Mission Folder: View Mission for 'Oh, Deer!'

State	Texas
Grade	7th
Mission Challenge	Environment
Method	Scientific Inquiry using Scientific Practices
Students	Isaiah Baier (PianoFingers18) Aaron Barbee (britishcommando2) Caleb Cole-Smith (CCS2005) Dimitrio Martinez (thufunkeecou)

Team Collaboration

(1) How was your team formed? Was your team assigned or did you choose to work with each other?

Oh, Deer was formed when we chose to work with each other. We are friends at school and are in the same science class. Every week we have one science period set aside for eCYBERMISSION. We had similar ideas and decided on our current topic based on our love of the outdoors. It helped that we know each other well so can trust and rely on the other person to do their part of the project.

(2) Provide a detailed description of each team member's responsibilities and jobs during your work on the Mission Folder.

Please see uploaded file Roles and Responsibilities of team members and Talents Chart for detailed descriptions of our roles.

Everyone worked on experiments in the lab and field and filling out answers to Mission folder questions together. We divided jobs based on strengths so while Isaiah was creating a simulation in powerpoint, Dimi was making graphs. Aaron is the webmaster and Caleb is a research specialist. We all interviewed experts in the field, used the app on plants, participated in planting native grasses, and encouraged each other.

(3) Did your team face any problems working together? If so, how did you solve them? If not, why do you think you were able to work together so well?

For the most part, we worked together very well; although we did have some struggles. For example Dimi, one of our team members, moved schools, so there was a lack of communication. Our solution was to stay in contact through email and text. Fortunately, he soon returned because we missed him. Another problem was that our group got easily distracted. Our solution was to get to work immediately to allow less time to get sidetracked. We also started working outside of school to be more productive. We also had a problem with our plants. The grasses we were testing were dying due to the cold. Our solution was to grow the grasses in our science room in our homemade greenhouse.

(4) What were some possible advantages to working together as a team on this project? How would working as individuals have made this project more difficult?

One advantage of having multiple people in our group is that there are multiple perspectives for the same project. Also, we can get more things done since we have multiple people working on different projects. Another reason that having a team is beneficial is that it makes things easier if one person is absent, another person can fill in for them and do there work. It is also good to have friends on a team for encouragement and support.

If this was an individual project, it would be much more difficult. For one, you would have to perform the tests all by yourself, requiring multiple days and having to go to multiple different locations. Also, you wouldn't have as many perspectives and therefore fewer ideas.

Uploaded Files:

- [View] **Roles and Responsibilities** (By: CCS2005, 02/26/2019, .pdf)
  A chart showing the individual strengths of the team members and their roles and responsibilities is in this upload.
- [View] **Team Action Plan** (By: CCS2005, 02/26/2019, .pdf)
  The plan of this team is presented in a graphic organizer to show the community issue, the hypotheses, experiments, solutions, and community benefits resulting from this project. This shows the big picture and the connections between each phase of the project.
- [View] **Timeline of the Project April 2018 - February 2019** (By: CCS2005, 02/26/2019, .pdf)
  A timeline is included to show some of the milestones of the team from April 2018 to February 2019.
- [View] **Contact List** (By: CCS2005, 02/27/2019, .pdf)
  The experts who contributed to our knowledge and implementation of the project solution are listed in this document, along with their contact information.
- [View] **Team Members Talent Chart** (By: CCS2005, 02/27/2019, .pdf)
  A chart was created to show the diversity in our teammates and what we bring to the team.

Scientific Inquiry

Problem Statement

(1) What problem in your community will your team be investigating through scientific inquiry using scientific practices? Specifically, based on this problem, what question will you be trying to answer?

An average of six million car accidents occur yearly in the United States, injuring over three million people. (Federal Highway Administration) Of these accidents, 1.23 million are attributed to being caused by deer. This number has increased on average 7.7% annually and causes over $4 billion in damage each year. (State Farm) Wildlife Vehicle Collisions are an issue that affects all states and every driver. Despite many attempts at solving this problem over the years, it just grows. Through scientific inquiry and processes, the Oh, Deer team will answer this question:

If light-colored native grasses are planted on the sides of roads, will they possess the reflective qualities needed to illuminate the road and potentially prevent car accidents due to wildlife?

(2) Research your problem. You must learn more about the problem you are trying to solve and also what testing has already been done. Find AT LEAST 10 different resources and list them here. They should include books, periodicals (magazines, journals, etc.), websites, experts, and any other resources you can think of. Be specific when listing them, and do not list your search engine (Google, etc.) as a resource.

Extensive research was conducted and included books, periodicals, websites, and personal interviews with experts. We learned new information and what others are doing to solve this problem.

"AAA Exchange." Auto Collision Tips, 2016, exchange.aaa.com/automotive/roadside-assistance/auto-collision-tips/.
"Avoid a Deer-Car Collision." III, www.iii.org/article/avoid-a-deer-car-collision.

Bartlett, Jeff S. "How to Avoid Collisions With Deer This Fall." Product Reviews and Ratings - Consumer Reports, www.consumerreports.org/car-safety/how-to-avoid-collisions-with-deer-this-fall/.

Bradshaw, Karen. Environmental Specialist. Texas Department of Transportation. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. October 17, 2018.

Clayton, M.K. "Introduced Bluestem Grasses: Management on Native Lands." Texas A & M Agrilife Extension, forages.tamu.edu/PDF/ERM036-Introduced-Bluestem-Grasses.pdf.

"Culture of Safety" Driving and Deer vs. Car Collisions. 14 Sept 2017
Deer Weight Chart." Wildlife-Related Diseases, www.pgc.pa.gov/Wildlife/WildlifeSpecies/White-tailedDeer/Pages/DeerWeightChart.aspx.

Deering, Jeremy. Traffic Engineer. Texas Department of Transportation. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. October 17, 2018.

"11 Tips For Avoiding Collisions With Wildlife." Farmers' Almanac, Farmers' Almanac, 12 Oct. 2018.
"Facts + Statistics: Deer Vehicle Collisions." III, 17 Nov. 2017,
"Galleta Grass (Pleuraphis Jamesii)." Great Basin Seeds. greatbasinseeds.com/product/galleta-grass/.

Harris, Shelley. Design Engineer. Texas Department of Transportation. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. October 17, 2018.

Hartfield, Edvin. Environmental Inspector. Personal Interview by Isaiah Baeir, Aaron Barbee, and Caleb Cole-Smith. October 17, 2018.

Hasco, Linda. "In Which Pa. Counties Are You Most Likely to Hit Bambi?" PennLive.com, PennLive.com, 23 July 2018,

"Hertz." Annenberg Learner, www.learner.org/courses/physics/glossary/definition.html?invariant=hertz.

Hickey, Michael. PhD Physics. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. September 17, 2018.

"Hornet Deer Whistle, Avoidance System Cars." A Safer Life Starts Here(R), www.safehomeproducts.com/shp2/SM/HORNET-DEER-REPELLER.ASPX.
"In Wyoming, A Solution To Wildlife Traffic Accidents." Science Friday,
"Lewisville Lake Environmental Learning Area." Lewisville Lake Environmental Learning Area | LLELA Home, www.llela.org/about-llela/habitats/prairie-restoration.

Montana Fish, Wildlife & Parks :: Principles of Wildlife Management, fwp.mt.gov/hunting/.

