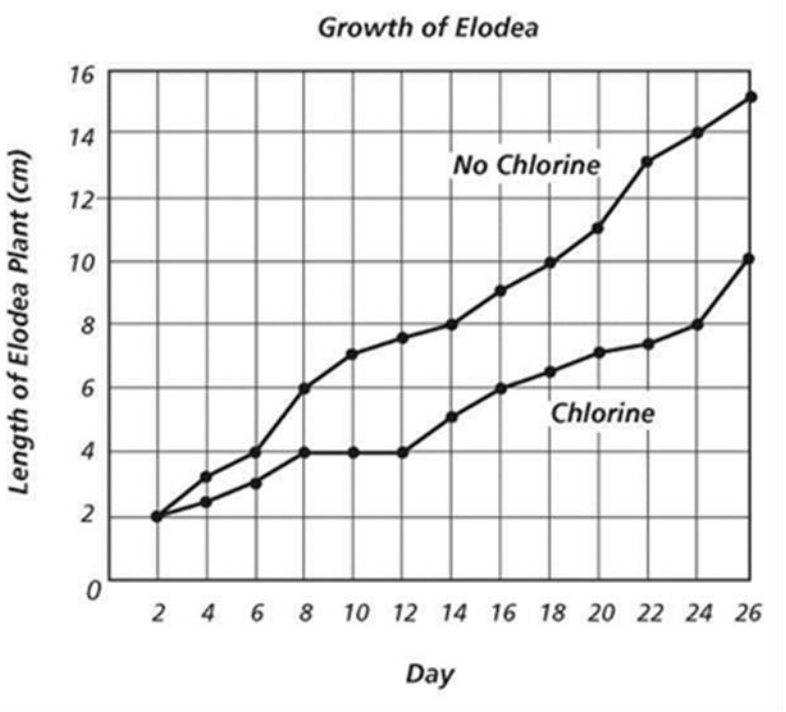
A. You and a friend have decided to experiment to find the effects of chlorinated tap water on the growth rate of the aquarium plant elodea.

B. You make the following hypothesis:

If there is chlorine in the elodea's water, then it will grow more slowly.

C. You've planned a controlled experiment, which you carry out over the course of several weeks.

D. To analyze your data, you make the following graph.



Answer the below questions:

1. Write a sentence that summarizes the data in the graph.

2. Does the data show that your hypothesis is correct or incorrect?

3. Write a conclusion for this experiment.

4. Explain whether you can reasonably draw this conclusion from your data: *Aquarium plants grow more slowly if there is chlorine in their water.*

5. Imagine you made the following hypothesis: *If there is chlorine in the elodea's water, then the plant will grow more quickly.* Would you have learned anything from the experiment? Why or why not?

2.9 BENEFIT TO THE COMMUNITY

Title: Seventh Grade Benefit for the Community Lesson Plan

Goal/Purpose:

To understand the impact everything people make or do has on other people and the world.

Objectives:

1.) Students will define how companies benefit our local community.
2.) Students will work in groups to list ways their product or idea may impact the world for the better.
3.) Students will develop three or four positive and negative ways their product could affect their community.

Standards:

Common Core State Standards for Mathematics
Statistics and Probability

Standard 1. Understand that statistics can be used to gain information about a population by examining a sample of the population. Generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

Standard 2. Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions.

Common Core State Standards for English Language Arts
Writing Standards (7 Grade)

Domain: Text Types and Purposes

Standard 1. Write arguments to support claims with clear reasons and relevant evidence.

a. Introduce claim(s), acknowledge alternate or opposing claims, and organize the reasons and evidence logically.

b. Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.

c. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), reasons, and evidence.

d. Establish and maintain a formal style.

e. Provide a concluding statement or section that follows from and supports the argument presented.

Speaking and Listening Standards

Domain: Presentation of Knowledge and Ideas

Standard 4. Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume, and clear pronunciation.

Time:

Three, 60-minute class periods.

Materials:

Movie: Meet the Robinson's (Fast forward to part showing futuristic inventions.)

The first section should be taught early in the school year (September or October). The second section should be taught before winter break (November or December). The last section should be taught in January.	DVD Player (or something to play the movie on) Worksheets on companies
Instructional Procedures: Part 1: Introduction to what 'The Benefit to the Community' folder is. 1.) Use Think-Pair-Share to come up with a list of what the 'Benefit to the Community' folder means to the groups. 2.) Use these questions to get started or make up own: a) How do you know if an invention is good for the community? b) What must a company do to ensure their actions are in the best interest of their community? c) What makes an invention bad for the community? d) What will you notice about the company if an invention is bad for the community? e) What are your thoughts about the pharmacy company that developed Paxil and sold it knowing that they could harm others? 3.) 1-3 Minutes: Think — Everyone should answer the questions on their own. 4.) 5 Minutes: Pair — Individuals should pair up with another person to talk about answers. 5.) 5 Minutes: Share—Pairs join two or three other sets of pairs and share answers. Ideas are then shared with the entire class. 6.) Watch pre-selected parts of the movie "Meet the Robinsons" and ask students to write down the different inventions that were made. They should notice if inventions have bad intentions or intentions not intended for the greater good-it could be problematic for others. Part 2: Second Class Period on this folder (November-December). 1.) Students revisit the notes from this the first time	**Teacher Notes:** Advanced students should help in planning the big eCYBERMISSION District Event. Event for showing projects could be at the local Library or Town meeting. Students could also display projects at local companies that support the project. **Reinforcement/Extension:** 1.) Groups that need help could have the teacher help them investigate a company together. 2.) Groups that are exceling can take time to send out surveys and have graphs that explain how useful their product will be to the world—look at the Aqua Bike product again. What are good things about the bike and what are the potential problems?

and if they have not done so, they need to assess the need for their invention or redesigned product.
2.) They should write how their product is used for good and point out any problems that might occur with their invention.

Part 3: Third Class Period on this folder (January).

1.) Students set up information they have so far and make sure they have presentations ready to talk about their product and present this to community members.
2.) Students should be prepared to understand that the presentation is not personal but will help with their product.
3.) The purpose of this time will be to allow students to hear/see things they might not think of when it comes to their product.
4.) For instance, cell phones were great but include harmful features -- RF waves, texting and driving accidents, and lack of social skills that come with reading or looking at cell phones while talking with others.
5.) After the conversations, each group member will need to type up a paper on how their idea benefits the community and have possible contingency plans if they are needed for their product.

Assessment:

Observations while groups are working for pre-assessment. For final assessment, students need to present their project idea to a local business. If the project has the community in mind, teams should be able to find a presentation area for final project.

Resources:

http://gysd.org/
http://www.kiva.org/
http://www.givekidstheworld.com/

3. Grade 8

3.1 TEAMWORK

Title: Eighth Grade Teamwork Lesson Plan

Goal/Purpose:

To learn about the dynamics of teamwork and how to effectively work in a group through a group Mission Challenge.

Objectives:

1.) Students will be able to identify behaviors that help teams function more effectively.

2.) Students will be able to identify behaviors that hamper team effectiveness.

3.) Students will learn how to work in groups and perform as a team.

Standards:

Common Core State Standards for English Language Arts

Speaking and Listening Standards (Grade 8)

Domain: Comprehension and Collaboration

Standard 1. 1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher led) with diverse partners on *grade 8 topics, texts, and issues,* building on others' ideas and expressing their own clearly.

a. Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.

b. Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed.

c. Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.

d. Acknowledge new information expressed by others, and, when warranted, qualify or justify their own

Time:

One, 45 to 60-minute period.

Materials:

Large groups: 10-15ft lightweight rod (often called Helium Stick and can be purchased online).

Small groups (4 students): Long straws or long pipe cleaners will work with two people on each side.

Roundtable Hint: Check with local metal fabrication and welding shops that may have lightweight hollow tubing at a cheaper price. Tent rods are too heavy and have too much flex for this activity.

Instructional Procedures:

1.) Have the group of 10-20 students divide into two lines and face each other. They will need to stand shoulder to shoulder (as close as possible).
2.) Explain the technical rules to the group (very important): Everyone's index fingers MUST remain in contact with the stick at all times, and the stick must rest on top of their fingers at all times (no grabbing, finger curling, etc.).
3.) Have the group extend their index fingers at waist level.
4.) Lay the stick across the group's fingers.
5.) The group must work together to lower the stick to the ground.
6.) Inevitably, the stick rises almost instantly - causing laughter, frustration, or confusion. The rise is caused by the small ripples of upward pressure as individuals each try to remain in contact with the stick.
7.) Refocus the group so they will continue to lower the stick. Here, it is important to give them enough time to problem solve through several attempts.
8.) Teacher leads a discussion using a variety of the discussion/reflection questions provided.

Assessment:

After the activity and discussion/reflection have students respond to the following prompt(s):

1.) What is one specific behavior you could improve to help your team work well together on your eCYBERMISSION project?
2.) What qualities should individuals possess in order to work well in a team environment?
3.) List three ways your team could communicate about your eCYBERMISSION project in class and outside of the classroom.
4.) Review dynamics of teamwork and how to effectively work in a group.

Teacher Notes:

Advanced or ESE/Special Needs

You can get a similar effect by putting three to four students on both sides of a meter stick. This task becomes more difficult as the length of the stick and number of people increase. Communication becomes very important for success.

Tip for success:

When you place the stick on the group's fingers, apply slight downward pressure before letting them begin. This helps create the initial upward pressure that creates the "helium stick" effect.

Reinforcement/Extension:

Make sure you discuss with the students how important teamwork and communication will be for their success with their eCYBERMISSION project

Additional Reflection/Discussion questions:
1.) What was the initial reaction of the group?
2.) How well did the group cope with this challenge?
3.) What skills did it take to be successful as a group?
4.) What creative solutions were suggested, and how did people react to the suggestions?
5.) What would an outside observer have seen as the strengths and weaknesses of the group?
6.) What roles did specific team members play?
7.) What did each group member learn about him/herself as an individual?
8. What other situations (e.g., at school, home or work) are like the Helium Stick exercise?
9.) Did everyone understand the mission and technical rules?
10.) Was anyone intentionally trying to sabotage the group's mission by lifting the stick?
11.) Did everyone sincerely want to accomplish the mission? Did everyone think it could be done?
12.) If applicable: If everyone understood the mission, and was committed to succeeding, why did the group get so far off track right away? (Try to elicit answers related to the group

	process, not the technical explanation of the challenge. For example, "We didn't plan well" more so than "We weren't holding our fingers correctly.) 13.) Who do you feel became the leader? 14.) Did someone make a contribution that helped get the team going in the right direction? 15.) What types of actions are important to keep a group focused on the mission? 16.) Ask the team to take a minute to think about what they did or said specifically to contribute to the group. What role did they play in the group? 17.) If applicable: Many times during this activity, people become frustrated with others who weren't lowering the stick, and often choose one person as the culprit. Also, some people gave up and let the stick come off their fingers. If either happened, be prepared to discuss how blame or giving up affects group dynamics.
Resources: http://www.ultimatecampresource.com/site/camp-activity/helium-stick.html http://wilderdom.com/games/descriptions/HeliumStick.html	

3.2 UNDERSTANDING AND SELECTING A MISSION CHALLENGE

Title: Eighth Grade Understanding and Selecting a Mission Challenge Lesson Plan

Goal/Purpose:

1.) To become familiar with the eCYBERMISSION website Mission Challenges.
2.) To explore topics within each of the Mission Challenges.
3.) For team members to learn to divide work equability and build on other's ideas.

Objectives:

1.) For students to create a concept map/web with illustrations for each of the Mission Challenges.
2.) Students will gain an understanding of the various Mission Challenges.
3.) Students will divide tasks so that all members of the team have an equal opportunity to contribute.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
• Ask questions that require sufficient and appropriate empirical evidence to answer.
• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Common Core State Standards for English Language Arts

Writing Standards (Grade 8)

Research to Build and Present Knowledge
Standard 7. Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions for further research and investigation.

Speaking and Listening Standard (Grade 8)
Domain: Comprehension and Collaboration

Standard 1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 8 topics, texts, and issues,* building on others' ideas and expressing their own clearly.
a. Come to discussions prepared having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
b. Follow rules for collegial discussions and

	decision-making, track progress toward specific goals and deadlines, and define individual roles as needed. **c.** Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas. **d.** Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views.
Time: Two, 45-minute class periods.	**Materials:** One computer station for each of the mission folders One laptop for each team to take notes on and build their concept map. Poster paper Tape Markers Yarn to connect the web Resource Worksheet 8-1: Mission Challenge Concept Map Example
Instructional Procedures: <u>Day 1: Research eCYBERMISSION Mission Challenge</u> Teacher sets up one computer station for each of the approved Mission Challenges. It is a good idea to have a sign by each station that identifies the Mission Challenge. 1. Go to the eCYBERMISSION website https://www.ecybermission.com. 2. Select the "ABOUT" tab at the top of the page and scroll down to "Mission Challenge." 3. Set up each computer station with a different Mission Challenge in advance of the students arriving. 4. Teacher should instruct students on the purpose of the activity, the goals and share an example. 5. Student teams should be assigned to match the number of stations. 6. Student teams will spend the three minutes creating a plan for how each team member will participate and what role they will play. 7. Teams will spend five minutes at each station and record the topics and other information related to the stations' Mission Challenge. They may also want to discuss possible illustrations they could use to represent the	**Teacher Notes:** 1.) You can have students take notes the first day and then create the web/map the second day, or you can have them build the map as they rotate through the stations if you have longer block scheduling. 2.) If technology integration is a priority in your district, this activity provides an opportunity for students to use computerized mapping software such as kidspiration, inspiration, or even create a prezi. 3.) If access to technology is limited, student teams can design their own maps on construction paper or poster paper. 4.) You can have each team create a concept map that includes all the folders, but we suggest dividing the folders among the groups so they can go deeper into each topic. 5.) In addition to learning to navigate the eCYBERMISSION website, this activity allows students to work in teams and realize that each member of a team has different strengths such as artistic skills, organizational skills, and technical computer skills.

folder topic.

8. At the end of five minutes, student teams rotate to the next station.

Day 2: Product Creation

Student teams select **one** of the Mission Challenges and build a map/web for that specific Mission Challenge and then combine each group's product into a large eCYBERMISSION Web for the classroom wall.

1. Teacher provides the computer/software or art supplies that students will need to complete the desired concept map/web.
2. Teacher explains the desired end-product. It is important that students understand that their research idea will fit into one these Mission Challenges.
3. Students get back into teams from the previous day.
4. Students take 10 minutes to brainstorm and plan the concept map as well as how each team member will be able to contribute to the final product.
5. Approximately 20 minutes of class time is devoted to teams creating the illustrated concept map.

Assessment:

1.) Student teams have two minutes to present their Mission Challenge concept map to the class and add it to the classroom concept map/web.
2.) If you want more than a brief overview, you may need to schedule additional time.

Resources:

Resource Worksheet 8-1: Mission Challenge Concept Map Example
How to create a concept Map in PowerPoint at the website https://www.iu.edu/~lsmt/help/?p=811
How to create a Concept Map in Excel at the website http://www.internet4classrooms.com/excel_concept_map.htm
Inspiration 8 Tutorial: Part 1 at Website http://www.teachertube.com/viewVideo.php?video_id=117095

Advanced/Gifted Students:

See Reinforcement and Enrichment.