"Mother Neff State Park." Texas Parks and Wildlife, 16 Oct. 2018, tpwd.texas.gov/state-parks/mother-neff/nature.

NTSB Home. National Transportation Safety Board (NTSB), www.ntsb.gov/Pages/default.aspx.

Pearson, Pat. Range Botanist. Bamert Seed Company. Muleshoe, Texas. Personal Interview by Aaron Barbee. October 29, 2018.

"Scientific Facts About How Deer See and Hear." Grand View Outdoors, 30 Nov. 2018, www.grandviewoutdoors.com/big-game-hunting/whitetail-deer/scientific-facts-about-how-deer-see-and-hear.

Stacks, Daniel. "Roadside Vegetation Management Manual." Roadside Vegetation Management Manual, 1 May 2018, onlinemanuals.txdot.gov/txdotmanuals/veg/veg.pdf.

Texas Department of Transportation. "Texas Department of Transportation." Texas-Mexico Border Crossings, www.txdot.gov/.

"Texas Leads States in Deaths from Deer Collisions." Insurance Journal, 4 Nov. 2015,
Pudenz, Jennifer. "How to Hunt Native Warm-Season Grasses | QDMA." Quality Deer Management Association, 18 July 2016, www.qdma.com/hunt-native-warm-season-grasses/.

Parks Canada Agency, and Government of Canada. "Parks Canada." Toronto Maple Leafs - History and Culture, 25
Feb.

Wachtel, Jerry. “REPORT ON DIGITAL SIGN BRIGHTNESS.” REPORT ON DIGITAL SIGN BRIGHTNESS, Nov. 2014,
“Wildlife-Vehicle Collision Reduction Study: Report To Congress.” U.S. Department of Transportation/Federal Highway Administration,

“White-Tailed Deer.” National Geographic, National Geographic, 21 Sept. 2018.

Wittie, Michael. Area Engineer. Texas Department of Transportation. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. October 17, 2018.

West Bend Mutual Insurance Company. “Deer vs. Car Collisions.” Culture Of Safety, 5 Apr. 2017,
“Wyoming: A Solution to wildlife traffic accidents may be in the bag”. Science Friday Segments.

(3) Explain what you learned from your research. What did you find out about your problem that you didn’t know before? What kinds of experiments have been done by other people before you? Be sure to put this in your OWN words, do not just copy and paste information. Also, be sure to cite your sources.

Since the invention of the automobile over 100 years ago, the threat of deer-car collisions has been a reality. Wildlife Vehicle Collisions (or WVC) can have a profound impact on wildlife of an area and the drivers on the road. From a human standpoint, there is a safety danger when animals are in and near the roadway and the result can be costly in terms of injury to the driver and vehicle damage. Many times, the animal that gets hit will be killed and in the case of 21 species that are endangered or threatened, road kill is actually one of the major threats to the survival of those species. (Federal Highway Administration)

For drivers in Texas and the rest of the nation, the majority of cases of WVC involve deer. Over 90% of the wildlife hit are whitetail deer. The reason for this is this species’ large and widespread population.
Other species in the deer family include elk and moose which are much larger and cause considerably more damage if hit. Fatality to the driver is more likely to occur because of the mass of these animals when compared to a whitetail deer - elk weigh six times as much as deer and moose can weigh ten times as much. (Pennsylvania Game Commission)

In order to reduce the numbers of deer collisions, many efforts have been made over the years and several organizations and agencies are involved. Every state has a department of transportation and each one has written handbooks for dealing with this specific issue. In fact, engineers with each department are charged with finding ways to decrease WVCs. (U.S. Department of Transportation)

Research shows several ways to impact this problem including the inventions of many devices such as a spinning whistle that can be attached to a grill of the car and acts as a signal to the deer. The Hornet Deer Repellent is one example and emits a sound in the 18,000 to 24,000-hertz range. Humans can hear from 20 to 20,000 hertz while deer can hear frequencies up to 30,000. One hertz is equivalent to one cycle per second of sound. Repeated studies have shown these to be ineffective and many people rely on them instead of common sense methods of preventing collisions by slowing down, using high beams, and avoiding the road at dawn and dusk. (Texas Department of Transportation)

Some methods are implemented in specific areas of high risk and include animal detection systems based on motion which light signs and cause flashing lights if an elk or moose is near the road and even high fencing for wildlife. These can interfere with migration and natural cycle movements of the animals, however, so wildlife crossing structures can be used instead. Found in the northwest U.S. and Canada, these structures are designed for larger game animals, though some are for mule deer and whitetail deer in the east. (Parks Canada)

We learned from our research that all plants are reflective, but some native Texas plants give off more light than other types of plants, which could be helpful if they are planted near roads to provide light to drivers so they can drive safely on the road and see where they are going. Other people have provided solutions like deer whistles but those “solutions” are mostly ineffective. (Montana Fish Wildlife and Parks)

Despite all the measures taken to stop deer collisions, the time of the day and the season of the year are critical factors that exist outside all other parameters. Deer are crepuscular animals meaning they are most active at dawn and dusk. The most likely time to hit a deer is from 5-9 a.m. and from 6 p.m. to midnight, with 6 - 7 p.m. being the highest point of activity during that evening time period. The seasons of the year where WVCs are most likely to occur are spring and fall, with November being the month with the highest number due to it being migration and mating season. (Texas Parks and Wildlife)

Consistent interviews by law enforcement with people who experienced deer/car collisions indicate the number one factor - LIGHT, or rather, the LACK of light on the roadway. Dawn and dusk are very troublesome because it is not dark enough for headlights to be 100% effective and the light scattering at these times of day cause hazy and dim conditions. (National Transportation Safety Board, NTSB) Quotes include, “I never saw the deer until I hit it,” and “It was just so dark and I never saw it coming.” Light gives drivers the ability to better see the roadway and the sides of the roadway, which may seem obvious. Light also improves the peripheral vision and the perception of movement in that line of sight. In order to effectively “spot” deer on the roadway at dawn, dusk, and night, one would need that which is most lacking - LIGHT. (Michael Hickey)

Experimental Design

(4) Based on the question you are trying to answer, and your research, what is your team’s hypothesis for this investigation?

According to our research, 89% of WVCs happen on two-lane roads which make some believe this is an issue only for rural communities. (NTSB) In fact, these kinds of highways are the most prevalent corridor in the United States and our drivers use these roadways more than any other single kind for travel. Furthermore, over 95% of the cases of WVCs were directly contributed to low light conditions. Wildlife Vehicle Collisions is an issue that has been tackled but not solved and definitely is an issue worth finding a solution. The facts confirm it to be a community problem in every state and for almost all drivers in our country.

Based on the question we are trying to answer and our extensive research, a hypothesis was formed for the overarching project as well as for each of the four specific investigations the team will conduct on the journey to a solution.

** Overarching Hypothesis for team Oh, Deer!
If highly reflective grasses are planted alongside roads to provide additional illumination, then drivers could potentially see better in this light and avoid a Wildlife Vehicle

Collision.

Investigation #1 Wildlife Detection Lighting using Technology - Hypothesis: If light conditions are increased by 20%, then people will be able to spot deer and brake to avoid a collision 50% of the time.

Investigation #2 Colors and Reflectivity in the Lab -
Hypothesis: If a wide range of colors is exposed to the same amount of white light, then black will be most absorbent, (followed by purple, blue, dark green, red, light green, pink, light blue, yellow, and white,) allowing a determination on the plant color needed on the roadsides.

Investigation #3 Plants and Reflectivity in the Lab - Hypothesis: If plants are yellow to white in color on their stems and tops, then they will reflect a greater amount of light as measured in lumens than plants with darker features, and could be considered for roadside planting. solution

Investigation #4 Plants and Reflectivity in the Field - Hypothesis: If light-colored plants are placed in the field, then they will be reflective and provide 20% more visible light onto roadways, allowing greater time to spot deer and brake.

(5) What are the independent and dependent variables in your investigation?

Investigation #1 Wildlife Detection Lighting using Technology -

Independent Variable - The amount of light in each scenario

Dependent Variable - The time it takes a person to see and respond to the deer.

Investigation #2 Colors and Reflectivity in the Lab -

Independent Variable - The color of the paper used in reflectivity.

Dependent Variable - The brightness of reflection coming off the colors based on a visual scale from 0 - 10.

Investigation #3 Plants and Reflectivity in the Lab -

Independent Variable - The kind of plant used in the investigation

Dependent Variable - The amount of light reflected as measured in lumens

Investigation #4 Plants and Reflectivity in the Field -

Independent Variable - The kind of plant used in the investigation

Dependent Variable - The amount of light reflected onto the roadway measured in lumens

(6) What are the constants in your investigation?

Investigation #1 Wildlife Detection Lighting using Technology - Constants - The visual reflective scale was the same; the timer used and the person doing the timing was the same; the kind of animal on each slide.

Investigation #2 Colors and Reflectivity in the Lab -
Constants - The distance standing away from the paper and shining the light; the strength of white light being used; the size of the paper; the distance between the light source, the phone, and the paper was kept consistent.

Investigation #3 Plants and Reflectivity in the Lab -
Constants - The distance between the phone app and the plant; the amount of light in the lab room itself; the phone app used for measuring lumens; the phone being used for the testing.

Investigation #4 Plants and Reflectivity in the Field -
Constants - The distance between plants and the phone app; the time of day when the reflectivity was measured.

(7) Will your investigation have a control group? If so, describe the control group. If not, why not?

Investigation #1 Wildlife Detection Lighting using Technology -
Control Group - The slide in the presentation in full light is a positive control and the slide in the presentation in total darkness is the negative control to which the experimental group will be compared.

Investigation #2 Colors and Reflectivity in the Lab -
Control Group - The black paper will be the positive control because it is known to absorb the most light and will be compared to the experimental group with other colors.

Investigation #3 Plants and Reflectivity in the Lab -

Control Group - There was not a plant with a documented amount of reflectivity found in our research, therefore there will be no control group in this experiment. Instead, we will compare the plants to one another when measuring lumens.

Investigation #4 Plants and Reflectivity in the Field -
Control Group - The control will be the light on the roadway under dark skies and car headlights with dark roadsides beside the road.

Experimental Process

(8) List all of the materials you used in your experiment. Be sure to include all physical materials as well as any technology or website used to collect data (not websites you used in your research).

**General Supplies

Measuring tape
Potting Soil
Plastic Cups
Plastic Bowls
Measuring Cups
Shovel
Cardboard box
Plastic wrap
Plastic containers
Measuring tape
Potting Soil
Plastic Cups
Plastic Bowls
Measuring Cups
Shovel
Cardboard box
Plastic wrap
Plastic containers

**Biotic Supplies
Triticale (Triticosecale) rye-wheat hybrid
Sideoats grama (Bouteloua curtipendula)
Blue Grama (Bouteloua Gracilis) native grass
Little Bluestem (Schizachyrium scoparium)
Big Bluestem (Schizachyrium Aldous)
Galleta Grass (Pleuraphis jamesii)

**Technological Supplies
Thermometer
Lux Light Meter App
Smartphone

(9) Explain your experimental process. Be sure to list all of the steps and safety precautions for your experiment. If no safety precautions are listed it will be assumed none were taken. Remember to write it so someone else could follow the steps and recreate your experiment.

We had four investigations for our project and the protocols or procedures are listed for each one separately.

Safety Precautions:
In the lab investigations:
1. Don't shine the lights in eyes
2. Washing hands after using potting soil to prevent diseases
3. Cleaning out after watering and feeding the plants

Safety:
In the field investigations:
1. Watching out for wildlife
2. Making sure to follow driving laws
3. Pull over safely to prevent a collision
4. Making sure that the area is well illuminated
5. Be careful holding the plants for sampling

Investigation #1 Wildlife Detection Lighting using Technology -
Procedure:
1. create a slideshow with dark roads and woods as a background on most of the slides, to simulate a driver on a road late at night.
2. put a picture of a deer in different places on each slide.
3. Then, time people of when they would find the deer to simulate a driver on a road at night when there is a deer coming.
4. Then, create a few more slides with roads next to woods except this time make the background pictures brighter than the first slides. Then, time their reactions again on the higher light concentration slides.

Investigation #2 Colors and Reflectivity in the Lab -
Procedure:
1. Bring plants into a dark lab to have better accuracy for the results.
2. Then, put one plant at a time on a table with a square piece of colored paper to show the reflectivity of the plant.
3.shine a light on the plant to see the reflectivity. We used different types of colored paper to create a visual scale for the plants.
4. Repeat three times to get better accuracy.
5. Repeat steps with other plants.

Investigation #3 Plants and Reflectivity in the Lab -
Procedure:
Bring plants into our school science lab
Put one plant on a testing table and turn out the lights
Shine a light on the plant using a flashlight
Use a lumens app on a phone to measure the exact amounts of visible light reflecting off of a plant
Repeat three times on each plant for accuracy
Record data on a google doc or in a notebook
Repeat with each grass

Investigation #4 Plants and Reflectivity in the Field -
Procedure:
Go to a road, particularly not heavily used.
Use a lumens app preferably the app Lux Light Meter Pro downloaded onto our cellphones.
Test plants of your choice three times each in the exact same position to prevent random errors
Then, record your results on a google doc or a notebook
Then, come back at night and test the same plants three times each in the same position as the previous test
Record your results in a google doc or notebook

Data Collection and Analysis

(10) Present the data you collected from your experiment. Be sure to include all of the numbers you collected from your observations and measurements. Use of graphs and charts is HIGHLY encouraged.

Please see uploads Lab Reports for each of the four experiments plus 2 extra experiments done All have data tables and graphs and detailed analysis in them. The photo essay shows pictures of the team at work. Thank you.

Investigation #1 Wildlife Detection Lighting using Technology -
Qualitative Data -Test number 1 is the longest taking experiment, which consisted of a deer at the side of the road and test number 3 was the had the least time recorded which was a deer on the road.
Quantitative Data - Test 1- 12.058 Test 2- 4.977 Test 3- 4.543 Test 4 8.729

Investigation #2 Colors and Reflectivity in the Lab -
Qualitative Data - White was the brightest and black was the darkest with all of the other colors in the middle. So turns out, the lighter the color the more the light is reflected and the darker colors absorb more color and reflect less light.

Quantitative Data - Dark Green-3 Red-4 Light Green-5 Yellow-9 Orange-8 Light Blue-7 Purple-1 Pink-6 Dark Blue-2

Investigation #3 Plants and Reflectivity in the Lab -
Qualitative Data -Triticale was the most reflective plant which causes the most visibility and blue grama was the least.