ESE/Special Needs Students:

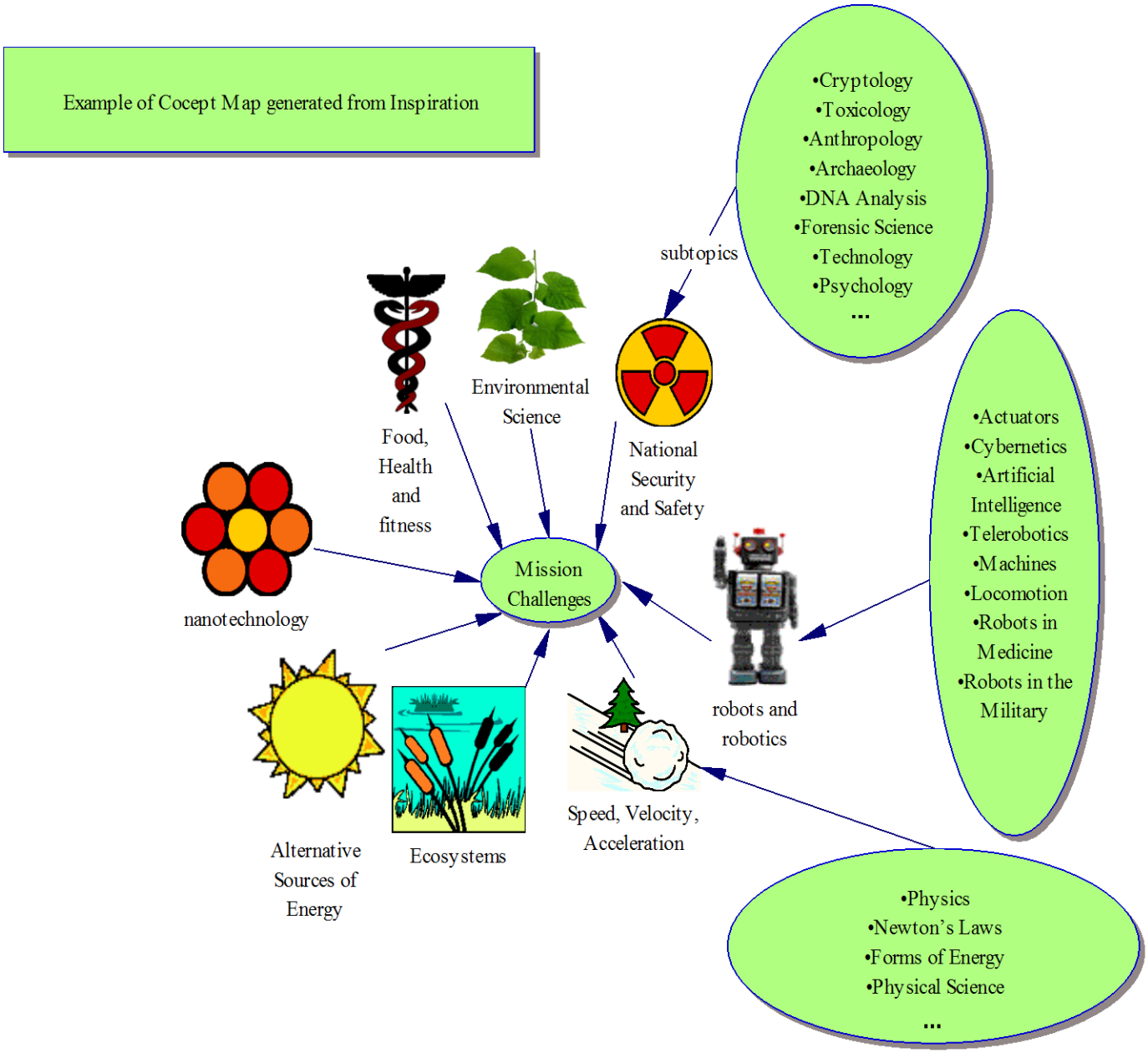
Teacher can provide a partially complete map or web.

Reinforcement/Extension:

1.) There are subtopics in the mission folders that the average eighth grade student may not find familiar.
2.) Preview the related subtopics listed in each folder. You may want to have additional computers set aside for researching topics and fields of study that the students find unfamiliar. This could provide an opportunity to challenge high achieving students.

Resource Worksheet 8-1: Mission Challenge Concept Map Example

generated from Inspiration



MISSION CHALLENGES

1) Alternative Energy Sources
    a. Going Green
    b. Energy Conservation
    c. Hybrid Cars
    d. Greenhouse Gases
    e. Renewable Energy
    f. Geology
    g. Natural Resources
    h. Wind Energy
    i. Geothermal Energy
    j. Solar Energy

2) Environment
    a. Preservation
    b. Use of Pesticides
    c. Recycling
    d. Going Green
    e. Weather
    f. Acid Rain
    g. Littering
    h. Pollution
    i. Forest Fire
    j. Oil Spills
    k. Landfills
    l. Floods

3) Food, Health & Fitness
    a. Nutrition
    b. Disease Prevention
    c. Food Science
    d. Health and Nutrition in Schools
    e. Taste Molecules
    f. Digestion
    g. Saturated and Unsaturated Fats
    h. Artificial Sweeteners

i. Cholesterol
j. Exercise
k. Mind Body Medicine
l. Sports and Recreation

4) Forces & Motion
   a. Physics
   b. Newton's Laws
   c. Forms of Energy
   d. Physical Science
   e. Aerodynamics
   f. National Aeronautics and Space Administration (NASA)
   g. Speed
   h. Force and Power
   i. Kinematics
   j. Mechanics

5) National Security & Safety
   a. Cryptology
   b. Toxicology
   c. Anthropology
   d. Archaeology
   e. DNA Analysis
   f. Forensic Science
   g. Technology
   h. Psychology
   i. Biometrics

6) Robotics
   a. Actuators
   b. Cybernetics
   c. Artificial Intelligence
   d. Telerobotics
   e. Machines
   f. Locomotion
   g. Robots in Medicine
   h. Robots in the Military

7) **Technology**
    a. **Electronics**
    b. **Computers**
    c. **Tools**
    d. **Machines**
    e. **Medicine**
    f. **Craft**
    g. **Engineering**

3.3 DEVELOPING A PROBLEM STATEMENT

Title: Eighth Grade Developing a Problem Statement Lesson Plan

Goal/Purpose:

1.) To better understand community problems and the way science can help solve these problems.
2.) To use research and observation to refine questions.

Objectives:

1.) Students will identify a problem and formulate probing scientific questions regarding the problem.
2.) Students will generate several hypotheses around the problem selected
3.) Students will list two or three experiments they could conduct for each hypothesis.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
• Ask questions that require sufficient and appropriate empirical evidence to answer.
• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Common Core State Standards for English Language Arts

Writing Standards (Grade 8)

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Speaking and Listening Standards (Grade 8)

Domain: Comprehension and Collaboration

Standard 1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 8 topics, texts, and issues,* building on others' ideas and expressing their own clearly.
a. Come to discussions prepared having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.
b. Follow rules for collegial discussions and decision-making, track progress toward specific

	goals and deadlines, and define individual roles as needed. **c.** Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas. **d.** Acknowledge new information expressed by others, and, when warranted, qualify or justify their own.
Time: Two class periods, 45 to 60 minutes each.	**Materials:** Paper Pencil Internet
Instructional Procedures: 1.) Refer students back to their Mission Challenge concept map/web to help the topic selection process. Teacher and students do a brief review of the map/web of Mission Challenges. **Group Activity:** <u>Day 1:</u> 1. Each student writes one possible community problem on their own sheet of paper. 2. Have students stand in a circle around the room with their sheet of paper and a pen/pencil. 3. Teacher explains that they will be sharing their ideas and that one question can lead to another. Just like rolling a snowball causes layers to be added making the snow ball bigger, brainstorming can help ideas expand in many directions. 4. When the teacher indicates, all students will crumple their paper into a "snowball." 5. When the teacher is sure that all students have an idea snowball, they will direct the students to gently underhand toss the snowball into the center of the circle. 6. When all the snowballs are in the center of the circle, the teacher instructs the students to pick up a snowball that is not theirs. The students have one minute to write any ideas that come to mind based on the problem written on the paper. 7. Repeat this process several times. 8. Students share the community problems listed on their paper while the teacher records each	**Teacher Notes:** *<u>Advanced/Gifted Students:</u>* 1.) Students navigate the MIT Community Problem Solving Website. 2.) Have teams correspond with MIT about the problem they have identified and document their work in their mission folder. *<u>ESE/Special Needs Students:</u>* Pair students or have the teacher provide support to this group while advanced students work independently. *<u>Suggested Homework Assignment:</u>* Have the students conduct three interviews with three different people in the community and ask them what problems they see in the community or in their daily lives before the brainstorming session. **Reinforcement/Extension:** *<u>Additional Suggestion for Day 2:</u>* You may want to provide students with some examples and non-examples of good problem statements and explain what traits the statement has that will help drive further investigation. If you have created a classroom concept map/web on the wall, students can add there refined problem to the correct mission folder.

unique problem for classroom display.

Day 2:

1. Students conduct Internet research to further understand one or more of the problems that were generated during the snowball activity and develop their question for investigation.
2. Teacher conducts teacher/group conferencing with each team to further help students refine the problem statement.
3. Teacher will help the class compile the ideas to display in the classroom as an idea generator. As teams select the topic the idea is marked off so that each team has a unique problem to investigate.
4. Teacher explains to students that they should be able to generate several hypotheses around the problem selected, AND they should be able to list two or three experiments they could conduct for each hypothesis.

Assessment:

1.) Teams will submit a written problem statement on the Problem Approval Form.
2.) Students will enter their problem and question into the eCYBERMISSION website by the assigned date.

Resources:

eCYBERMISSION website view winning Mission Folders link at the bottom of each teams summary information https://www.ecybermission.com/public/About/About_Winners.aspx

eCYBERMISSION Idea eNGINE at https://ecybermission.ideascale.com/

Community Problem Solving @ MIT at the website http://web.mit.edu/cpsproject/home.html

Resource Worksheet 8-2: Problem Approval Form

Team Name	
Team Members	

What is the problem your team is trying to solve?

What Mission Challenge will you be working with?

Why did your team choose this problem?

Your topic has been awarded “conditional” approval. You have identified a problem that fits well in a Mission Folder and has the potential to be developed into a valid scientific investigation. To receive full approval you will need to develop several testable hypotheses centered on the problem you identified and propose multiple investigations that could be conducted for each hypothesis.

Advisor signature	Date

3.4 CONDUCTING RESEARCH

Title: Eighth Grade Conducting Research Lesson Plan

Goal/Purpose:

1.) To distinguish the difference between reliable and non-reliable sources.
2.) To utilize the internet to investigate the validity of information provided on internet websites.

Objective:

1.) Students will locate reliable and unreliable resources on the internet and identify the characteristics of each type of site.

Standards:

Standards:

Next Generation Science Standards:

Practice 7: Engaging in Argument from Evidence

• Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem.
• Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.

Common Core State Standards for English Languages Arts

Reading Standards for Informational Text (Grade 8)

Domain: Integration of Knowledge and Ideas

Standard 8. Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient; recognize when irrelevant evidence is introduced.

Standard 9. Analyze a case in which two or more texts provide conflicting information on the same topic and identify where the texts disagree on matters of fact or interpretation.

Time:

One, 45-50 minute class period.

Materials:

Students Need:
Resource Worksheet 8-3: How Do You Research?
Resource Worksheet 8-4: Evaluating Research
Computer Access
Teacher Needs:
Teacher Laptop
Projector
Screen

Instructional Procedures:

1.) Reference "Resource Worksheet 8-3: How Do You Research?"
2.) Teacher has Internet displayed on a projector for the class. Show students how to get to the Google search engine.
3.) Click on first hit http://www.dhmo.org/.
4.) Talk about the looks of the site. Is it professional? Why or why not?
5.) Ask students what they think dihydrogen monoxide is? Explain it is H_20 or water.
6.) Go back to Google search and look at the searches again. Notice: http://en.wikipedia.org/wiki/Dihydrogen_monoxide_hoax
7.) Talk to the students about the CRAAP Test (resource worksheet 8-4), which can be used to help determine if a website is presenting valid and usable information.
8.) Homework Assignment: Students are to turn in three to five creditable sources for his or her eCYBERMISSION topic.

Assessment:

1.) Look at homework from students and see if they could find credible and non-credible sources.
2.) Discuss why students thought non-credible sources were actually credible.
3.) Assist students in distinguishing between the different types of sites.

Resources:

Evaluating Information – Applying the CRAAP Test, Meriam Library, California State University, Chico at the Website: http://www.csuchico.edu/lins/handouts/eval_websites.pdf

Son of Citation Machine at Website: http://citationmachine.net/index2.php

Google Scholar at Website: http://scholar.google.com/intl/en/scholar/about.html

Teacher Notes:

Advanced/Gifted Students:
Challenge advanced students to find another topic where the same problem as the H_2O example arises.

ESE/Special Needs Students:
Have a reliable site and a non-reliable site bookmarked for the students. Have them compare the two sites and list differences and similarities between the reliable and non-reliable site.

Reinforcement/Extension:

1.) After completing the research activity, students need to begin researching their eCYBERMISSION topic.
2.) Have students record each source they find and why they feel it is a creditable source.
3.) Utilize your eCYBERMISSION jump drive or note book to keep track of all the Websites you visit that have relevant information because these will need to be documented in your mission folder.

Teacher Tip:

Frequent checks to make sure they are keeping track of their source citations will be very beneficial.

Resource Worksheet 8-3: How Do You Research?

K – W – L

WHAT YOU KNOW	WHAT YOU WANT TO KNOW	WHAT YOU LEARNED

Resource Worksheet 8-4: Evaluating Research

EVALUATING INFORMATION – APPLYING THE CRAAP TEST[3]

When you search for information, you're going to find lots of it . . . but is it good information? You will have to determine that for yourself, and the CRAAP Test can help. The CRAAP Test is a list of questions to help you evaluate the information you find. Different criteria will be more or less important depending on your situation or need. Key: Indicates a criterion is for web.

Evaluation Criteria

Currency: The timeliness of the information.
1) When was the information published or posted?
2) Has the information been revised or updated?
3) Does your topic require current information, or will older sources work as well?
4) Are the links functional?

Relevance: The importance of the information for your needs.
5) Does the information relate to your topic or answer your question?
6) Who is the intended audience?
7) Is the information an appropriate level (i.e. not too elementary or advanced for your needs)?
8) Have you looked at a variety of sources before determining this is one you will use?
9) Would you be comfortable citing this source in your research paper?

Authority: The source of the information.
10) Who is the author/publisher/source/sponsor?
11) What are the author's credentials or organizational affiliations?
12) Is the author qualified to write on the topic?
13) Is there contact information, such as a publisher or email address?
14) Does the URL reveal anything about the author or source? Examples: .com .edu .gov .org .net

Accuracy: The reliability, truthfulness and correctness of the content.
15) Where does the information come from?
16) Is the information supported by evidence?
17) Has the information been reviewed or refereed?
18) Can you verify any of the information in another source or from personal knowledge?
19) Does the language or tone seem unbiased and free of emotion?
20) Are there spelling, grammar or typographical errors?

Purpose: The reason the information exists.
21) What is the purpose of the information? Is it to inform, teach, sell, entertain or persuade?
22) Do the authors/sponsors make their intentions or purpose clear?
23) Is the information fact, opinion or propaganda?
24) Does the point of view appear objective and impartial?
25) Are there political, ideological, cultural, religious, institutional or personal biases?

[3] www.csuchico.edu/lins/handouts/evalsites.html

3.5 STATE A HYPOTHESIS

Title: Eighth Grade State a Hypothesis Lesson Plan

Goal/Purpose:

To understand what makes a hypothesis testable.

Objectives:

1.) Students will generate multiple testable hypotheses for a single problem.
2.) Students will write multiple testable hypotheses for the eCYBERMISSION problem they have chosen to investigate.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Common Core State Standards for English Language Arts
Writing Standards (Grade 8)
Domain: Research to Build and Present Knowledge
Standard 7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

Time:

One class period, 45-60 minutes.

Materials:

How to Correctly Write a Hypothesis (http://www.angelfire.com/scifi/ricks/hypothesis.html)
Different size rectangular shaped paper
Resource Worksheets 8-5 & 8-6
Student notebooks
Student computers
Teacher computer/projector

Instructional Procedures:

1.) Hand out paper of different sizes to students (each student gets one piece of paper). Allow students two minutes to make a paper airplane. Students are to line up at the back of the classroom and fly the airplane forward.

2.) Pick up the six (or more) "good" airplanes that flew the furthest and six (or more) "bad" airplanes that flew the shortest distance.

3.) Have students return to their seats. Show them the good and bad airplanes. Ask them to brainstorm for two minutes why they think the good ones flew better than the bad ones.

3.) On the front board, write distance flown in center circle of a web. Tell students this is the dependent variable, it is what you are measuring.

4.) Around the web write the reasons the students think the good airplanes flew further. Explain that the things that change the distance flown are independent variables (example: size of plane, shape of wings, how much force the person used to throw the plane).

5.) Have students pick one variable they think is most important to flight (example: size of plane).

6.) Now that they have picked the independent and dependent variable, they can make a hypothesis. Tell students that in order to test the hypothesis, they most try to keep all the other independent variables the same. Brainstorm how to best stabilize the other variables.

7.) Students and teacher will read and review "How to Correctly Write a Hypothesis."

8.) Have students write a hypothesis for the airplane experiment based on the data they observed. If time allows they could do a quick test of the hypothesis.