Quantitative Data - Triticale-7 Galleta Grass-6 Little Bluestem 5.3
Sideoats Grama-5 Big Bluestem 2.7 Blue Grama 2.3

investigation #4 Plants and Reflectivity in the Field -
Qualitative Data - Out of four plants plant number four was the most reflective and plant number one was the least

Quantitative Data - Plant 1 was 2014 lumens, plant 2 was 3173 lumens, plant 3 was 3015 lumens, and plant 4 was 3477 lumens

(11) What are your potential sources of error? Remember, this doesn't mean "Did everything work?", all tests have potential sources of error, so make sure you understand what that means. Explain how these sources of error could have affected your results.

Systematic Errors are errors in accuracy due to faulty equipment and cannot be improved by repeating the tests. For our project, the following were systematic errors we had:
In the Visual Test, it was the scale because it required human guessing.
In the wildlife detection survey, it was the changing of the light that could not be consistently performed.

Random errors are errors that have to do with how precise or closely spaced together the answers are in data. By repeating tests many times, you can reduce the impact of random errors on the precision of your answer. In our experiments, the following were random errors we had:
In the lumens test, the random errors were minimized by repeating the field testing 90 times.
In the Visual Test, the data was closely grouped and highly precise.

Drawing Conclusions

(12) What conclusions can you draw based on the data you gathered during your experiment(s)?

Objects either absorb, refract or reflect light. From our experiments, we gathered data showing evidence that all plants are reflective to some degree. Some grasses show low amounts of reflectivity, but other plants are highly reflective which would be helpful along roads so people can see better at dawn, dusk, and at night preventing car-animal collisions.

Based on our data from the four investigations, we can draw these conclusions:

~ Light is a key factor in deer-car collisions

~ A light increase by 20% can lead to a 75% increase in the ability of a person to stop in time after seeing the deer

~ Little bluestem and Galleta grass are highly reflective and can increase light by 20%

~ Planted by roadsides, light-colored plants DO reflect light as measured in lums in our tests and can be an innovative solution for lighting roadways in areas where electrical lighting is not feasible.

Please see our lab reports for more detailed results.

Uploaded Files:

- [**View**] **A Community Problem Worth Solving** (By: CCS2005, 02/26/2019, .pdf)

  Evidence of a major community problem in our area and across the United States shows the reason why our team chose to make a difference this year and decrease the number of wildlife-vehicle collisions through an innovative solution.

- [View] **Plant Reflectivity Lab Report** (By: CCS2005, 02/27/2019, .pdf)

  A complete report with the scientific process featured including problem, hypothesis, materials list, procedure, average data collected in lumens. conclusions, and photographs of the team working.
- [View] **Collaborations with Experts in this Field of Study** (By: CCS2005, 02/27/2019, .pdf)

  A document that shows the names and associations of the people contributing to our research is included, along with photographs of working with Texas Department of Transportation engineers during the beginning phases of the project. We are grateful for the collaborations and input from these experts in the field.
- [View] **Lab Report - Investigation #2 Colors and Reflectivity in the Lab** (By: CCS2005, 02/27/2019, .pdf)

  This is a complete lab report including all steps of the scientific process for this experiment, along with data tables and graphs.
- [View] **Investigation #3 Plants and Color Scale Reflectivity** (By: CCS2005, 02/27/2019, .pdf)

  A lab report including all steps in the scientific inquiry process measuring reflective light off plants (native grasses) and comparing this to a color scale created by the team. Includes data tables and graphs.
- [View] **Lab Report - Investigation #4 Plant Reflectivity in the Field** (By: CCS2005, 02/27/2019, .pdf)

  A lab report with every step of the scientific process is included with the results of the field testing in two areas of Texas - west TX and east TX. Data tables and graphs are included.
- [View] **Lab Report - Investigation #1 Wildlife Detection Lighting with Technology** (By: CCS2005, 02/27/2019, .pptx)

  The use of team member created simulations in which human subjects needed to watch a powerpoint slides light was slowly increased from complete darkness to full light on the computer screen. When the person could recognize a deer in the scene (roadway scene), they alerted the team and the time it took them to see it was recorded. This lab report contains the slides and the results of the tests. It is attached here as a powerpoint so judges can try out the test for themselves.
- [View] **Purpose of Plants Selected for Testing** (By: CCS2005, 02/27/2019, .pdf)

  A chart was created to show the three primary plants selected for roadsides which are reflective. It explains why each was chosen and the benefits native grasses could provide to lighting the roadways through their levels of reflectivity.
- [View] **Bibliography or Works Cited** (By: CCS2005, 02/27/2019, .pdf)

  Bibliography for the team
- [View] **Lab Report - West Texas Field Tests** (By: CCS2005, 02/27/2019, .pdf)

  Using technology with the downloaded Lumens app - this is a report showing how this was incorporated into the project. Data Tables, pictures, app use included

Community Benefit

(1) Explain how investigating the problem your team chose will help the community. Be sure to include the impacts your research will have on individuals, businesses, organizations, and the environment in your community (if any). Make it very clear why solving this problem would help your community.

Investigating this project will have many positive impacts on the community and the environment. Solutions can drastically decrease wildlife-collisions across states with abundant wildlife. The deer population and other wildlife would increase resulting in benefits for the ecosystem, ecotourism, and sportsmen.

Impacts on Individuals - A car accident involving a large mammal such as a deer (150 pounds), elk (750 pounds) or moose (1,200 pounds) can be devastating and prove fatal when hit in such a way that the animal rolls back onto the hood and through the windshield. For most drivers experiencing a wildlife collision, the response of, “I never saw it!” is common. The greater the ability to see the animal on the roadway or on the side of the roadway, then the greater the ability to avoid that collision. Oh, Deer’s solution to use native plants on the roadways with white or light-colored seed tops and tufts will increase the visibility on the roadway by over 30% which was shown to decrease reaction time by this percentage as well. The ability to spot wildlife on the roadside GREATLY increases a driver’s likelihood of braking and preventing a wildlife collision. This can be a life-saving solution to a 100-year-old problem. The impact affects an individual’s emotional state but there are economic factors as well. An average of $3,300 is incurred per deer collision meaning the savings deeply affects family budgets, as well as insurance companies.

Impacts on Businesses - Work vehicles are often involved in these wildlife collisions when driving occurs at dawn or dusk. These are the most common times for employees to go to work and return home. For people living in areas with high populations of deer, it is not really a matter of IF you will hit a deer, but a matter of WHEN you will hit a deer. In our community, when people speak of this, it is mostly about “the time I hit a deer” and this would be prevented, which saves businesses money. Their supplies will be delivered on time and there will not be a loss of work for their employees if collisions are prevented.

Impacts on Organizations - State departments of transportation, the National Highway Safety Administration, and the Federal Highway Administration are organizations that conduct an annual Wildlife-Vehicle-Collision (WVC) Study and make recommendations to Congress to reduce injuries and fatalities. According to their website, the findings show there are no simple solutions to this issue. They present methods which are considered “best practices” (see upload “A Community Problem Worth Solving”) and include outreach, education, detection systems likes whistles, and fencing/crossing specifically for very large game animals like elk, moose, and caribou.