9.) Provide students with the Resource Worksheet 8-5: Guidelines and Practice for Writing Your Hypothesis, so students can practice hypothesis writing skills.

10.) Students share their hypothesis with the class. Student teams can share their hypotheses on a classroom document camera.

11.) Conclude the activity by having student write their hypothesis and add it to their eCYBERMISSION Mission Folder using Resource Worksheet 8-6: Writing Your Hypothesis**.**

Teacher Notes:

The airplane activity could easily be substitute for a calmer activity if classroom management is a concern. Any simple independent dependent relationship will work.

This activity would be easily adaptable to a classroom blog activity.

Advanced/Gifted Students:

Advanced: Challenge students to come up with another scenario to practice writing hypotheses.

ESE/Special Needs Students:

Depending on the background and process skills of your students, you may need to provide additional scaffolding such as general format for hypotheses such as "If _____, then _____, because_____."

Reinforcement/Extension:

When students have completed the practice opportunity for writing hypotheses, they should write the hypothesis for their problem and add it to the eCYBERMISSION folder.

Assessment:

Student Teams submit at least three testable hypotheses that can be used to complete the eCYBERMISSION project.

Resources:

How to correctly write a hypothesis, used with permission of Paul Ricks, from the website:
http://www.angelfire.com/scifi/ricks/hypothesis.html

Resource Worksheet 8-5: Guidelines and Practice for Writing Your Hypothesis
http://www.docstoc.com/docs/44517659/Guidelines-and-Practice-for-Writing-Your-HypothesisStrong

Hypothesis:
http://www.sciencebuddies.org/blog/2010/02/a-strong-hypothesis.php

How to Write a Hypothesis:
http://www.sciencebuddies.org/science-fair-projects/project_hypothesis.shtml

Resource Worksheet 8-5: Guidelines and Practice for Writing Your Hypothesis[4]

Here a few of the basic steps:

1.) Start your hypothesis with the word "If"

2.) Identify the two parts that will be tested.

3.) Determine which will be your independent variable (the variable you change) and what will be your dependent variable (the variable you measure to see how it responds to changes in the independent variable).

4.) Connect your independent variable with the dependent variable.
- (the independent variable) is related to (the dependent variable)
- (the independent variable) is affected by (the dependent variable)
- (the independent variable) is compared to (the dependent variable)
- (the independent variable) causes (the dependent variable)

5.) Finish with a prediction reason "because"

6.) Consider the following example: Anne has noticed that eighth-grade girls seem to get better grades on organizational skills tests such as notebook quizzes.

Anna's first attempt at writing her hypothesis:

"If test scores of boys and girls are compared, then boys and girls will receive *different* grades on organizational skills tests."

This version is much too general. There is no specific prediction.

"If test scores of boys and girls are compared, then girls will get *better* grades than boys on tests of organizational abilities."

Now she has a prediction. However, this hypothesis is not measurable in its current form. Anne finally writes a measurable hypothesis. The measurable hypothesis states:

[4] http://www.docstoc.com/docs/44517659/Guidelines-and-Practice-for-Writing-Your-HypothesisStrong

"If test scores of boys and girls are compared, then eighth-grade girls receive *significantly higher* grades on notebook quizzes than eighth-grade boys."

Do you see that Anne has added specific details that make the hypothesis measureable? What difference will you measure? The difference in scores on notebook quizzes or eighth-grade boys and eighth -grade boys. You should also see that the hypothesis is specific to eighth graders.

Now Anna needs to add a *prediction reason* – a because -- to complete her hypothesis.

"If test scores of boys and girls are compared, then eighth-grade girls receive significantly *higher* grades on notebook quizzes than eighth-grade boys because eighth-grade girls take better, more complete notes than eighth-grade boys."

(Source: Adapted from www.angelfire.com/scifi/ricks/hypothesis.html)

Resource Worksheet 8-6: Writing Your Hypothesis

Name_____

Period_____

WRITING YOUR HYPOTHESIS

So how should you write a hypothesis? First, identify what the problem is. If you fail to identify the problem, you most certainly will have difficulty writing the hypothesis. Second, identify the major variables. Third, make an educated guess as to what the direction of the relationship or difference is. Fourth, state a reason for your prediction. Now you are ready to write a hypothesis. Do not use the terms "I think" to start the hypothesis.

PROBLEM: Mark believes that groceries at Costco will be less expensive than groceries at Safeway.

Variables to be compared/related: _____
_____

If: _____

Hypothesis_____

Hypothesis reason: _____

PROBLEM: Leslie has observed that more small dogs are adopted at animal shelters than large dogs.

Variables to be compared/related: _____ _____

If: _____

Hypothesis_____

Hypothesis reason: _____

PROBLEM: Amy believes that as the number of years of driving experience people have increases the number of speeding tickets they receive decreases.

Variables to be compared/related: _____
_____

If: _____

Hypothesis_____

Hypothesis reason: _____

PROBLEM: Roger has observed that students who take honors classes in college are less likely to drop out of college than students who do not.

Variables to be compared/related: _____

_____

If: _____

Hypothesis_____

Hypothesis reason: _____

Sometimes a general observation may lead to several different hypotheses. Read the scenario which follows and write three *measurable hypotheses* based upon the different groups being compared.

PROBLEM: Frank notices that when the seventh-grade girls are able to do better on the "bend and reach test" flexibility test than seventh-grade boys, eighth-grade boys, or eighth-grade girls.

Variables to be compared/related: _____ _____

Hypothesis_____

Hypothesis reason: _____

Read the scenario which follows and write three *measurable hypotheses* based upon the three different variables being considered.

PROBLEM: Scientists from the Department of Fish and Game have noticed that trout are more likely to get parasites when they are living in shallower, warmer and muddier waters.

Variables to be compared/related: _____ _____

Hypothesis_____

Hypothesis reason: _____

(Source: http://www.docstoc.com/docs/44517659/Guidelines-and-Practice-for-Writing-Your-Hypothesis Adapted from www.angelfire.com/scifi/ricks/hypothesis.html)

3.6 CONDUCT AN EXPERIMENT

Title: Eighth Grade Conducting an Experiment Lesson Plan

Goal/Purpose:

To plan and carry out a science investigation and develop probing questions and hypotheses for further research.

Objectives:

1.) Students will decide what data to gather and what tools are needed to gather the data.
2.) Students will determine how to measure and record the data.
3.) Students will decide how much data is needed to produce reliable results.
4.) Students will consider limitations on the precision of the data.
5.) Students will identify variables and controls in the experiment.

Standards:

Next Generation Science Standards:

Practice 3. Planning and Carrying Out Investigations

• Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.
• Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.
• Evaluate the accuracy of various methods for collecting data.

Practice 6. Constructing Explanations and Designing Solutions

• Apply scientific ideas or principles to design, construct, and/or test a design of an object, tool, process or system.
• Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints.

Practice 8. Obtaining, Evaluating, and Communicating Information

• Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.

Common Core State Standards Writing Standards for Literacy in History/Social Studies, Science, and Technical (Grade 6-8)

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions

	that allow for multiple avenues of exploration. **Standard 9.** Draw evidence from informational texts to support analysis reflection, and research.
Time: Three class periods, 45 to 60 minutes each.	**Materials:** Penny Paper towel Beakers Water Droppers Resource Worksheet 8-7: Independent Investigation Guidelines.
Instructional Procedures: Day 1: Penny Lab 1. The teacher will present the student with the question, "How many drops of water can fit on one side of a penny?" 2. Students will use the Penny Lab instructions (http://sciencespot.net/Media/pennylab.pdf)to perform initial testing and collection of data. 3. The teacher will lead a discussion with the suggested questions. Day 2: Designing an independent investigation 1. The teacher will explain that scientists sometimes repeat the work of others to verify the results of other scientists; however, new questions often lead to new discoveries. 2. The teacher provides the students/student teams with Resource Worksheet 8-7: Independent Investigation Guidelines. 3. The students will brainstorm various "treatments" or things they could change and test about the Penny Lab. For example you can change the temperature of the pennies, use newer or older pennies or test different solutions instead of water. 4. Students select an independent and dependent variable. 5. Students generate their own hypothesis and procedure using the Resource Worksheet 8-7: Independent Investigation Guidelines. Remind students that the tests must be safe and are limited to common household products. Students must be able to collect their data in the allotted class time. 6. Students submit their investigation plan by	**Teacher Notes:** Please see the teacher notes in the Penny Lab document. *Advanced/Gifted Students:* Students may be given more latitude in designing their independent investigation *ESE/Special Needs Students:* Students may benefit from choosing one of the suggested treatments to the penny. **Reinforcement/Extension:** 1.) If students need more practice with investigations, you may want to direct them to the virtual investigation website provided in the resource section. 2.) After students have completed the practice investigation, have teams brainstorm how they could test their eCYBERMISSION hypothesis. 3.) Their investigation steps will need to be added to their eCYBERMISSION folder.

the end of day two.

Day 3:

1. Students review any teacher comments about their design plan and make any necessary changes.
2. Students set up the investigation and collect data.
3. Students complete the Independent Investigation Student Form Assessment (see Independent Investigation Rubric - http://sciencespot.net/Media/indinvestrbrc.pdf).

Assessment:

Student resource worksheet 8-7
Investigation Plan

Resources:

Independent Investigation Rubric: http://sciencespot.net/Media/indinvestrbrc.pdf
Penny Lab: http://sciencespot.net/Media/pennylab.pdf
Preparing experimental Procedures for a science fair at website: http://www.sciencebuddies.org/science-fair-projects/project_experimental_procedure.shtml
General Science Lesson Plans page of The Science Classroom at: http://sciencespot.net/Pages/classgen.html.
Virtual practice investigations at website: http://www.sciencebuddies.org/science-fair-projects/project_experimental_procedure.shtml

Independent Investigation Guidelines[5]

STEP 1: CREATE A QUESTION

1.) What do you want to find out?
2.) Does your question relate to the topic?
3.) Can you develop an experiment to answer your question?
4.) Does your question make sense? Is it confusing?

STEP 2: HYPOTHESIS

1.) What do you think will happen?
2.) BE SPECIFIC!
3.) Use complete sentences.

STEP 3: PROCEDURE

1.) What steps will you follow to find an answer?
2.) BE SPECIFIC! Label your steps using 1, 2, 3, etc.
3.) Would someone else be able to follow your directions?
4.) How will you collect your data?
5.) How will you ensure reliable results?
6.) What safety issues need to be addressed?

STEP 4: EXPERIMENT & DATA

1.) Be sure to display your data in an organized manner. Use a table or chart to help you show your results. Don't forget to label!
2.) Include enough data to prove or disprove your hypothesis.

STEP 5: ANALYSIS/CONCLUSION

1.) What happened during your experiment?
2.) Did your results support your hypothesis?
3.) Write a summary of what you learned during your experiment and address your results.
4.) Explain any unexpected results.
5.) Are your results reliable?
6.) Did you use complete sentences?

[5] Source: http://sciencespot.net/Media/indinvestgdlns.pdf

3.7 DATA COLLECTION AND ANALYSIS

Title: Eighth Grade Data Collection and Analysis Lesson Plan

Goal/Purpose:

To understand how to organize data and represent data graphically.

Objectives:

1.) Students will organize data in a data table.
2.) Students will create a labeled graph of the data.
3.) Students will draw conclusions from a data graph.

Standards:

Next Generation Science Standards:

Practice 4: Analyzing and Interpreting

• Construct, analyze, and/or interpret graphical displays of data and/or large data sets to identify linear and nonlinear relationships.
• Distinguish between causal and correlational relationships in data.
• Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trails).
• Analyze and interpret data to determine similarities and differences in findings.
• Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Practice 8. Obtaining, Evaluating, and Communicating Information

• Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.

Common Core State Standards for Mathematics (Grade 8)

Domain: Functions

Standard 4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

Standard 5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

Time:

Two class periods, approximately 50 minutes each.

Materials:

Projection equipment
Class set of tree rings (you can enlarge a picture of tree ring if tree cookies are unobtainable)
Ruler or calipers
Resource Worksheet 8-8: Tree Ring Data Sheet
Resource Worksheet 8-9: Forest A, Forest B

Instructional Procedures:

Day 1: Building background knowledge

1. Review with students the basic types of graphs, how they are similar and different and when it is appropriate to use each one.
2. Provide students with a video clip (please see Arbor Day Foundation clip in resource section) or short reading passage about tree rings to build background knowledge. *See Resources for links.

Day 2: Tree Ring Lab

1. Have students work in pairs to study their slice of a tree. These are often called tree biscuits or tree cookies. You can also obtain tree core samples.
2. There are many pictures of tree rings on the Internet. If you are unable to obtain actual tree samples, you can print these off the Internet and laminate them. Students can then use a wax pencil or vis-à-vis to mark on their sample.
3. Give students a tree ring sample and Resource Worksheet 8-8: Tree Ring Data Sheet.
4. Provide students with a ruler or calipers for measuring the bands.
5. Teacher monitors as students work to identify areas that need additional instruction.

Assessment:

1.) Formative assessment, observation and monitoring as students practice this skill.
2.) Summative assessment Resource Worksheet 8-9: Forest A, Forest B.

Resources:

Arbor Day Foundation, The Life of a Tree website: http://www.arborday.org/kids/carly/lifeofatree/
Skittles lab at website:

Teacher Notes:

1.) As a pre-assessment of the students' abilities, the teacher may want to cut various types of graphs out of newspapers and magazines (enough so that each student has one).
2.) Have students state what type of graph they have, independent and dependent variables, scale, and patterns they see. This may provide a quick check of background knowledge.
3.) The tree ring activity with the actual tree samples is more interesting and engaging to the students.
4.) You can compare more data and do more analysis, if you can collect tree slices of the same type of tree, from two different climates, that were cut at the same time.
5.) Have the students use calipers to measure 5 or 10-year bands. While this may require some resourcefulness on the teacher's part, the sample can be used from year to year.
6.) Enlist the help of students, parents, community members and university partners to help find the tree ring samples.

Advanced/Gifted Students:
Advanced students could compare multiple tree samples and use the collected data to support their conclusions.

ESE/Special Needs Students:
1.) When graphing, provide ESE students with a graphing template or individual steps for completing their graph.
2.) The Skittles lab may be appropriate for ESL students or those requiring modified assignments. There are many versions of this activity available on the Internet.

www.ahsd.org/science/sassaman/Intro%20unit/Skittles%20Lab.htm Graphing Tutorial website: http://nces.ed.gov/nceskids/help/user_guide/graph/whentouse.asp The National Christmas Tree Association, Real Trees 4 Kids website: http://www.realtrees4kids.org/sixeight/stemsrings.htm	**Reinforcement/Extension:** Resource Worksheet 8-9: Forest A, Forest B can be done as a stand-alone activity, an enrichment activity or as an assessment.

Resource Worksheet 8-8: Tree Ring Data Sheet

Name_____

Class Period_____

Scientists have been studying tree ring growth for many years. The study of past patterns of plant growth is called dendrochronology.

Many scientists believe that the sun has an 11-year cycle of heating and cooling. They wonder if this affects plant growth as well. Follow the steps below to fill out your data table.

1.) Find 11 growth years where the bands appear similar in width. Remember that a light ring and a dark ring make up one year.

Measure the total distance across the 11 bands. _____

What units do you think are best to use? _____

2.) Measure 11 more bands on either side of the rings you just measured.

Measure the total distance across these bands. _____

Were these bands closer to the center or closer to the edge? _____

3.) Measure another 11 years of growth bands that are touching one of the sets you already measured.

Measure the total distance across the 11 bands. _____

Were these bands closer to the center or closer to the edge? _____

4.) Measure another 11 years of growth bands that are touching one of the sets you already measured.

Measure the total distance across the 11 bands. _____

Were these bands closer to the center or closer to the edge? _____

5.) Complete the table to accurately represent your data. Remember to organize it from oldest to newest growth.

6.) Discuss with your team how you could create a graph to show the data collected on the 11-year periods of growth.

7.) Create an appropriate graph of the data making sure to include all labels.

8.) If the Sun's 11-year cycle affects plant growth, what pattern should you see in the graph? Does the graph show that the tree growth was affected by the sun's cycle? Explain why or why not?

9.) What other factors may have affected the tree growth data?

10.) Discuss the importance of accurate measurement when collecting data.

Resource Worksheet 8-9: Forest A, Forest B

Name _____
Class Period _____
Date: _____

1.) The thicknesses of the annual rings of trees indicate what type of environmental situation was occurring at the time of its development. A thin ring usually indicates a rough period of development. This can include things such as lack of water, forest fires or a major insect infestation. On the other hand, a thick ring indicates just the opposite.