Impacts on the Environment - Native grasses can help reflect light onto roadways, particularly in areas that do not have electric lighting or where it is not feasible to have this. They not only add light that can prevent collisions, but they also control erosion as well. Three stands of native grasses are being planted by roadsides in Crosby County and additional testing will be conducted throughout the seasons to examine their effects. Deer repelling plants with strong aromas are also being used to discourage deer from being near roadways and our team is working on those efforts as well. Peppermint and lavender are two such plants

Our community involvement-
* Met with TXDOT (Texas Department of Transportation)
* Created flyers
* Created website
* Public Service Announcement
* Met with environmental specialists
* Radio presentation
* Blogs

* Community newsletters
* Presentation at Cabela's/ Bass Pro Shop
* Present findings to Bamert Seed Company
* Present findings to Texas Parks and Wildlife
* Present findings to Muleshoe National Wildlife Refuge

Throughout this project, our team has found valuable information that means life-saving measures for the people of our state and nation. The solution is innovative and could spread to other states such as New Mexico whose numbers of collisions are as high as Texas. We are excited about the possibilities of using nature to solve a problem 100 years old and hope others will see what can be done using our valuable natural resources.

Uploaded Files:

- [View] **Community Flyer** (By: Advisor, 02/25/2019, .ppt)
  Community flyer made after a presentation of the project goals at Texas Tech University during Regional South Plains Engineering and Science Fair
- [View] **Grasses for Roadways** (By: CCS2005, 02/27/2019, .pdf)
  The most reflective grasses are featured in this document that shows photographs of those tested and planted on roadways to increase visibility and decrease deer-car collisions.
- [View] **Poster** (By: CCS2005, 02/27/2019, .pdf)
  A poster telling drivers how to avoid deer collisions by following some common sense traffic rules was created.
- [View] **Website Link and QR Code** (By: CCS2005, 02/27/2019, .pdf)
  A link to the website we created and a QR code short cut to that site is provided in this document. https://ohdeerscs.weebly.com
- [View] **Photo Essay** (By: CCS2005, 02/27/2019, .pdf)
  Photos of the team in action

Mission Verification

(1) Does your Mission Folder project involve vertebrate testing, defined as animals with backbones and spinal columns (which include humans)? If yes, team must complete and attach an IRB approval form.

Yes

(2) Did your team use a survey for any part of your project? If yes, team must complete and attach a survey approval form.

Yes

(3) You will need to include an abstract of 250 words or less. As part of the abstract you will need to describe your project and explain how you used STEM (Science, Technology, Engineering and Mathematics) to improve your community

In the United States, there are over 1.23 million deer-vehicle collisions causing over $4 billion in damage and killing hundreds. A large amount of research was conducted and the majority of these accidents are due to poor illumination of the road in front of them. Although this problem has been tackled for many years, the number of collisions rises 7% annually and no resolution has been found. Driving down a road lined with pine, it was dark and elk and deer practically invisible. Turn the curve and white-barked aspen tree groves now lined the road which literally lit up! Oh, Deer developed an innovative solution to this problem. What if native grasses had highly reflective qualities as well? Such plants with lightly colored stems or seed tufts could be planted on roadsides to provide added light, allowing drivers to see deer and avoid collisions. The team used a visual test and downloaded multiple apps that measure lumens or luminous flux. We planted and tested many different types of native plants in the lab and in the field. After testing, it was determined that little bluestem and galleta grass were highly reflective and when planted on roadsides would provide 20% more light than without it, allowing a 50% improvement in a driver's ability to see deer and brake. This solution will not only save lives, but create safer roadways for all Americans.

Uploaded Files:

- [View] **IRB FORM** (By: CCS2005, 02/26/2019, .jpg)
  An IRB form was required because of human participants viewing presentations and giving feedback on the ability to see wildlife in light and dark situations.
- [View] **Survey Approval Form** (By: CCS2005, 02/26/2019, .jpg)
  A survey approval form was needed because human participants gave feedback on the ability to see deer in both light and dark situations and then answered survey questions.

Oh, Deer!

Join the fight trying to stop deer-vehicle collisions

Aaron	Caleb	Isaiah	Dimi
Communication Specialist Strong Leadership Skills	Enthusiasm For The Project Coordinated the Brainstorming Sessions	Records Notes during Interviews with Community Experts	Works Together well with Anyone Good Listener
Graphs, Charts, Data Generator	Thorough Researcher	Interviewing Specialist Writes Thank-you notes	Problem Solver/Troubleshooter Asks tough questions
Bright	Data Collection & Measurements	Enjoys Experiments Good Lab Manager	Strong Lab Scientist
Public Speaker during Presentations	Strong Writing Skills Organizer for Meetings.	Takes notes during interviews	Idea Generator Studies Plant Growth
High Vocabulary in Verbal and Written Communication	Thorough during Research & Summaries	Prepared Support Materials Artist	Innovator and Creative Advanced Mathematician
Driven and Determined Poster Presentations	Analyzes Data Well Draws Conclusions	Organized On Time	Sees the Big Picture Easily Grand Ideas and dreams
Data Collection Created Tables & Qualitative Data Sheets	Independent Worker Highly Dependable	Physically Outgoing Easily Flexible & Compromises	Detail-oriented Advanced Calculator Skills
Socially Outgoing Works well with Other People of all Ages	Logical & a Voice of Reason for the Team Keeps others on Track	An encourager to the Team and an Outgoing Team Member	Academically Advanced Memory for Details
Outreaches to the Community	Prepared Powerpoints and Presentations Thought of our Team Name	Scientifically Records Results	Good Listener Appreciative of Others Ideas

Community Problem:
There are over 1.5 million car accidents each year, and and over half of them are related to animal car collisions. Are project is to help prevent these accidents.

Hypothesis:
If we can find plants that can reflect light from your headlights onto the road, it will lower the average amount of car accidents.

Experiment :
Will the road be illuminated if we place white, green or blue plants along the side of the road?

Solution-
We grew different plants that have qualities that can reflect light onto the road.

Community Benefit
Native plants on roadways mean less maintenance for the highway department and greater light on roads.

Hypothesis:
If native plants are tested for reflectivity, they will be found to provide more light on roadways than bermuda that is historically used.

Experiment :
What is the reflectivity of native plants for this area of Texas?

Solution-
Native plants were found to have white tipped stems and fluffy white seeds at the top of the stalks and these allowed for greater lums to be shone onto the roadway.

Community Benefit
Native plants on roadways mean less maintenance for the highway department and greater light on roads.

Hypothesis:
If more light is shone on the highway, then people are more likely to see deer or other wildlife.

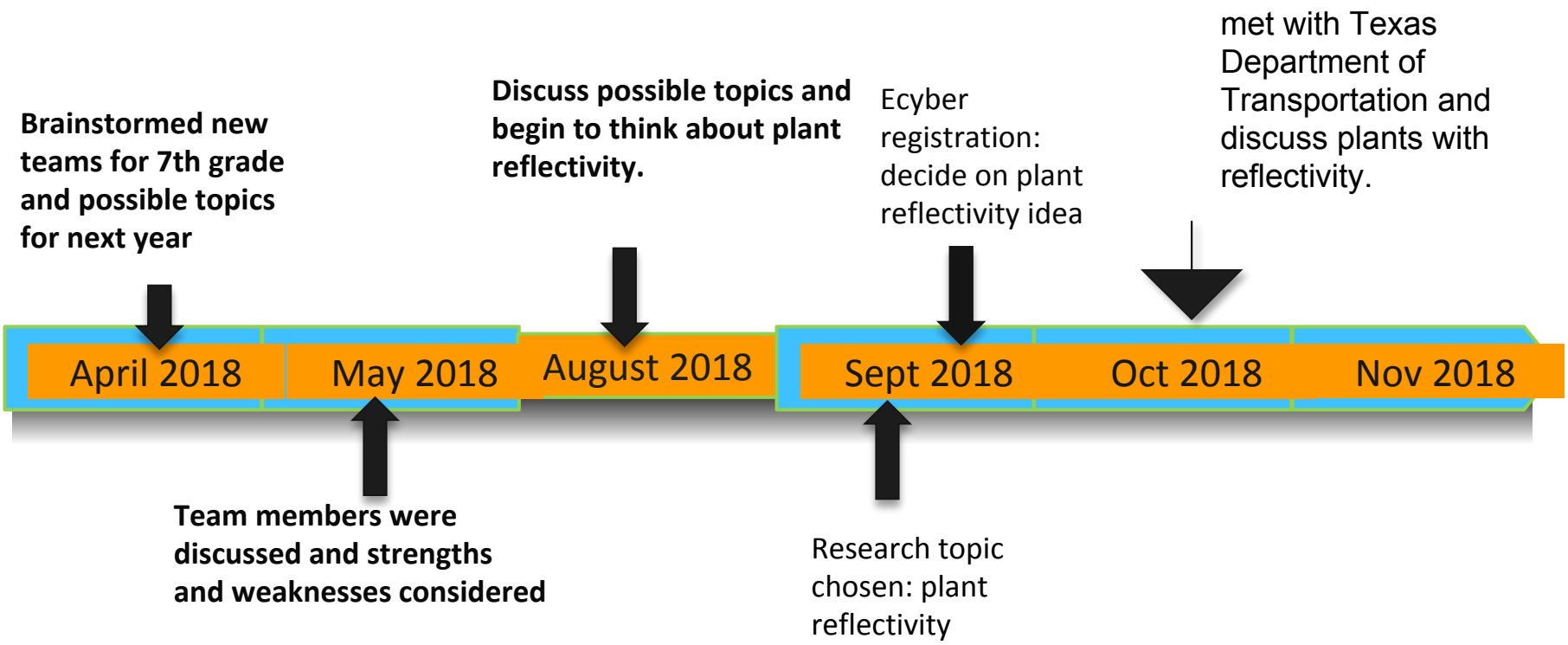
Experiment:
Create simulations involving deer on the road and on the side of the road in different light conditions. Ask people to identify when they see the wildlife as we time their reactions.

Solution-
A lighted road either by artificial lighting, reflectors, or plants results in better reaction times for drivers

Community Benefit
More light from plants means better chances to avoid deer collisions

Oh Deer

Timeline for eCYBERMISSION Project



April 2018 ~ Feb 2019

Silver Bullet Timeline Continued ...

Evaluate the best choices for grasses to be planted along roadsides

Present information to others - South Plains Regional Science & Engineering Fair - advance to the state level

We plant and take care of blue grama plant seeds while also observing and recording the water take-in of other native plants

Complete mission folder and submit work

Contact List

Texas Department of Transportation
135 E Slaton Hwy.
Lubbock, TX 79404
806-748-4320 (office)
806-392-1614 (cell)

Michael Wittie
Area Engineer
Texas Department of Transportation

Shelley Harris
Lubbock District
Design Engineer
TXDOT

Jeremy Dearing
Traffic Engineer
Texas Department of Transportation

Edvin Hartfield
Environmental Inspector
Texas Department of Transportation

Karen Bradshaw
Environmental Specialist
Texas Department of Transportation

Pat Pearson
Range Botanist
Bamert Seed Company
Muleshoe, Texas

Laura Wilbanks
Wildlife Biologist
Texas Master Naturalist
Levelland, Texas

Dr. Michael Hickey
PhD Physics, PhD Chemistry
Southcrest Christian School
Lubbock, Texas

Oh, Deer!

Aaron	Caleb	Isaiah	Dimi
Good Public Speaker Extrovert	Research Specialist Talented summarizer	Bright Personality Cooperative	Enthusiasm for the Project
Advanced Reader	Strong Leadership Skills	Well Conducted During Experiments Strong Lab Scientist	Insightful Goes Into Detail
Outreaches to the Community	Very Good Team Collaborator	Determined to Finish Work Despite Conditions	Independent worker
Advanced Computer Skills	Hardest Worker on the Team	Great Listener	Advanced Tennis Player
Google Slides Strength	Educationally Advanced	Pianist	Compassionate
Track	Troubleshooter Very Good at Adapting	Entrepreneur	World Traveler
Interested in Space!	Reader	Philanthropist	Intelligent
Technology Savvy	Loves Sports	Tennis Player	Family Oriented
Outdoorsman	Protective	Love to Play Soccer	Bilingual

DEER COLLISIONS

Oh, Deer!

eCYBERMISSION 2018-2019

7th Grade STEM Research Team

www.washingtonpost.com

EVIDENCE OF A COMMUNITY PROBLEM WORTH SOLVING

The following presentation shows several reasons the team chose the issue of wildlife-car collisions as a community problem worth solving this year. In the top five states for animal-car collision claims to insurance, Texas has a major problem because there are more roads in this state than in any other – which means more places on which to encounter wildlife while driving.

http://kanecountyconnects.com/2017/11/top-10-illinois-counties-for-deer-collisions/