2.) A forest management team was studying two different forests to look for patterns in tree growth. They collected measurements from several trees in the same forest and averaged the data. This is what they found:

In Forest A, the annual ring width from 10 years ago was .3cm. An average ring width of .5cm was found in the rings from 30 years ago. An average ring width of .2cm was found for the rings from 50 years ago. The rings from 20 years ago had an average ring width of .4cm. The average ring width was .9cm for rings from 35 year ago and the 60-year-old rings had an average ring width of .4cm.

In Forest B, the annual ring width from 10 years ago was .4cm. An average ring width of .7cm was found in the rings from 30 years ago. An average ring width of .5cm was found for the rings from 50 years ago. The rings from 20 years ago had an average ring width of .2 cm. The average ring width was 1.2 cm for rings from 35 year ago and the 60-year-old rings had an average ring width of .6cm.

3.) What is the independent variable? _____

4.) What is the dependent variable? _____

5.) What is a valid hypothesis for this study?

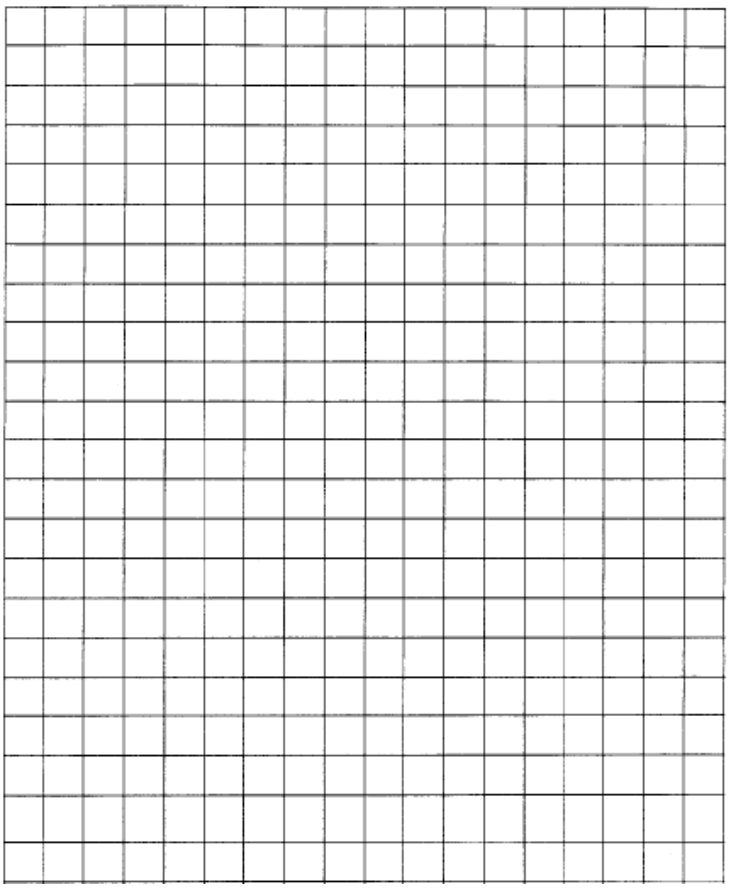
_____
_____
_____

6.) What are two variables the team might need to consider if they are going to compare Forest A to Forest B? _____ and _____

7.) Complete the table to show the data for <u>both</u> forests in the space below.

Number of Years	Forest A	Forest B

8.) Make a line graph of the data for both forests on the grid below. Remember all the items that you need to include on a graph. You may use colored pencils if you think it would help.



9.) What was the average thickness of the annual rings of 40-year-old trees in Forest A? How do you know this?

10.) Based on this data, what can you conclude about:
   a. Forest A and Forest B in general?
   b. What differences can you quantify?
   c. Possible sources of error.
   d. What might be a future investigation related to these findings?

3.8 DRAWING CONCLUSIONS

Title: Eighth Grade Drawing Conclusions Lesson Plan

Goal/Purpose:

1.) To apply the scientific practices to draw conclusions and propose future investigations.

Objective:

Provided with a set of data, students will work through the scientific process to create tables and graphs and formulate conclusions.

Standards:

Next Generation Science Standards:

Practice 1. Asking Questions and Defining Problems.

• Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.
• Ask questions to identify and/or clarify evidence and/or the premise(s) of an argument.
• Ask questions to clarify and/or refine a model, an explanation, or an engineering problem.

Practice 4: Analyzing and Interpreting

• Distinguish between causal and correlational relationships in data.
• Consider limitations of data analysis (e.g., measurement error), and/or seek to improve precision and accuracy of data with better technological tools and methods (e.g., multiple trails).
• Analyze and interpret data to determine similarities and differences in findings.
• Analyze data to define an optimal operational range for a proposed object, tool, process or system that best meets criteria for success.

Practice 6: Constructing Explanations and Designing Solutions

• Construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
• Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.

Time:

Two, 60-minute class periods.

Materials:

Resource Worksheet 8-10: Scientific Investigation Practice Problems
Computer projection system
Internet

Instructional Procedures:

1.) Review the scientific practices with the students.
2.) Point out to students that the ability to draw good conclusions involves an understanding of all the parts of the investigative process.
3.) It may be appropriate at this point to group students and differentiate the level of support given to each group.
4.) Students are given the Resource Worksheet 8-10: Scientific Investigation Practice Problems.
5.) These practice problems include data sets that should be represented with a line graph, bar graph and circle graph (pie chart).
7.) Students are also asked to draw conclusions and propose related investigations.

Assessment:

1.) Students self-evaluate the work they did on each of the five problems and circle the problem they think represents their best work.
2.) Teacher provides assessment and feedback that will help them better address the eCYBERMISSION Mission Folder conclusion criteria.

Resources:

Drawing Conclusion Handout:
http://betterlesson.com/document/226492/prentice-hall-drawing-conclusions-pdf

eCYBERMISSION Grading Rubric:
https://www.ecybermission.com/public/About/About_Judging.aspx (Under Judging Criteria you will need click where it says "here" and you can download the appropriate rubric).

Scientific Conclusions at website:
http://www.sciencebuddies.org/science-fair-projects/project_conclusions.shtml

Teacher Notes:

1.) There are five practice problems for the students to work with.
2.) The teacher can assign one a night or can provide various levels of support in the classroom. Teachers may also elect to use cooperative strategies.
3.) It is important that this age group of students has the ability to generate tables and graphs by hand, however; it is important that they learn how to digitally create tables and graphs as well.

Advanced/Gifted Students:
Additional criteria that should be included in the conclusion such as how the data could be transformed and more detailed discussion about increases, decreases, or trends. Creative writers may enjoy the challenge of writing their own problem that includes data.

ESE/Special Needs Students:
Provide small group extended support for ESE students. May need to reduce the number of practice problems and allow additional time for completion.

Reinforcement/Extension:

After completing the practice problems successfully, students should be able to analyze their own data for their eCYBERMISSION Project. Students should write conclusions and enter this into their mission folder.

Resource Worksheet 8-10: Scientific Investigation Practice Problems

WORKING WITH DATA PRACTICE

Read the following five passages and

a. State a question or problem that is being investigated
b. State a testable hypothesis the students may have had
c. Identify the independent variable
d. Identify the dependent variable
e. Identify at least two controlled variables for each problem
f. Generate a table
g. Select the most appropriate type of graph and produce the graph
h. Write a conclusion that includes if your hypothesis was correct or incorrect, what was actually observed, possible sources of error, and propose an investigation that would build off of the data gathered.

1. The heights that balls bounced when dropped from different distances were measured. A ball dropped 50 cm bounced 40 cm high. A 10 cm drop bounced 8 cm. A ball bounced 24 cm when dropped 30 cm. The bounce was 56 cm high for a 70 cm drop. A 100 cm drop bounced 80 cm high.

a)
b)
c)
d)
e)
f)
g)
h)

2. The trees that were given 1 L of water each day grew 2 inches from June to August. The trees that grew 4 inches from June to August got 2 L of water each day. The trees that received 3 liters of water each day grew 6 inches during the same time frame.

a)
b)
c)
d)
e)
f)
g)
h)

3. The distance covered by a runner during each second of a race was measured. During the 15th second of the race, the runner covered two meters. Three meters were covered during the 12th second. Four meters were covered during the 9th second. During the 6th second three meters were covered. During the 3rd second, two meters were traveled.

a)
b)
c)
d)
e)
f)
g)
h)

4. A student observed that tall people usually have larger feet. The student recorded heights and shoe sizes of several people. Cindy is 130cm tall and wears a size 9 shoe. Ty is 140cm tall and wears a size 10 shoe. Cory is 160cm tall and wears a size 13 shoe. Cindy's little sister is 90cm tall and wears a size 1 shoe.

a)
b)
c)
d)
e)
f)
g)
h)

5. Students wondered about where electricity comes from. They found that in 2004, 39 percent of electricity came from coal. Seven percent of electricity came from oil. Hydroelectric sources provided for 16 percent of electricity and the same percent for nuclear energy. Electricity from natural gas was 4 percent more than Hydroelectric and nuclear did. Two percent of the electricity used came from renewable resources.

a)
b)
c)
d)
e)
f)
g)
h)

3.9 BENEFIT TO THE COMMUNITY

Title: Eighth Grade Benefit to The Community Lesson Plan

Goal/Purpose:

1.) To apply the data and conclusions from their group's Mission Folder research.

2.) To identify the benefits the students' eCYBERMISSION project may have beyond the classroom.

Objective:

Students will answer questions about the benefit of their research, which will be entered into their Mission Folder.

Standards:

Next Generation Science Standards:

Practice 7: Engaging in Argument from Evidence

• Respectfully provide and receive critiques about one's explanations, procedures, models, and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail.
• Construct, use and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation an explanation or a model for a phenomenon or a solution to a problem.
• Make an oral or written argument that supports or refutes the advertised performance of a device, process, or system based on empirical evidence concerning whether or not the technology meets relevant criteria and constraints.

Practice 8: Obtaining, Evaluating, and Communicating Information

• Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).
• Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.
• Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts.
• Communicate scientific and/or technical information (e.g., about a proposed object, tool, process, system) in writing and/or through oral presentations.

Common Core State Standards for English Languages Arts

Writing Standards (Grade 8)

Standard 1. Write arguments to support claims

	with clear reasons and relevant evidence. **a**. Introduce claim(s), acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically. **b.** Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text. **c.** Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence. **d.** Establish and maintain a formal style. **e.** Provide a concluding statement or section that follows from and supports the argument presented.
Time: Two, 45-60-minute class periods	**Materials:** Resource Worksheet 8-11: Benefit to the Community Worksheet
Instructional Procedures: <u>Day 1:</u> Resource Worksheet 8-11: Benefit to the Community Worksheet 1. Teams access their data tables, graphs, and conclusions either online or as printed hard copies. 2. Teacher hands out Resource Worksheet 8-11: Benefit to the Community Worksheet. Students complete the worksheet. <u>Day 2:</u> Collaboration among teams 1. Team's review Resource Worksheet 8-11. 2. Two teams merge to brainstorm and identify additional benefits. 3. Students contact companies and organizations that extend their view of the problem and solution. **Assessment:** Student teams submit their worksheet 8-11 for teacher feedback and then enter their responses into the Mission Folder.	**Teacher Notes:** 1.) It is the intent of the worksheet to help students breakdown the compound questions found in the mission folder. 2.) It is a good idea to always refer back to the judges grading rubric to make sure students are addressing each part of the question. <u>*Advanced/Gifted Students:*</u> Advanced students could compose emails or letters to organizations requesting support for their project. They can also set up meetings with principals, school board members and parent teacher organizations. <u>*ESE/Special Needs Students:*</u> Use appropriate group strategies to ensure ESE students can share their skills and contribute to the team effort. **Reinforcement/Extension:** 1.) Encourage student teams to contact people outside their school. This can help them expand

Resources: eCYBERMISSION Grading Rubric: https://www.ecybermission.com/public/About/About_Judging.aspx (Under Judging Criteria you will need click where it says "here" and you can download the appropriate rubric). United We Serve at website: http://www.serve.gov/toolkits/general/one.asp Customer Service Manager, 20 Business Telephone Etiquette Tips at website: http://customerservicemanager.com/20-business-telephone-etiquette-tips.htm	their research and broaden the scope of their solution. 2.) Keep records and screen shots of the correspondence to add to their mission folder.

Resource Worksheet 8-11: Benefit to the Community Worksheet

This worksheet will help your team identify how your project benefits the community. After consulting with other teams, you will submit this to your instructor for feedback and complete the benefit to community section of the Mission Folder.

Restate your problem:

_____
_____
_____

Part I: Benefit to Community

1. How do your experiments help solve the problem or show the potential to solve the problem?

Your team's ideas:

_____
_____
_____

Collaborating team's ideas:

_____
_____
_____

2. How does your data support that there is a significant benefit to your community?

Your team's ideas:

_____
_____
_____

Collaborating team's ideas:

_____
_____
_____

3. Describe next steps for further research and experimentation?

Your team's ideas:

_____
_____
_____

Collaborating team's ideas:

_____
_____
_____

4. How could you implement your solution in the future?

Your team's ideas:

_____
_____
_____

Collaborating team's ideas:

_____
_____
_____

Part II: Extension

1. What businesses or companies could help you with implementation or advancing the research you have done?

Business Name	Phone Number or email	Contact person

2. Who could you contact at the college or university level to expand on what you currently know about your topic?

University/College Department	Phone Number or email	Contact person

3. What organizations could help you at the community, state or national level?

Organizations	Phone Number or email	Contact person

4. Grade 9

4.1 TEAMWORK

Title: Ninth Grade Teamwork Lesson Plan

Goal/Purpose:

1.) To foster a group atmosphere among students at the beginning of a new school year while learning about their individual strengths in a group setting.
2.) To encourage individual team members to cooperate to achieve the team's objective.
3.) To generate a sense of camaraderie amongst group members to prepare them for the eCYBERMISSION teamwork process.

Objective:

Students will work together to create the tallest tower possible using only the materials provided by the teacher.

Standards:

Next Generation Science Standards:

Practice 6: Constructing Explanations and Designing Solutions

• Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do in the future.
• Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
• Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Common Core State Standards for English Languages Arts

Speaking and Listening Standards (Grade 9)

Domain: Comprehension and Collaboration

1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grades 9–10 topics, texts, and issues,* building on others' ideas and expressing their own clearly and persuasively.

Time:

One 45-55 minutes class period

Materials:

Meter stick
Each group will need these items:

- Large box or plastic tray
- Two pieces of 8.5"x11" construction paper
- Ten paper clips (each approximately 5cm x 1cm in size)
- Masking tape (1 meter long per group)

Instructional Procedures:

1.) Students should be placed into groups of three or four prior to the start of the activity. Use a random method of assigning groups, such as drawing seat numbers or names.
2.) Prior to the activity, place the materials into a large box or plastic tray. Each group should have their own box or tray.
3.) Instruct the students of their task – to create the tallest tower that they can with the materials within their box/tray.

Group Activity:

Instruct the students that the following parameters will apply to their tower-building process:
1.) The tower must use all of the materials supplied in the box/tray.
2.) The tower must be free-standing, not attached to any other object, and remain standing during the measuring process.
3.) Teams will not be given replacement items from their box of materials and should brainstorm how to build the tallest tower prior to using the materials.
4.) The tower will be measured straight from the bottom (where the materials begin) to the highest point (where the materials end).
5.) The group with the tallest tower will be given a special award or prize (such as extra credit toward their grade, a free homework pass or other such item).
6.) Instruct the students that have (X) amount of time to complete their towers. Decide on how much time you would like to give your groups based on the class's ability levels and your own available classroom time.
7.) Remind the students at periodic intervals of how much time they have remaining for the activity. Good reminder times would be at the 20, 10, 5 and 1 minute-remaining intervals.
8.) When time is up, students should be told to no longer touch/alter their towers.
9.) Go around to each group and measure their towers with a meter stick (use centimeters to introduce and encourage the use of the metric system of measurement). Read aloud the result so other groups can keep track of the outcome of the activity within the class.