TOP STATES FOR DEER COLLISIONS

1. West Virginia
2. Montana
3. Pennsylvania
4. Wisconsin
5. Iowa
6. South Dakota
7. Minnesota
8. Michigan
9. Mississippi

https://www.iii.org/article/avoid-a-deer-car-collision

www.pennlive.com

AVOID WILDLIFE COLLISIONS

Slow down

Be aware

Be alert

Brake, don't swerve

Assume there are more coming

Do not rely on whistles

Buckle up

Avoid driving at dawn or dusk

Use high beams when possible

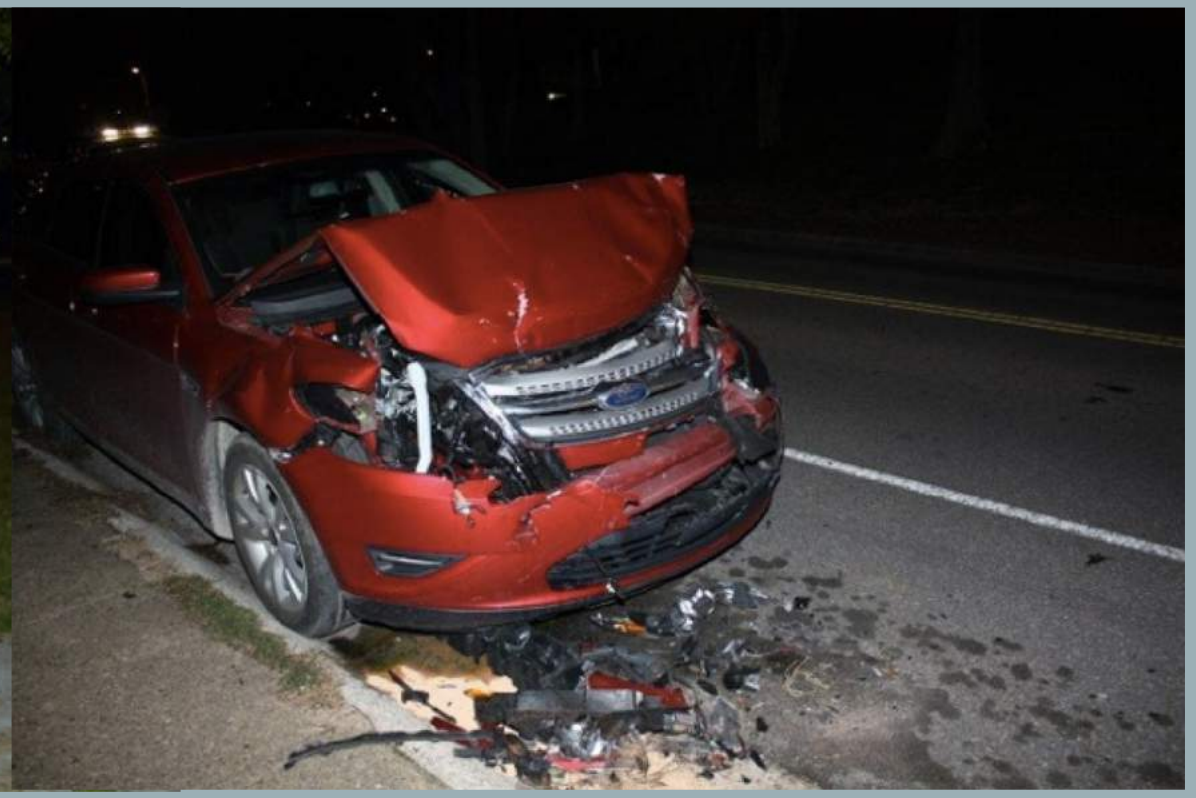
Pay attention to crossing signs

http://www.wildlifecollisions.ca/links.htm

WEIGHTS OF LARGE WILDLIFE

Moose: 840 – 1,500 lbs 	Red deer: 440 lbs 	Sika deer: 93 lbs
Reindeer: 350 – 400 lbs 	White-tailed deer: 150 lbs 	Mule deer: 120 – 330 lbs
Roe deer: 22 – 77 lbs 	Fallow deer: 100 – 180 lbs 	Sambar deer: 390 lbs
Elk: 710 – 730 lbs 	Chital: 79 lbs 	Barasingha: 370 lbs

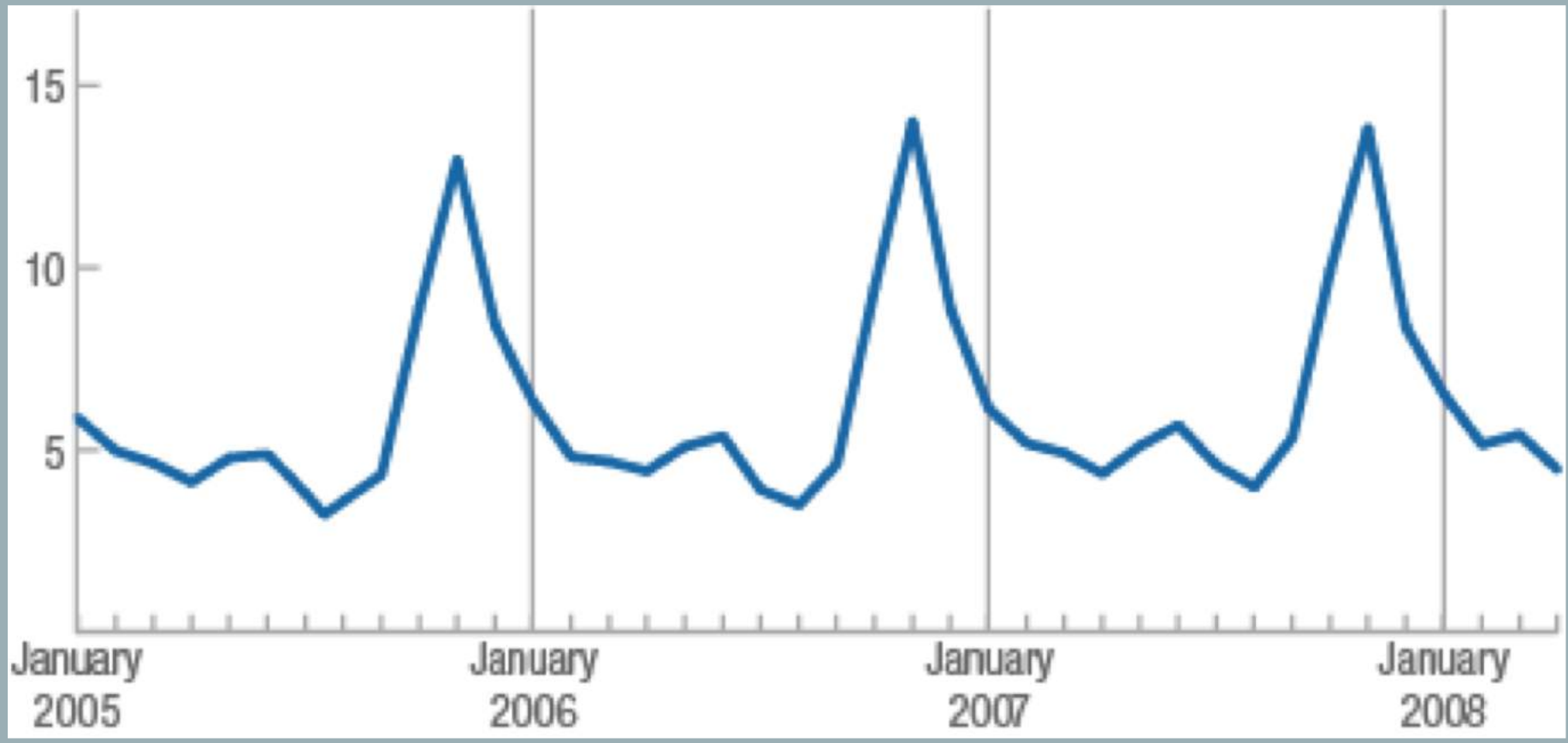
DAMAGE CAN BE COSTLY



The damage from deer collisions with vehicles can reach 4 billion dollars annually.