Teacher Notes:

Advanced/Gifted Students:
1.) Students judge quality of design process of other groups' towers and make suggestions for improvement or praise for building techniques.
2.) Shorten the amount of time given for teams to build their towers.
3.) Allow students to think "outside the box" in such a way that would allow them to be within the parameters of the activity, but achieve a better result (*i.e.*, combining materials from two groups, using other materials not supplied)

ESE/Special Needs Students:
1.) Build a tower for the class using different materials and show them how the materials can be manipulated into different shapes and ways in order to build a tall tower.
2.) Give students an opportunity to rebuild their towers with fresh materials if they are unsuccessful on the first try.
3.) Have students view towers built by other groups and allow them to use one technique that they didn't use before to rebuild their group's tower.

Reinforcement/Extension:

1.) During the tower-making process, walk around to each group and listen to their ideas and problem-solving techniques. Encourage the ideas and thoughts of those that would lead to a successful outcome, and question/have the student rethink those that might lead to a less successful outcome.
2.) After the activity is over, discuss the outcomes of their group's tower. Students will naturally want to talk about their tower's strengths and weaknesses.
3.) Discuss the teamwork process of eCYBERMISSION with the students, and explain how they will need to use the skills that they used to create their towers to complete their eCYBERMISSION Projects.

Assessment:

The groups' towers will be judged/graded based on the height from the base of the tower to the tallest point. The towers must be free-standing and must not fall over during measurement by the teacher.

Teachers can offer extra credit/prizes for the team with the tallest tower and also recognize teams that have the second, third, fourth, etc...towers in height. Teachers can also offer extra credit/prizes for creativity, uniqueness of design or an overall grand prize award that would encompass classrooms across the teacher's schedule or other teachers within the school.

After the activity and discussion/reflection have students respond to the following prompt(s):
1.) What factors come into play in order to work as an effective team?
2.) What qualities should individuals possess in order to work well in a team environment?
3.) How important was communication among team members in order to accomplish this task?
4.) How important was creativity, collaboration, and communication?
Review dynamics of teamwork and how to effectively work in a group to accomplish a difficult task with minimal supplies.

Resources:

http://www.corestandards.org
http://floridastandards.org
http://www.teampedia.net/wiki/index.php?title=The_Tallest_Tower#Objectives
http://ezinearticles.com/?Whats-the-Purpose-of-Team-Building-Activities?&id=2077478

4.2 UNDERSTANDING AND SELECTING A MISSION CHALLENGE

Title: Ninth Grade Understanding and Selecting a Mission Challenge Lesson Plan

Goal/Purpose:

1.) For the students to understand and select a Mission Challenge.

Objective:

Students will gain an understanding of the various Mission Challenges and focus their interests into a specific area.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.

• Ask questions that require sufficient and appropriate empirical evidence to answer.

• Ask questions that can be investigated within the scope of the school laboratory, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

• Ask and/or evaluate questions that challenge the premise of an argument, the interpretation of a data set, or the suitability of a design.

• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects (Grade 9-10)

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Standard 8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

Standard 9. Draw evidence from informational texts to support analysis, reflection, and research.

Time:

Two class periods, 50 minutes each.

Instructional Procedures:

1.) A PEST Activity is a brainstorming focus tool. It gives students a specific goal in their brainstorming, to pinpoint problems in specific areas.

2.) Each letter stands for a specific area of concern

- **P** is for People causing problems (general rather than specific)
- **E** is for Environments or places causing problems
- **S** is for Situations which means what is happening that causes a problem
- **T** is for Things that are causing problems

P (People)	E (Environments —places)	S (Situations —what is happening)	T (Things)
LIST	LIST	LIST	LIST

3.) After the PEST list is generated, students will then propose potential solutions to the various issues.

Materials:

Student notebooks
Whiteboard

Teacher Notes:

Advanced or ESE/Special Needs

1.) Students can be encouraged to come up with a specific number of brainstorming ideas, more as enrichment or fewer as an accommodation.
2.) This can also be adapted as a whole group discussion only, without the writing component. As a whole class activity, brainstorming is both powerful and flexible as a tool for reaching all students. Allow students the flexibility to create their own paths to the answers, encouraging them to reach their own potential.
3.) As a class activity, this lesson can take as long as necessary to get the ideas across, and can be more or less detailed as the instructor prefers.

Reinforcement/Extension:

1.) The enrichment aspect of this activity is based upon the follow-up projects that are generated by the brainstorming.
2.) This lesson is intended to be used as an opener for a larger class project tied to

Group Activity:

Students will be asked to generate a PEST list for each of the potential Mission Challenges (Alternative Sources of Energy; Environment; Food, Health & Fitness; Forces & Motion; National Security & Safety; Robotics; Technology) as they relate to their own community.

1.) Go over the general rules for brainstorming, including being open and not limiting ideas (with the exception of the general guideline of community problems), being reasonably positive, being supportive of other's ideas, etc… Draw the above diagram on the board and ask students to copy it into their notebooks.

2.) Explain what PEST means and have students suggest ideas for how it could be used productively.
3.) Give the specifics of the brainstorming goal:

What are some problems around our community and school that you see? How do they relate to the above categories?
4.) Go through each letter and give about two minutes of writing in their notebooks for each. Walk around and select students to write examples on the board of some of their ideas. Discuss as a class each letter before moving on, and make additions to the board as necessary.
5.) Ask students to write down any of the ideas they saw on the board that they think are important but missing from their own lists. Encourage discussion of various ideas at this point.
6.) Ask students to circle what they think is the most important issue in each area.
7.) End with a discussion of the issues labeled "most important," and why students thought this was so.
8.) The following day, have students self-select into groups that they see as most important and interesting. Rearrange groups as necessary.

Assessment:

1.) Assessment of a brainstorming session is based mainly upon the ideas generated.
2.) Students will demonstrate their understanding or misconceptions of the various topics through the ideas they generate.

eCYBERMISSION. The nature of an eCYBERMISSION project is that it encourages problem-solving and higher-order thinking, key components of enrichment.

3.) The potential problems discussed will show student interests as well as their strengths and weaknesses.
4.) Students will gain a more in-depth understanding of the various Mission Challenges.

Resources: Adapted from lesson ideas by Dr. Scott Hunsaker, Utah State University.
More brainstorming activities:
http://www.glencoe.com/sec/busadmin/entre/teacher/creative/brain/index.htm

Explanation of brainstorming:
http://olc.spsd.sk.ca/de/pd/instr/strats/brainstorming/index.html
Graphic Organizer generator to help with brainstorming:
http://www.eduplace.com/graphicorganizer/

4.3 DEVELOPING A PROBLEM STATEMENT

Title: Ninth Grade Developing a Problem Statement Lesson Plan

Goal/Purpose:

1.) To encourage students to generate questions about their community, environment and world.
2.) To narrow the problem statement of their chosen topic of investigation to one that is testable, practical, safe and beneficial to their community.
3.) To work successfully through a complex problem with a group of other students in an organized, efficient manner.
4.) To create consensus among team members about the problem statement using a self-generated rubric.

Objective:

Students will work within their eCYBERMISSION Teams to learn the properties of a well-constructed problem statement, narrow the focus of their problem statement and determine that their problem statement meets all the requirements to successfully complete the eCYBERMISSION Mission Folder for their selected Mission Challenge.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
• Ask questions that require sufficient and appropriate empirical evidence to answer.
• Ask questions that can be investigated within the scope of the school laboratory, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
• Ask and/or evaluate questions that challenge the premise of an argument, the interpretation of a data set, or the suitability of a design.
• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects (Grade 9-10)

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Standard 8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

Standard 9. Draw evidence from informational texts to support analysis, reflection, and research.

Time:

One or two class periods, 45 minutes each.

Materials:

Develop Your Problem Statement Worksheet (Resource Worksheet 9-1).
Problem Statement Bingo Activity (Resource Worksheets 9-2 and 9-3).
Mission Challenge Pictures (eCYBERMISSION Website)
Resource Worksheet 9-4 (if needed)

Instructional Procedures:

Part 1

1.) Students should sit with their eCYBERMISSION Teams (if they have already been determined). Otherwise, students should be placed in randomized groups of three to four students.
2.) Students should have already selected one of the Mission Challenges (from the previous lesson plan, "Understanding and Selecting a Mission Challenge"). If not, they can select one preliminarily as an example exercise for this lesson.
3.) Give each student group a copy of the "Develop Your Problem Statement" Worksheet (Resource Worksheet 9-1).
4.) Prior to student groups working independently, generate a class discussion in which the Team Advisor models the completion of the "Develop Your Problem Statement" worksheet. An example topic can be preselected by the Team Advisor or by class choice.
5.) Student groups should then be instructed to complete the worksheet using Internet or library research. The Team Advisor can circulate and facilitate groups' research as appropriate for each individual classroom's academic level.
6.) As student groups complete the worksheet, the visuals will help them to see that they are narrowing their Mission Challenge topic into a testable problem statement. The triangle sections with directives on top match the color scheme of the empty triangles below, where the students will be generating their workable problem statement on a step-by-step basis.
7.) When a student group has completed the worksheet for Part 1, they can move on to Part 2 as time allows.

Part 2

1.) Students will have created a preliminary problem statement from the "Develop Your Problem Statement" activity in Part 1.

Teacher Notes:

Advanced/Gifted Students:

1.) Student groups could consult with an industry specialist, scientist, or other expert in their Mission Challenge topic prior to completing the Problem Statement Bingo activity.
2.) Students would be given only a certain number of opportunities to ask the Team Advisor for direct assistance in order to finalize their problem statement.

ESE/Special Needs Students:

1.) Limit the topics within the Mission Challenges to those which can generate a solvable problem for the students' particular abilities or limitations.
2.) Have student groups complete fewer sections of the Develop the Problem Statement worksheet, and provide more direct assistance for the other sections.
3.) Eliminate several squares within the Problem Statement Bingo worksheet, and address them directly for the students at the time of final problem statement selection.
4.) Give students question starters and word prompts to begin the formation of their final problem statement. (See Resource Worksheet 9-4).

Reinforcement/Extension:

1.) Prior to the activity, go over the seven eCYBERMISSION Mission Challenges. Use the Mission Challenge pictures from the eCYBERMISSION Website to trigger discussion/questions about each one.
2.) Use extinction techniques to discourage student groups from frequently asking for the Team Advisor's direct help on creating their

2.) Students will now be asked to apply the "Problem Statement Bingo" activity to their preliminary research statement. This activity asks the student groups to answer specific questions about their proposed research statement and provides them with a guideline as to whether their experiment meets the qualifications necessary for a successful completion of their eCYBERMISSION Mission Folder.
3.) Give each student group a copy of Research Statement Bingo (Resource Worksheet 9-2) and a copy of Research Statement Bingo Answers (Resource Worksheet 9-3).
4.) Students should work as a group to answer the Bingo questions in the corresponding boxes of their own Research Statement Bingo Answer worksheet based on the preliminary research statement they created from Part 1.
5.) As a preliminary guideline, students should be able to effectively answer 25 out of the 30 Bingo questions in order to determine that they have a quality problem statement for their eCYBERMISSION Mission Folder. However, it is up to the teacher to determine if more or less questions answered would still lead to a testable problem statement.

Assessment:

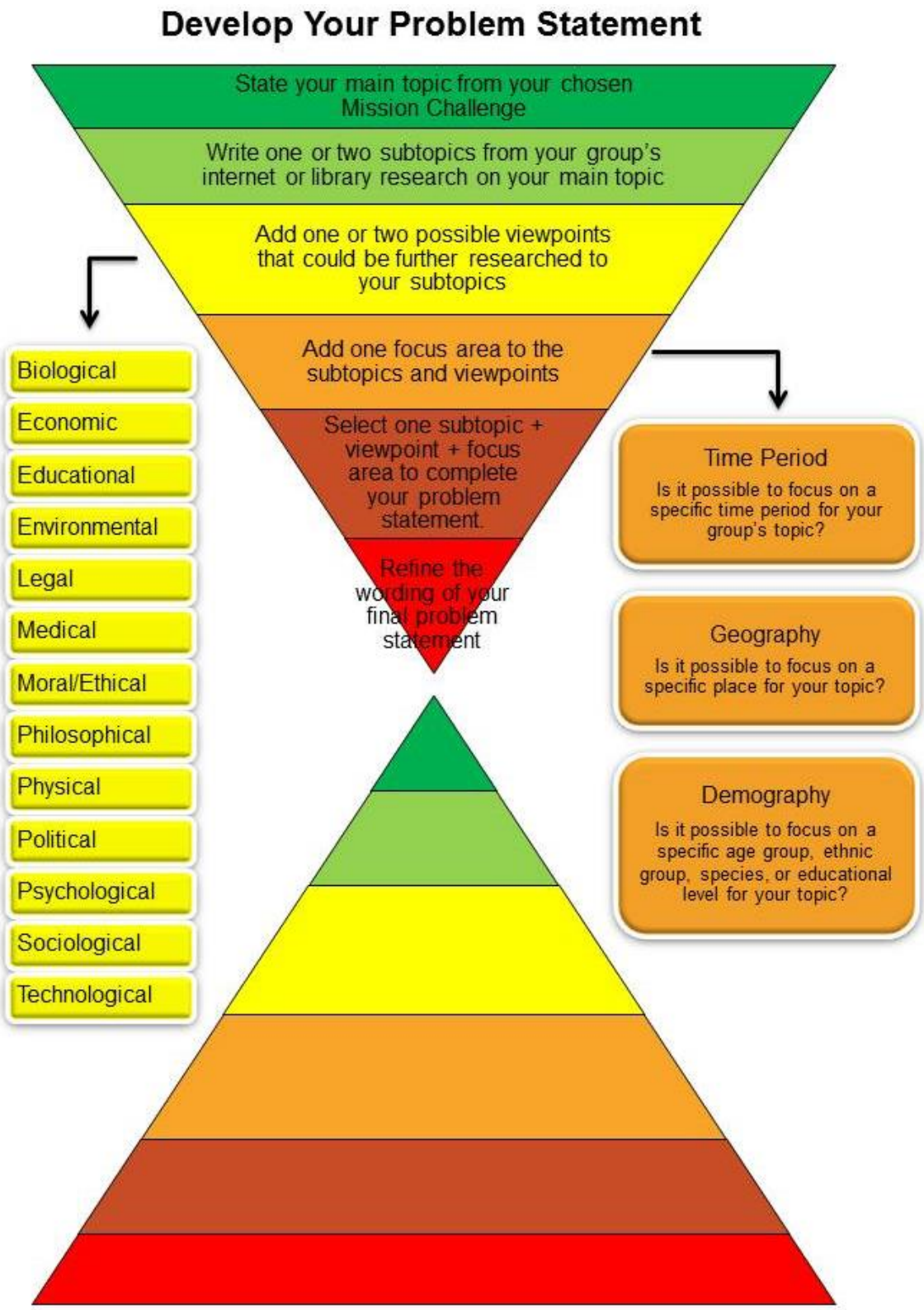
1.) The finalization of an appropriate, testable research statement is the main formative assessment. However, informal assessments can be integrated as needed for your classroom needs.
2.) Use appropriate feedback strategies as students attempt to finalize their research statement.
3.) Students complete a self-assessment of the quality of their research statement through the Problem Statement Bingo Activity.

Resources:

http://www.corestandards.org
http://floridastandards.org
http://www.wikihow.com/Write-a-Problem-Statement
http://suite101.com/article/scientific-inquiry-as-a-process-for-learning-a147274
http://school.discoveryeducation.com/sciencefaircentral/Getting-Started/Validate-Topic.html
http://www.district196.org/rhs/library/formulatequestion.htm

problem statement. Use the "Ask Three, Then Me" rule to encourage students to find solutions to their own questions.
3.) Students can post their Problem Statement Bingo Worksheets around the classroom to generate a class discussion or gallery walk in order to refine their problem statements further by soliciting input from their peers.

Resource Worksheet 9-1: Developing Your Problem Statement



Resource Worksheet 9-2: Problem Statement Bingo

Problem Statement Properties	How?	What?	When?	Where?	Why?	Who?
Time	How much time will our problem take?	What time of the day/night will our project need to take place in?	When will our experiment need to take place in order to complete it before the eCYBERMISSION deadline?	Where can we complete the experiment that will allow us to take the least amount of time?	Why will time be important in our experiment?	Who will decide how much time our experiment will take?
Materials	How will we obtain the materials to conduct the experiment?	What materials do we think we need in order to conduct the experiment?	When will we need to obtain the materials for our project?	Where will we get our materials for the experiment?	Why do we need the materials for our experiment?	Who will get the materials for our experiment?
Safety	How will we maintain proper laboratory safety procedures?	What safety precautions need to be in place for our experiment?	When will we determine the safety precautions necessary to complete our experiment?	Where will we conduct our experiment in order to have the maximum amount of safety?	Why do we need to have safety procedures for our experiment?	Who will determine that our safety precautions are enough for our experiment?

Benefit to Community	How will be able to show our project's benefit to the community?	What benefit to the community will our experiment have?	When will the community benefit from the results of our experiment?	Where in the community will our experiment have the most effect or impact?	Why does this experiment benefit the community?	Who in the community will benefit from our experiment?
Appropriateness	How will we know that our experiment is appropriate for eCYBERMISSION?	What makes our research statement an appropriate experiment to conduct?	When would be an appropriate time to conduct our experiment?	Where would be the most appropriate location to conduct our experiment?	Why do we need to determine if our research statement and experiment are appropriate?	Who will determine the appropriateness of our research statement or experiment?

Resource Worksheet 9-3: Problem Statement Bingo Answers

Problem Statement Properties	How?	What?	When?	Where?	Why?	Who?
Time						
Materials						
Safety						
Benefit to						

Community						
Appropriateness						

Final Problem Statement_____

_____

Resource Worksheet 9-4:
Question and Prompt Guiding for ESE/Special Needs Students

Use the following incomplete questions and/or word prompts to help guide ESE or other special needs students toward the creation of a successful eCYBERMISSION problem statement.

- What might happen if…?
- What could be the result if…?
- How are…?
- What are the effects of…?
- How can we…?
- Is the amount of…?
- Which type of…?
- Identify…
- Construct/make/build/create/plan/design/fabricate…
- Analyze/compare/contrast…
- Predict/interpret…
- Distinguish…
- Prevent…
- Verify…

4.4 CONDUCTING RESEARCH

Title: Ninth Grade Conducting Research Lesson Plan

Goal/Purpose:

1.) To research background information on selected problem statement topic in order to begin forming the eventual hypothesis for their team's eCYBERMISSION project.
2.) To determine the experimental variables and control factors of their problem statement in order to guide their background information gathering process.
3.) To evaluate Internet websites, journal articles, and other prior research evidence, gathered from a variety of either field experts or other similar sources, for their factual and/or scientific credibility.
4.) To maintain accurate documentation of background research materials and their locations or sources in order to cite them within their eCYBERMISSION Mission Folders.
5.) To work cooperatively with group members while gathering background information about their eCYBERMISSION problem statement.

Objectives:

1.) Students will work with their eCYBERMISSION Teams to identify the keywords and experimental variables contained within their eCYBERMISSION Problem statement.
2.) Students will determine the causal pattern evidenced by the phrasing of their problem statement (or rephrase as necessary).
3.) Students will gather background information from reliable sources to solidify their views, opinions and rationale for conducting experimentation on their problem statement for their selected Mission Folder.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that can be investigated within the scope of the school laboratory, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

Practice 7: Engaging in Argument from Evidence

• Construct, use, and/or present an oral and written argument or counter-arguments based on data and evidence.
• Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions.

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects (Grade 9-10)

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Standard 8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
Standard 9. Draw evidence from informational texts to support analysis, reflection, and research.

Time:

Three, 45-55-minute class periods.

Parts 1 & 2 – can be conducted in a regular classroom setting.

Part 3 – should be conducted in a library or computer lab setting.

Materials:

Resource Worksheet 9-3 *(*Found in Problem Statement Lesson Plan)*
Resource Worksheet 9-5
Resource Worksheet 9-6
Index cards
Computer
Projector
Videos from the following Website:
http://www.pz.harvard.edu/ucp/causalpatternsinscience/causal/causal_examples.cfm

Instructional Procedures:

Part 1

1.) Students should sit with their eCYBERMISSION Teams.
2.) Students should have already completed the activities from the Develop Your Problem Statement lesson plan.
3.) Teams should have their completed Problem Statement Bingo Worksheet (Resource Worksheet 9-3) in front of them.
4.) Give each team a copy of the "Conducting Background Research" Worksheet (Resource Worksheet 9-5).
5.) Prior to teams working independently, generate a class discussion in which the Team Advisor models the completion of the "Conducting Background Research" Worksheet. An example topic can be preselected by the Team Advisor or by class choice.
6.) Emphasize the difference between a keyword and a generic term occurring more than once (*e.g.*, cooking method, temperature, water amount vs. and, a, the, because, etc.). This will eliminate redundancy in the worksheet and create meaningful items that the teams will be writing on their worksheets.
7.) Teams should then be instructed to complete the worksheet. The Team Advisor can circulate and facilitate the teams' completion as appropriate for each individual classroom's academic level.
8.) As teams complete the worksheet, they will be generating items that will require the team to use the library, Internet or other resources in order to gather information that will be documented in their eCYBERMISSION Mission Folders.
9.) The items that are generated will be written on

Teacher Notes:

Advanced/Gifted Students:
1.) Student can create their own video scenarios about each science causal pattern and present them to the class. The students can then try to guess which causal pattern is demonstrated in the student-created videos.
2.) Students should brainstorm resources for acquiring background information about their problem statement OTHER than the Internet (*e.g.*, Department of Agriculture, CDC, universities, police departments, business partners, elected public officials, etc.) and require that at least five of their documented resources come from these alternative information sources.

ESE/Special needs students:
1.) Students might need assistance in recognizing key words and phrases on their Problem Statement Bingo worksheet.
2.) If mathematical formulas or special scientific equipment is required, give these teams the information necessary to aid their background research.
3.) If possible, have each team discuss their problem statement with an expert in the field of their topic.
4.) As students conduct background research, help them to understand which information would be most helpful to their hypothesis and experimental design, and which information could be eliminated as unnecessary or extraneous.

Reinforcement/Extension:

1.) Prior to the activity, have the teams review their final problem statement with you. If any revisions to the wording or phrasing of the problem statement need to be done, encourage the students to work together to finalize their problem statement.
2.) Have teams complete the first part of the

individual index cards (maximum of 18 per team). You can provide the index cards to the teams if resources allow, or ask the teams to provide their own index cards a week prior to your anticipated start time for this lesson. 10.) If a team completes the worksheet for Part 1, they can use classroom resources that are available in order to begin collecting background research as time allows. <u>Part 2</u> 1.) Prior to beginning this part of the lesson plan, be sure to acquire a computer that can be connected to a projector for the video section. 2.) Review the Materials section of this lesson plan for the website that contains the necessary videos and preview the videos to make sure they are available through your school's Internet provider with a firewall. 3.) Students should have completed the Conducting Background Research (Resource 9-5) Worksheet. Before beginning Part 2 it is not necessary for all the teams to have completed their index cards. 4.) Give each team a copy of the "Conducting Background Research" Worksheet (Resource Worksheet 9-6). 5.) Briefly describe each of the six causal patterns that occur in science. Have the teams generate an example of each pattern prior to viewing the videos (not required). 6.) Play the videos from the website. You can play them more than once in order for every student to connect the causal pattern to the events in the video. 7.) Pause between videos and give each team enough time to decide which causal pattern is represented by the video. If there is disagreement about the causal patterns, generate an informal class debate, with each team explaining their position prior to providing the correct answers. 8.) At the end of the video series, teams should be able to determine the causal pattern in their own problem statement. This determination will help them to direct the background research they will be conducting during their library/computer time. <u>Part 3</u> 1.) Prior to beginning Part 3, consult with your media specialist to secure available computer lab	"Problem Statement" section of their Mission Folders. This can be completed during assigned computer usage time or on the teams' own time. Encourage a deadline for teams to complete this section that aligns with your curriculum. 3.) Teams can use their library/computer time from Part 3 of this lesson plan to complete the "Problem Statement" section of their Mission Folders. If teams are having difficulty completing the "Benefit to the Community" section of the Mission Folder, they can wait until the later lesson that will finalize how their problem statement will impact their community.

time (if necessary). Students should complete their research as close to completing Parts 1 and 2 of this lesson plan as possible.
2.) As the teams use their index cards from Part 1, have them start to determine which information is most important to their problem statement, and which information is leading toward a hypothesis about the outcome of their Mission Folder experiment. Color coding/highlighting the index cards that are the most helpful toward that goal will help students organize their thoughts and drive their experimental design.

Assessment:

1) Both Resource Worksheets 9-5 and 9-6 can be used to give each team feedback and grading.
2) Successful and timely completion of the problem statement section of the Mission Folder can also be used to assess the teams' understanding of this lesson plan.

Resources:

http://www.corestandards.org
http://floridastandards.org
http://www.wikihow.com/Write-a-Problem-Statement
http://suite101.com/article/scientific-inquiry-as-a-process-for-learning-a147274
http://school.discoveryeducation.com/sciencefaircentral/Getting-Started/Validate-Topic.html
http://www.district196.org/rhs/library/formulatequestion.htm
http://www.sciencebuddies.org/science-fair-projects/project_background_research_plan.shtml
http://www.pz.harvard.edu/ucp/causalpatternsinscience/resources/resources.cfm

"McColskey, W., O'Sullivan, R. (1993). *How To Assess Student Performance in Science: Going Beyond Multiple-Choice Tests.* SERVE. U.S. Department of Education.

Resource Worksheet 9-5: Conducting Background Research

"A day in the library (or on the Internet) will save you a year in the lab."

Rather than starting from scratch in putting together a plan for answering your Mission Folder problem statement, you first want to collect as much information about your problem statement as you can. Scientists and engineers do this by using the library and Internet to help them understand what, if anything, has been discovered about their topic before they begin their experiments. They want to know what has worked and what has not worked for others that had similar problem statements or questions about their topic. Conducting background research will also help you state a hypothesis based on what you find out, as well as create an experiment that will most likely give you an accurate answer to your problem statement.

This worksheet will help direct and guide your background research based on your problem statement.

- Write any descriptive words or phrases that occurred *more than once* on your Problem Statement Bingo Worksheet:

_____ _____ _____

_____ _____ _____

_____ _____ _____

- List any mathematical formulas or scientific equipment you think you might need in order to answer your problem statement:

:

_____ _____ _____

_____ _____ _____

_____ _____ _____

Obtain one index card for each of the items that you wrote above. Write each item on its own index card, and then use your library/computer time to collect information about each item. When you find a website or other source of information for an item, make sure to write the location where you found the information on the back of the card to share with your eCYBERMISSION Team Members. Also write a brief statement on the back of the card which describes or explains the information that the resource provided for you.

Your eCYBERMISSION Mission Folder requires that you list at least 10 resources that are helping you to understand your Mission Folder topic and problem statement. Save the index cards for further use and reference as you complete the Mission Folder.

Resource Worksheet 9-6: Conducting Background Research [6]

Six Causal Patterns in Science

This worksheet will help you determine the type of scientific relationship that your Mission Folder problem statement is attempting to determine between one or more scientific variables that your team is investigating. After watching the video series and answering the questions, see if you can determine the causal pattern that your team is attempting to prove in your problem statement.

Linear Causality

- A particular effect on an object(s) is created by one specific and identifiable cause.
- There is clearly a direct link between the cause and the effect.
- The relationship between cause and effect occurs only in one direction.
- There is only one cause and one effect.

Domino Causality

- A particular event causes another event, which causes another event, etc.
- An effect can become the cause of another event, which can then become the cause of another event (*i.e.*, a chain reaction).
- Usually the event has a clear beginning and a clear ending

Cyclic Causality

- Object 'A' impacts object 'B', which then impacts object 'A', which then impacts object 'B' again, which then impacts object 'A' again.
- Usually involves a repeated pattern.
- Typically no clear beginning or ending to the pattern, just a constant cause and effect relationship between object 'A' and object 'B.'

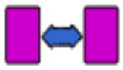
Spiraling Causality

- Object 'A' impacts object 'B', which then impacts object 'A', which then impacts object 'B' again, which then impacts object 'A' again.
- The repeating pattern will escalate or deescalate in the effects that occur on each object(s).
- Typically no clear beginning or ending to the pattern, just a constant cause and effect relationship of escalating or deescalating proportions between object 'A' and object 'B.'

Relational Causality

- The relationship between two objects or events accounts for an overall outcome or effect.
- Usually involves comparing two objects or events to each other.
- If one object or event changes, so does the overall outcome or effect.

Mutual Causality



- Two objects or events impact each other, creating an overall outcome or effect.
- The overall outcome or effect can be positive for both, negative for both, or positive for one and negative for the other.
- The overall outcome or effect can be immediate or occur over a long period of time.
- Usually the outcome or event has a clear beginning and a clear ending.

[6] *Adapted from http://www.pz.harvard.edu/ucp/causalpatternsinscience/resources/resources.cfm*

VIDEO QUESTIONS

1) Describe what the video that represented the CYCLIC CAUSALITY was about. How do you know it was showing this causal pattern of science?

2) Describe what the video that represented the RELATIONAL CAUSALITY was about. How do you know it was showing this causal pattern of science?

3) Describe what the video that represented the DOMINO CAUSALITY was about. How do you know it was showing this causal pattern of science?

4) Describe what the video that represented the SPIRALING CAUSALITY was about. How do you know it was showing this causal pattern of science?

5) Describe what the video that represented the LINEAR CAUSALITY was about. How do you know it was showing this causal pattern of science?

6) Describe what the video that represented the MUTUAL CAUSALITY was about. How do you know it was showing this causal pattern of science?

MISSION FOLDER QUESTIONS

1) Which type of causal pattern best represents your team's Mission Folder problem statement?

2) Why do you think your team's problem statement has this type of causal pattern of science?

3) How will knowing the type of causal pattern of your problem statement help your team to form a hypothesis?

4) How will knowing the causal pattern help your team to conduct the experiment?

4.5 STATE A HYPOTHESIS

Title: Ninth Grade State a Hypothesis Lesson Plan

Goal/Purpose:

To understand and develop a hypothesis.

Objective:

Students will define and use a hypothesis in a scientific investigation.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that can be investigated within the scope of the school laboratory, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.

• Evaluate a question to determine if it is testable and relevant.

• Ask questions to determine the relationships, including quantitative relationships, between independent and dependent variables.

• Ask questions to clarify and refine a model, an explanation, or an engineering problem.

• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

Practice 4. Analyzing and Interpreting Data

• Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.

• Consider limitations of data analysis (e.g., measurement error, sample selection), when analyzing and interpreting data.

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects (Grade 9-10)

Domain: Research to Build and Present

Knowledge

Standard 7. Conduct short as well as more sustained research projects to answer a question (including a self-generated

question) or solve a problem; narrow or

broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

Standard 8. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

Standard 9. Draw evidence from informational texts to support analysis, reflection, and research.

Time:

Two, 50-minute class periods.

Materials:

Potato cut with apple corer
Lemon Juice
Candlestick
Slivered Almond
Matches or Lighter
Potassium Iodate Solution
Sodium Meta-Bisulfite
Starch Solution
Sulfuric Acid Solution
Beakers
Timers

Instructional Procedures:

1.) Begin the class with a demonstration that causes students to question what happened and why. There are a number of demonstrations online which could be used, which are described as "discrepant events." This demonstration is the potato candle demo.
2.) Ask students to carefully write observations, both qualitative and quantitative, about an object that is brought out at the front of the classroom. The object looks like an ordinary white candle in a candle holder. The instructor should be careful to never refer to the object in direct or specific language, instead using general words and advising the students to describe in the best detail possible using what they know.
3.) Once students have drawn and described the object in their notebooks, light the candle. Ask students how it is different, and to describe anything they notice about it.
4.) Blow out the candle. While it is still smoking, bite off and chew the top half of the "candle." Make a great show of chewing loudly and asking students to describe what happened.
5.) Now ask students to hypothesize what they think the object is and why. It should lead to a discussion of what our assumptions are and what a hypothesis is, and how science is about using observations and experiences, not assumptions, to form hypotheses.
6.) Students are now asked to perform an experiment commonly called the "iodine clock." By mixing two clear liquids, students can make the solution turn dark blue to yellow and back to clear again. They can change concentrations to make the change happen in a predictable time period. (*See Flinn Scientific or attachment for the complete instructions).
7.) Students are encouraged to come up with and then change their hypotheses as they get more information during their experiment. At the end of the investigation, lead a class discussion on the importance of a good hypothesis and thought process as you go into an experiment, but that a hypothesis does not have to be correct to be helpful as you draw your conclusions.

Assessment:

1.) Students will write a description of the criteria that go into making a good hypothesis, one to two paragraphs.
2.) They will then write what they think are five "good"

Teacher Notes:

Potato Candle

1.) To prepare the potato candle, get an ordinary apple corer or corer/slicer. The center is exactly the correct size to replicate an ordinary taper candle. Use a large baking potato. Once you've created the "candle," store it in lemon juice or it will turn brown.
2.) Cut an "X" in one end of the potato, and stick in a slivered almond. Nuts burn well, and work great for this demo. Burn the end just slightly before setting it out so that it looks like a wick.
3.) Use an obvious candlestick, something interesting or old is best. The candlestick will draw interest and keep students from noticing the candle.

Advanced/Gifted Students

Iodine Clock

1.) Demonstrate the reaction first, and then give students the materials for the experiment.
2.) Challenge them to make a timer that is exactly 25 seconds.
3.) See www.flinnsci.com for more detailed instructions, or do a search for "iodine clock experiment."

ESE/Special Needs Students:

1.) Establish groups of mixed abilities, so that students can assist each other in the experiment
2.) Prepare the liquids ahead of time in the correct quantities, rather than requiring students to do so.

Reinforcement/Extension:

1.) There are many inquiry-based experiments for students to do which would help them learn to create a good hypothesis. A good guideline for teachers is to start with a question such as "What factors affect…?"

hypotheses about ordinary objects or events, and five "bad" ones, with explanations.
3.) Students are assessed on their knowledge of definitions as well as their explanations of the use of various hypotheses.

2.) Examples:

- What factors affect the flight of a paper airplane?
- What factors affect the rate of photosynthesis?
- What factors affect the rusting of steel wool?
- What factors affect the velocity of a marble roller coaster marble?

Resources:

www.flinnsci.com

Walter L. Saunders (2003) *Learning Cycle: Investigative Labs for Middle School Science*, Virtualbookworm Publishing

CHEM FAX!
P.O. Box 219 • Batavia, IL 60510
(800) 452-1261 • Fax (866) 452-1436
www.flinnsci.com • E-mail: flinn@flinnsci.com

FLINN SCIENTIFIC, INC
"Your Safer Source for Science Supplies"

Publication No. 10245

Iodine Clock Reaction

A Study of the Effects of Concentration, Temperature, and a Catalyst on Reaction Rate

Introduction

Mix two colorless solutions and watch as, after a few seconds, they suddenly change from colorless to a dramatic deep-blue color! Captivate your students' attention with this popular starch–iodine clock reaction while studying the effects of concentration, temperature, and a catalyst on the rate of reaction.

Concepts

- Clock Reactions
- Kinetics/Rates of Reaction
- Catalysts
- Indicators

Materials

Potassium iodate solution, KIO_3, 0.20 M, 325 mL
Starch solution, 2%, 180 mL
Sodium metabisulfite, $Na_2S_2O_5$, 3.8 g
Sulfuric acid solution, H_2SO_4, 0.1 M, 10 mL
Water, distilled or deionized
Balance
Beakers, 250-mL, 6
Beakers, 400-mL, 6
Graduated cylinder, 10-mL
Graduated cylinder, 50-mL
Graduated cylinder, 100-mL
Hot plate
Ice bath
Thermometer
Timer or stopwatch
Stirring rod

Safety Precautions

Potassium iodate is an oxidizer. It is moderately toxic by ingestion and a body tissue irritant. Sodium metabisulfite is a skin and tissue irritant. Sulfuric acid solution is corrosive to eyes, skin, and other tissues. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information. Wash hands thoroughly with soap and water before leaving the laboratory.

Preparation

1. Prepare 100 mL of a 0.20 M sodium metabisulfite solution by dissolving 3.8 g of sodium metabisulfite in enough distilled or deionized water to make 100 mL of solution. This solution has a poor shelf life (about 1–2 months) and should be prepared fresh for the demonstration.
2. Prepare a 2% starch solution by first making a smooth paste with 20 g of soluble (potato) starch and 100 mL of distilled or deionized water. Pour the starch paste into 1 L of boiling water while stirring. Stir until dissolved and the solution is clear. Allow the solution to cool to room temperature before use. Starch solutions have a poor shelf life and will form mold if kept too long. Fresh solutions work best. Use within one or two months.

3. Prepare a series of solutions called Solution A according to the following chart. Use 400-mL beakers.

	Beaker 1A	Beaker 2A	Beaker 3A	Beaker 4A	Beaker 5A	Beaker 6A
Potassium Iodate Solution, 0.20 M	50 mL	100 mL	25 mL	50 mL	50 mL	50 mL
Distilled or Deionized Water	150 mL	100 mL	175 mL	150 mL	150 mL	140 mL
Sulfuric Acid Solution, 0.1 M	0 mL	0 mL	0 mL	0 mL	0 mL	10 mL
Temperature of Solution A	Room Temp	Room Temp	Room Temp	45 °C	10 °C	Room Temp

4. Prepare a series of six identical solutions called Solution B (1B–6B) by mixing 10 mL of 0.20 M sodium metabisulfite solution, 30 mL of starch solution, and 40 mL of distilled or deionized water in 250-mL beakers. Keep each of the solutions at room temperature.

Procedure

1. *Control Reaction.* Pour Solution 1B into Solution 1A. Stir. Carefully time the reaction with a stopwatch or timer. Record the time from when the two solutions are mixed until the appearance of the blue color.
2. *The Effect of Concentration upon Reaction Rate.* Pour Solution 2B into Solution 2A. Record the time from when the two solutions are mixed until the appearance of the blue color. Repeat with Solutions 3B and 3A.
3. *The Effect of Temperature upon Reaction Rate.* Pour Solution 4B into Solution 4A. Record the time from when the two solutions are mixed until the appearance of the blue color. Repeat with Solutions 5B and 5A.
4. *The Effect of a Catalyst on the Reaction Rate.* Pour Solution 6B into Solution 6A. Record the time from when the two solutions are mixed until the appearance of the blue color. *Note:* Sulfuric acid is a catalyst for this reaction.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. The resulting solutions may be flushed down the drain with excess water according to Flinn Suggested Disposal Method #26b.

Results and Discussion

	1	2	3	4	5	6
[KIO_3]	0.04 M	0.07 M	0.02 M	0.04 M	0.04 M	0.04 M
Temperature	Room Temp	Room Temp	Room Temp	Warm	Cool	Room Temp
Catalyst Added?	No	No	No	No	No	Yes
Time Until the Blue Color	6 sec	3 sec	12 sec	4 sec	8 sec	2 sec

In this reaction, potassium iodate and sodium metabisulfite react to form iodine. The starch solution serves as an indicator of the end of the reaction by forming a deep-blue colored starch–iodine complex. The reaction time can thus be measured by noting the time until the appearance of the blue color for each trial. Three general statements can be made by looking at the results from this experiment. (1) The reaction rate increases as concentration increases and decreases as the concentration decreases. (2) The reaction rate increases with increasing temperature and decreases with decreasing temperature. (3) The reaction rate increases in the presence of a catalyst.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter, chemical reactions

Materials for the *Iodine Clock Reaction* are available from Flinn Scientific, Inc.

Catalog No.	Description
P0168	Potassium Iodate Solution, 0.2 M, 500 mL
S0151	Starch Solution, 500 mL
S0317	Sodium Metabisulfite, 100 g

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

4.6 CONDUCT AN EXPERIMENT

Title: Ninth Grade Conduct an Experiment Lesson Plan

Goal/Purpose:

For teams to conduct a procedure carried out under controlled conditions in order to discover an effect to test or establish their hypothesis.

Objective:

After constructing an effective hypothesis, student teams will work together to test their hypothesis through an experiment.

Standards:

Next Generation Science Standards:

Practice 3. Planning and Carrying Out Investigations

• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trails, cost, risk, time), and refine the design accordingly.

• Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigations' design to ensure variables are controlled.

Practice 6. Constructing Explanations and Designing Solutions

• Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do in the future.

• Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.

• Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects (Grade 9-10)

Domain: Research to Build and Present Knowledge

Standard 7. Conduct short as well as more sustained research projects to answer a question

	(including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **Standard 8.** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. **Standard 9.** Draw evidence from informational texts to support analysis, reflection, and research.
Time: Two, 50-minute class periods.	**Materials:** Experimental Procedures Guide (http://www.experiment-resources.com/conduct-science-experiments.html) Actual Project being used for experiment Notebook/ iPad Data tables Periodic-table Safety goggles as needed
Instructional Procedures: *Steps to Identifying and Conducting an Appropriate Experiment to Test a Hypothesis.* 1.) Students will work in their eCYBERMISSION Teams. 2.) Teams brainstorm a list of all potential hypotheses to be tested. 3.) Make predictions. 4.) For each hypothesis, ask what would be true if the hypothesis were true. 5.) Once you have formed a hypothesis, you will need to develop your experimental procedure to test whether your hypothesis is true or false. 6.) Write the Experimental Procedure. a.) The experimental procedure is a step-by-step recipe for the science experiment. A good procedure contains enough detail that someone else could easily duplicate the experiment.	**Teacher Notes:** *Advanced/Gifted Students:* 1.) Students will take on the role as leader and will want to manage the project, insure disbursement of shared responsibilities between all team members. 2.) Allow students to think "outside the box" in such a way that would allow them to be within the parameters of the experiment, but not to jeopardize the results (*i.e.*, facts must speak from themselves.) *ESE/Special Needs Students:* 1.) Ensure students are placed in teams which will allow each member the best opportunity to utilize their individual skills to help complete the task. 2.) Always check for understanding, cooperation and collaboration between team members. **Reinforcement/Extension:**

b.) Identify the independent and dependent variables.
c.) The first step of designing the experimental procedure involves planning how to change the independent variable and how to measure the impact that this change has on the dependent variable.
d.) To guarantee a fair test when conducting the experiment, make sure that the only thing changing is the independent variable. All controlled variables must remain constant.

7.) Design the Experiments.
a.) How can you identify an appropriate experiment that will effectively test your hypothesis? Begin by asking yourselves, "What can I do that will give me one result if my hypothesis is true, and a different result if my hypothesis is false?" Design at least one possible experiment for each hypothesis. Be sure that each experiment tests only one hypothesis.
b.) Design experimental group vs. control group. Every good experiment compares different groups of trials with each other. Such a comparison helps ensure that the changes you see when you modify the independent variable are in fact caused by the independent variable. There are two types of trial groups: experimental groups and control groups.
Experimental group: trials where the independent variable is changed. For example, if your question asks whether fertilizer makes a plant grow bigger, then the experimental group consists of all trials in which the plants receive fertilizer.
Control group: all those trials where you leave the independent variable in its natural state.
8.) Repeat the Experiment.
a.) Repeating the science experiment several times is an important step to verify that your results are consistent and not just an accident.
b.) For a typical experiment, you should plan

1.) During the experiments, walk around to each group and listen to their ideas and problem-solving techniques.
2.) Encourage the ideas and thoughts of those that would lead to a successful outcome, and question/have the student rethink those that might lead to a less successful outcome.
3.) After the activity is over, discuss the outcomes of their group's experiment and results. Students will naturally want to talk about their experiments strengths and weaknesses.
4.) Continue to reinforce the teamwork process of eCYBERMISSION with the students, and explain how they will need to continue communicating to complete their eCYBERMISSION projects.

to repeat the experiment at least three times. The more you test the experiment, the more valid your results.

9.) The following tips will be helpful when you prepare to create and conduct your experiment:

a.) Make sure to review your experimental procedure. Are all of the necessary steps written down? Do you have any questions about how to do any of the steps?
b.) Collect and organize all materials, supplies and equipment needed to do the experiment.
c.) Think ahead about safety! Are there any safety precautions you should take? Will you need adult supervision? Will you need to wear gloves or protective eyewear? Keep a fire extinguisher nearby, if applicable.
d.) Record all observations during your experiments in a science notebook.
e.) Prepare a data table so you can quickly write down your measurements as you observe them.
f.) Follow your experimental procedure exactly. If you need to make changes in the procedure, which often happens, you must write down the changes exactly as you make them.
g.) Be consistent, careful and accurate when taking measurements.
h.) If possible, take pictures of your experiments along the way; these will help to explain what you did and enhance your Mission Folders.

Assessment:

Knowledge and understanding on:

1.) How to conduct an experiment
2.) Understanding the results
3.) Prepare data and drawing conclusions
4.) Record everything in their notebooks.

Resources: http://www.miniscience.com/SciProjIntro.asp http://www.corestandards.org http://www.experiment-resources.com/conduct-science-experiments.html	

4.7 DATA COLLECTION AND ANALYSIS

Title: Ninth Grade Data Collection and Analysis Lesson Plan

Goal/Purpose:

The purpose of data collection is to obtain information to keep on record, also to make decisions about important issues, or to pass information on to others.
1.) For student teams to determine the most appropriate data to collect to test their hypothesis.
2.) To analyze data in order to draw conclusions and make decisions about their eCYBERMISSION project.

Objectives:

1.) Students will create a data collection plan that identifies the reason for data collection, what data to collect, and the method for data collection.
2.) Teams will test and modify their data collection plan.

Standards:

Next Generation Science Standards:

Practice 1: Asking Questions and Defining Problems.

• Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.
• Ask questions that require sufficient and appropriate empirical evidence to answer.
• Ask questions that can be investigated within the scope of the school laboratory, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
• Ask and/or evaluate questions that challenge the premise of an argument, the interpretation of a data set, or the suitability of a design.
• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

Practice 3. Planning and Carrying Out Investigation

• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trails, cost, risk, time), and refine the design accordingly.
• Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider possible confounding variables or effects and evaluate the investigations' design to ensure variables are controlled.

Practice 4 Analyzing and Interpreting Data

• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.

	• Analyze data to identify design features or characteristics of the components of a proposed process of system to optimize it relative to criteria for success. **Common Core State Standards for Mathematics (Grade 9)** **Domain: Quantities** **Reason quantitatively and use units to solve problems.** **Standard 1.** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. **Standard 2**. Define appropriate quantities for the purpose of descriptive modeling. 3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects (Grade 9-10)** **Domain: Research to Build and Present Knowledge** **Standard 7.** Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. **Standard 8.** Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation. **Standard 9.** Draw evidence from informational texts to support analysis, reflection, and research.
Time: This lesson will take two, 50-minute class	**Materials:** Actual Project

periods.	Notebook/iPad/Data tables Periodic-table Safety goggles as needed Worksheet 9-7

Instructional Procedures:

Day 1

Before breaking into teams the teacher will first go over the development of a data collection plan, using the following information: Steps to Data Collection and Analysis.

1. The first step in the planning process is determining why the data is being collected in the first place (e.g., internal quality improvement, funding requirement).
2. After this is identified, the next steps involve ascertaining: who will collect the data, what data will be collected, when the data will be collected, where the data will be collected and how the data will be collected.
3. The plan should also consider how the data will be analyzed and presented.
4. For appropriate interpretation, the analysis of collected data should include a determination of the validity of extracted data.
5. Once the planning phase is complete, the collection method should be tested and modified based on user feedback.
6. For successful data collection and analysis, the process needs to be easy for the user. Data that needs to be collected for quality measures should be built as seamlessly as possible into user workflows. Users should also be aware of the data collection process and taught how to enter data correctly.
7. Data collection usually takes place early on in an improvement project, and is often formalized through a data collection plan which often contains the following activity.

- *Pre-collection activity* - agree on goals, target data, definitions, methods.
- *Collection* - data collection.
- *Present Findings* - usually involves some

Teacher Notes:

Advanced/Gifted Students:

1.) Students will take on the role as leader and will want to manage the project, insure disbursement of shared responsibilities between all team members

2.) Allow students to think "outside the box" in such a way that would allow them to be within the parameters of the experiment, but not to jeopardize the results (*i.e*., facts must speak from themselves.)

ESE/Special Needs Students:

1.) Ensure students are placed in teams that will allow each member the best opportunity to utilize their individual skills to help complete the task.

2.) Always check for understanding, cooperation and collaboration between team members.

Reinforcement/Extension:

1.) Teacher and students should review the "**Resource Worksheet 9-7: Analyzing Your Data and Drawing Conclusions Worksheet"** on the eCYBERMISSION Mission Folder tips and worksheets page. See attached.

2.) During the Data Collection, walk around to each group and listen to their ideas and problem-solving techniques. Encourage the ideas and thoughts of those that would lead to a successful outcome, and question/have the student rethink those that might lead to a less successful outcome.

3.) After the activity is over, discuss the outcomes of their group's experiment and results. Students will naturally want to talk about their experiments strengths and weaknesses.

4.) Continue to reinforce the teamwork process of eCYBERMISSION with the students, and explain how they will need to continue communicating to complete their eCYBERMISSION Projects.

form of sorting analysis and/or presentation.

8. Prior to any data collection, the pre-collection activity is one of the most crucial steps in the process. It is often discovered too late that the value of their interview information is discounted as a consequence of poor sampling of both questions and informants and poor elicitation techniques.
9. After the pre-collection activity is fully completed, data collection in the field, whether by interviewing or other methods, can be carried out in a structured, systematic and scientific way.
10. A formal data collection process is necessary. As it ensures that data gathered are both defined and accurate and that subsequent decisions based on arguments embodied in the findings are valid. The process provides both a baseline from which to measure and, in certain cases, a target on what to improve.
11. Other main types of collection include: census, sample survey, and administrative by-product and each with their respective advantages and disadvantages.
12. A census refers to data collection about everyone or everything in a group or population and has advantages, such as accuracy and detail and disadvantages, such as cost and time.
13. A sample survey is a data collection method that includes only part of the total population and has advantages, such as cost and time and disadvantages, such as accuracy and detail.
14. Administrative by-product data are collected as a byproduct of an organization's day-to-day operations and has advantages, such as accuracy, time simplicity and disadvantages, such as no flexibility and lack of control.

15. Students will work in their eCYBERMISSION Teams on Worksheet 9-7 and record ideas in their team notebook.

Day 2
Students will work in their eCYBERMISSION Teams to continue formulating their data collection plan.

Assessment:

Knowledge and understanding on:
1.) Steps to data collection and analysis
2.) Understanding the results
3.) Prepare data and drawing conclusions
4.) Record everything in their notebooks.

Resources:

http://www.corestandards.org

Review eCYBERMISSION Mission Folder Tips on eCYBERMISSION web page under Resources. (https://www.ecybermission.com/help/helpdocs/Mission%20Folder%20Submission%20Tips%20and%20Guidelines.pdf)

http://people.uwec.edu/piercech/ResearchMethods/Data%20collection%20methods/DATA%20COLLECTION%20METHODS.htm

http://www.sagepub.com/upm-data/10985_Chapter_4.pdf

Resource Worksheet 9-7: Analyzing your Data and Drawing Conclusions

As you begin to analyze the data you collected through experiments, make sure your team sets aside time to review the information with your Team Advisor and discuss how best to showcase your results and conclusions.

Within your Mission Folder, you should state whether your hypothesis was true or false, what you learned from your experiments, and how your project could be improved.

Below you will find helpful questions for you and your teammates to consider as you review your data.

1. Data Analysis: Review data and results critically

    a. Is the data complete and accurate?

    b. Do I need to collect more data?

    c. Did I make any mistakes in my research or experimentation?

2. Summarize Data: What is the best way to summarize the data?

    a. Calculate an average of data collected?

    b. Summarize the results as a ratio or percentage?

    c. Display data clearly and concisely?

3. Display Data as a Graph or Table

    a. Place independent variable on the X-axis of a graph.

    b. Place dependent variable on the Y-axis of a graph.

    c. Label axes.

    d. Include units of measurement.

    e. Show each set of data in a different color or symbol.

    f. Include a legend.

    g. Convert data to show all units of measurement on the same scale.

Now that you have analyzed your data, the last step is to draw your conclusions. Conclusions summarize whether the experiment or survey results support or contradict the original hypothesis. Teams should include key facts from your team's background research to help explain the results.

If the results of your experiment support that your hypothesis is TRUE, summarize how this occurred by comparing the relationships between the independent and dependent variables.

If the results of the experiments or surveys do NOT support the hypothesis and prove the hypothesis is FALSE, you should not change or manipulate the results to fit the original hypothesis. Simply explain why things did not go as expected. Scientists often find that results do not support their hypothesis. They use those unexpected results as the first step in constructing a new hypothesis. If you think you need additional experimentation, you should describe what you think should happen next.

4.8 DRAWING CONCLUSIONS

Title: Ninth Grade Draw Conclusions Lesson Plan

Goal/Purpose:

To understand and draw conclusions through research.

Objectives:

1.) Students will define and identify criteria for drawing conclusions in scientific investigations.
2.) Students will conduct a research evaluation using the Internet.

Standards:

Next Generation Science Standards:

Practice 4 Analyzing and Interpreting Data

• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution.
• Analyze data to identify design features or characteristics of the components of a proposed process of system to optimize it relative to criteria for success.

Practice 6: Constructing Explanations and Designing Solutions

• Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do in the future.
• Apply scientific ideas, principles, and/or evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.
• Design, evaluate, and/or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Common Core State Standards for English Languages Arts

Reading Standards (Grade 9)

Domain: Key Ideas and Details

Standard 1. Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Speaking and Listening Standards (Grade 9-10)

Domain: Presentation of Knowledge and Ideas

Standard 4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are

	appropriate to purpose, audience, and task.
Time: Two, 50-minute class periods.	**Materials:** Notebooks Worksheet 9-7 Internet access
Instructional Procedures: 1.) Students are given the following questions to write about in their journals: a. What is a scientific conclusion? b. What is a conclusion based on? c. What criteria make a good conclusion? 2.) Students are then asked to conduct a research evaluation activity using the Internet. Worksheet 9-7 (found below) will be provided. 3.) Students are not required to research specific topics, but rather find their own. 4.) Once students have completed their research, they are to meet in groups of approximately four and discuss what they found. They should decide as a group to share two studies: a. An example of GOOD conclusions and why b. An example of POOR conclusions and why 5.) Groups will then post their information on a class discussion page, and will be asked to comment on the various examples over the next week as part of their assignment. **Assessment:** 1.) This is an open-ended assignment which asks for critical thinking and evaluation skills, much like they would be asked to do in real-life research. 2.) The assessment will be in evaluating their ability to understand the research and conclusions they find, their ability to actually find meaningful research, and in evaluating their ability to draw their own conclusions from the research.	**Teacher Notes:** 1.) There are several ways to conduct this activity; individually or in groups, or the way it is currently set it up as a combination. 2.) If computer access is limited, research can be conducted in groups or with mobile devices. *Advanced/Gifted Students:* 1) Students can be asked to complete this activity on their own time, either in groups or individually. 2) Students can also be encouraged to write an analysis of what makes a good resource, and why certain websites are more useful than others. *ESE/Special Needs Students:* 1) Students can present their best examples to the class instead of posting it to a discussion board. Students would just be asked to evaluate and comment in their notebooks instead. 2) As an alternative, the teacher can give some examples of websites as a means to giving students something to start with. 3) The teacher can also lead a class discussion of what makes a good experiment and what might skew data or conclusions, such as bias or not enough data.

Resources:	Reinforcement/Extension:
http://listverse.com/2009/06/02/10-truly-bizarre-scientific-studies/ http://www.badscience.net/ http://www.improbable.com/	A good enrichment opportunity is to ask students to find 10 examples of “bad science” in popular media reports, including a discussion of how data can be manipulated to make something seem more extreme than it really is. Have students create a brochure or handout on how to use resources on the internet, which can be used to instruct other classes.

Resource Worksheet 9-7: Drawing Conclusions-The Good, The Bad and The Ugly

Using the Internet, your job is to first discover, then evaluate examples of current or past scientific research. Just because it is science doesn't mean it's right! Describe the examples you find in the space below. Some websites to get you started are listed as well.

www.google.com

http://listverse.com/2009/06/02/10-truly-bizarre-scientific-studies/

http://www.badscience.net/

http://www.improbable.com/

Five examples of BAD SCIENCE—think about what the problems were.

Website	Name of Study and Year	Description of Study and Conclusions	Why it's BAD

Five examples of GOOD SCIENCE—think about what makes these studies good.

Website	Name of Study and Year	Description of Study and Conclusions	Why it's GOOD

Five examples of a VARIETY that you found interesting (or funny) and why.

Website	Name of Study and Year	Description of Study and Conclusions	Why it's GOOD, BAD or UGLY

BEST PRACTICES

eCYBERMISSION Curriculum Integration

Many Team Advisors use eCYBERMISSION as an after-school or extracurricular club activity, while others fully integrate eCYBERMISSION into their lesson plans. Use eCYBERMISSION to fit both your time and students' interests and abilities. For more target and specific information on how to effectively use eCYBERMISSION in your classroom or engage your entire school, contact Mission Control.

Tips on Encouraging Students to Participate

The following tips may help you to generate student interest in the competition and encourage participation:

- Emphasize the unique nature of eCYBERMISSION - a Science, Technology, Engineering and Mathematics (STEM) competition seeking diverse talents and interests.
- Stress the importance of STEM and inform them of this field's promising career paths, especially in today's unpredictable economy.
- eCYBERMISSION is one of the only competitions that actively encourages students to utilize both scientific inquiry using scientific practices and the engineering design process, enabling students to be ahead of the curve in high school.
- Explain the benefits of participating in a national competition. This includes interacting with scientists and engineers on a national level and gaining exposure for your team not only locally, but potentially regionally and nationally as well.
- Inform students about the prizes and awards (please see Awards section for further information).
- Provide incentives for your students, such as extra credit or a special field trip.
- Teams can be formed in each of your classes, or across classes to encourage socializing and STEM communication both outside the confines of the classroom and school.

Building the Bridge from eCYBERMISSION to the Classroom

Depending on your school district and curriculum requirements, you may have some different options on using eCYBERMISSION in your classroom. Consider building the competition into your daily class work, forming an afterschool club or assigning participation in the competition as extra credit work.

The following are strategies for integrating eCYBERMISSION into your classroom that have worked successfully for Team Advisors like yourself:

- Help students generate ideas for the competition based on things that they have learned in the current or previous school year.
- Help student teams generate ideas for the competition by asking them what STEM lessons or topics they liked most in the current or previous school year.
- Encourage students to look at the Mission Challenges and choose one that is most important to them. This will help them narrow down their topic (for more information, please see the Mission Challenges section).
- Encourage students to use school resources such as textbooks or equipment in the classroom. This will help students to use material directly connected to the classroom curriculum.
- Suggest that they go back to their books, notes or the web to further investigate options for solving their Mission Challenge.
- Make eCYBERMISSION an assignment for your entire class. Have teams in your class focus their Mission Folder on some aspect of what you have taught during the school year. To provide even more focus, ask all teams to focus on the same community problem or Mission Challenge in order to streamline the topics of interest.
- Participate in eCYBERMISSION Webinars as a class or team and encourage students to ask questions throughout the session.

- Utilize the Mission Folder Development section of Team resources on the eCYBERMISSION website to teach students about the different phases of the competition and how they relate to their projects. Mission Folder Development documents can be reviewed during class and taught in conjunction with provided worksheets.

Matching a Mission to Your Curriculum

The eCYBERMISSION competition is built on the principle that children can learn STEM by applying concepts they learn in the classroom to the world around them. The competition encourages the use of research, experimentation, and discovery to give students the opportunity to learn in the way that will benefit them the most. Student teams can incorporate much of the information they have learned in the classroom as they build their Mission Folder and supplement these concepts with hands-on discoveries during the competition.

Tips for Leading a Successful Team

- Utilize the eCYBERMISSION resources; such as the social media sites, Discussion Forums, CyberGuide chats, Team Talk, Virtual Lessons, and Mission Folder Development.
- To save time, provide a list of topics for your team members to consider or develop. Have team members select the topic that interests them most.
- Post a large task list and timeline in your meeting space and have team members initial each task as it is completed.
- Have your team members use Microsoft Word or a similar word processing program to document their data before uploading any answers to their Mission Folder. This will help with editing and spell check.
- Recognize your team members' accomplishments by throwing an eCYBERMISSION party after their Mission Folder is submitted.

Recognizing Team Achievements

While eCYBERMISSION is a rewarding experience for all involved, it is also a competition. Students sometimes get wrapped up in the competitive aspect of the program and lose sight of what's truly important; to be intellectually challenged and increase student knowledge in STEM, better preparing them for a productive future.

The following ideas have helped past Team Advisors acknowledge the hard work and dedication of their teams throughout the duration of the competition.

- Hold a class or group awards ceremony, creating superlative awards for each team or student to recognize their individual achievements and strengths.
- If possible, have an eCYBERMISSION Ambassador or representative from a U.S. Army installation recognize your students for their hard work after they submit their Mission Folder.
- Send a press release and photographs to the local newspaper.
- Throw an eCYBERMISSION party and take a team picture after the project is submitted.
- Share your team's successes on the eCYBERMISSION social media sites. Links to each of these sites can be found on the official eCYBERMISSION website.

PUBLIC RELATIONS AND COMMUNITY INVOLVEMENT

Forging Community/District Partnerships

While participating with your teams in eCYBERMISSION, it might seem challenging to provide your teams with the resources that they need in order to complete a successful Mission Folder. Some experiments or engineering projects will require extra materials or perhaps some sophisticated equipment in order for the teams to accomplish what they want to find out in their problem statements. There are resources in the community that can assist you in completing your team's Mission Folders, and these resources should be contacted as soon as possible to give your teams the best possible opportunities with eCYBERMISSION.

- School District/Administration – school districts and school-level administrators should be willing to allow your participation in eCYBERMISSION, as there is a nationwide push for more students to participate in STEM programs, and eCYBERMISSION is a free program.
- Grants and Funding – there are numerous local, state, and national grants available to teachers who are participating in STEM programs within their classroom. Contact the grant coordinator at your school or district in order to find out about available grants or stipends for your team's participation in eCYBERMISSION.
- Title 1 Schools – if you teach in a Title 1 school, there are many federal funding programs available to help you obtain materials and supplies for participation in STEM-related education. Contact the Department of Education for further information.
- Local Businesses/Chamber of Commerce – your local Chamber of Commerce will be able to direct you to businesses that are willing to sponsor or fund STEM programs within a school district. They will also know what businesses are willing and eager to provide experts in their field for your teams.
- Museums – local museums will have experts in their field available to help your teams collect background information about their Mission Folders. Some museums may have equipment or supplies that they would be willing to share with your teams as well.
- Local Colleges or Universities – professors are always conducting research in addition to their teaching duties. They have access to equipment that they may be able to allow your teams to use, or be able to help analyze data from an experiment your team has already conducted. Most local colleges or universities partner with the local school districts for various reasons, so make sure you take advantage of these connections.

CyberGuides

CyberGuides are civilian or military volunteers with an active Department of Defense security clearance who provide online assistance to eCYBERMISSION Teams.

- What is the role of a CyberGuide?
  eCYBERMISSION CyberGuides support student teams online through the use of Discussion Forums and CyberGuide Chats.
- How can I contact a CyberGuide for my teams?
  Teams can use the eCYBERMISSION Discussion Forums feature of the website to contact CyberGuides for assistance with their project. They often will be available for scheduled private chat sessions to assist your teams. We encourage CyberGuides to provide feedback whenever they are available to assist students. CyberGuides will also lead several scheduled chats throughout the competition year.

ADDITIONAL RESOURCES AND INFORMATION

How can Team Advisors get additional information?

There are a number of places you can go for additional information and help in completing your projects. These resources are to help you and your teams succeed in the best way possible, and can give you the latest, up-to-date information on the competition.

eCYBERMISSION Website

The eCYBERMISSION website is the most comprehensive tool you can use to answer questions you have on your project. The website is set up in several sections; including information specific to projects, information about previous projects and winners, prizes, judging criteria and more. In the Advisor Resources area, you have to ability to read over the scoring rubrics and questions for both types of projects.

The website is also where you will register, work on your project, and submit it when it is complete. Take some time to get familiar with it before the deadline nears, and you will find that all of the information you need is there.

Archived Webinars

Archived webinars are recorded presentations on specific topics. eCYBERMISSION offers archived webinars on the website on topics ranging from how to choose a Mission Challenge to how to best document your data. If students have specific questions about certain techniques or guidelines for their projects, watching an archived webinar may be a good way to see what the expectations really are.

Community Resources

There are many resources online as well in your own community that can help with a project. Depending on the topic, there are numerous non-profit or educational groups with members who will go out of their way to help. Try local and national foundations and teaching groups to start, as well as universities. Local governments are also generally helpful. Groups like the National Science Foundation or the National Energy Foundation can help put you in touch with scientists in your own area who may be able to assist. A good place to start is to brainstorm who would be most interested and who would most benefit from the work your group is doing.

Mission Control

Finally, Mission Control is truly a great resource for questions that just don't fit into a specific category. If you are frustrated or at a standstill, or simply want to clarify something you are working on, give Mission Control a call. They are ready and willing to help with any question you might have, from registration to submission. They are willing to make suggestions, clarify expectations, and help navigate the website. As you work through the process of completing your mission, Mission Control is there to help you succeed.