https://oakridgetoday.com/tag/deer/

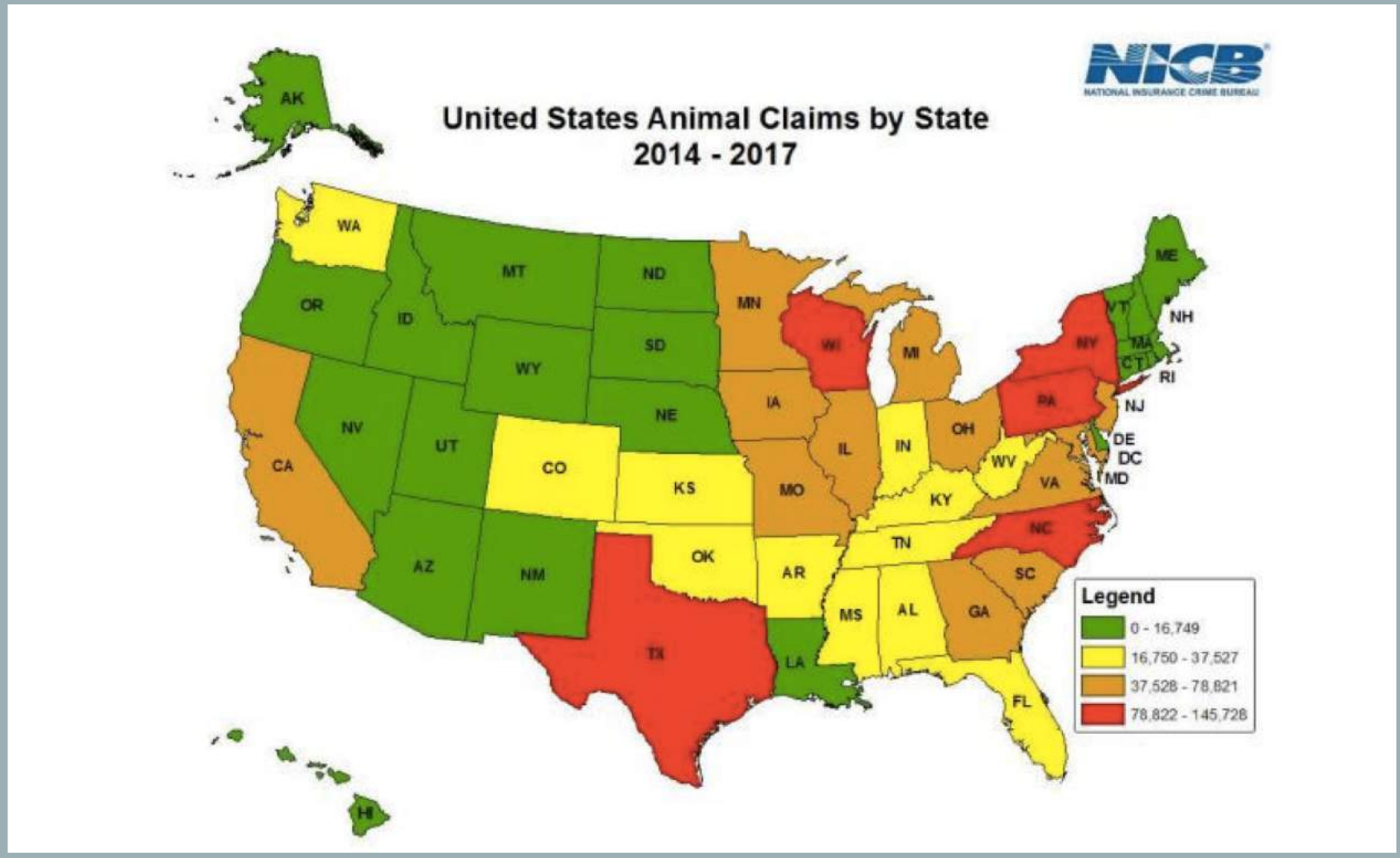
NOVEMBER IS PEAK MONTH FOR DEER COLLISIONS



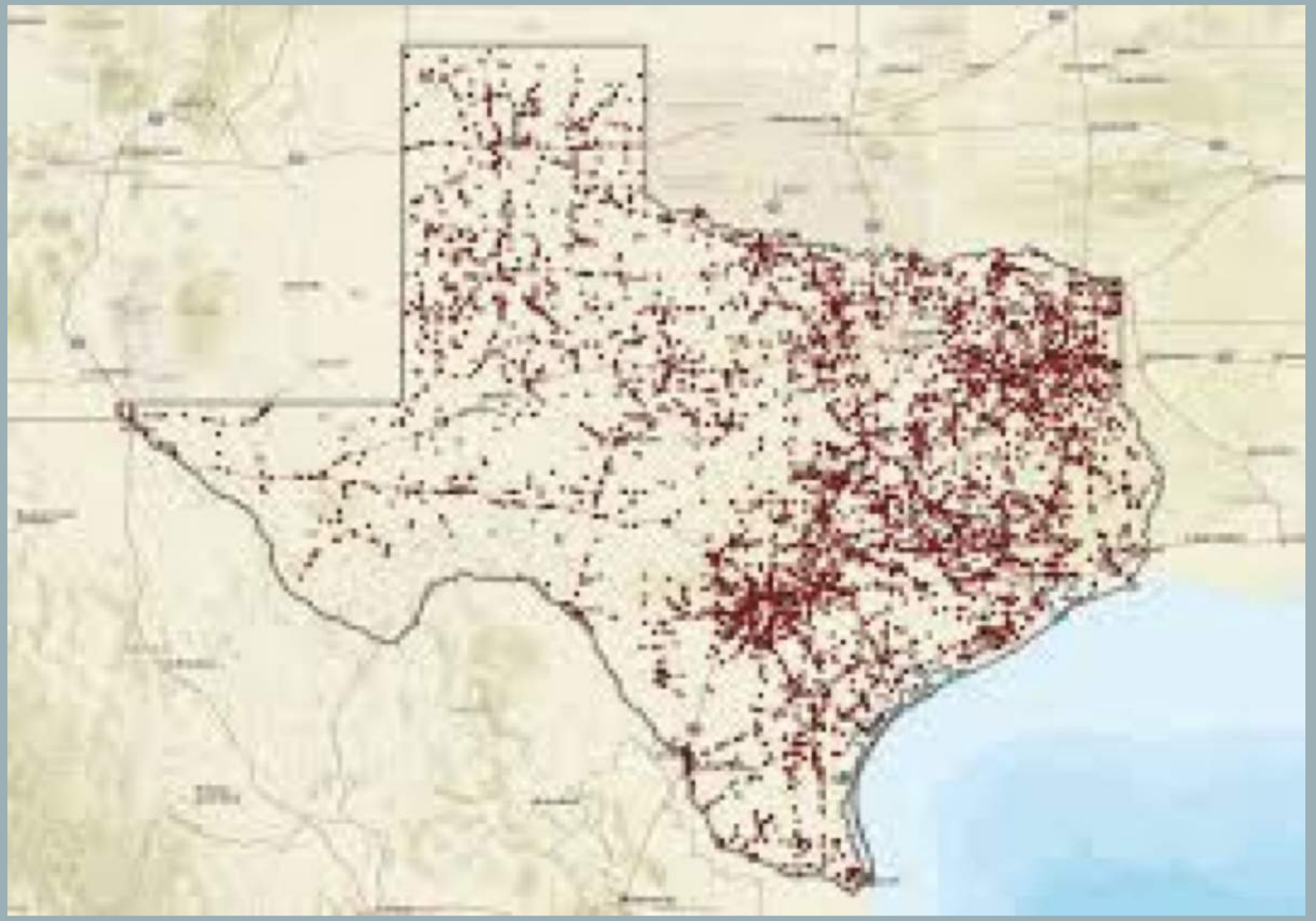
https://www.iihs.org/iihs/sr/statusreport/article/43/10/2

TOP 5 STATES FOR COLLISION CLAIMS

TEXAS MICHIGAN PENNSYLVANIA
NEW YORK NORTH CAROLINA



DEER DENSITY COLLISIONS IN TEXAS



http://www.caee.utexas.edu/prof/kockelman/public_html/TRB19AVCs.pdf

Preventing Animal Related Car Collisions

Why we chose this project:

We chose this project because there are many accidents yearly that are caused by animals and we want to help improve the ability to see the road and avoid collisions.

Problem

There are about 61,000 deer-car collisions on Texas roads yearly. Serious damage includes a crushed hood, shattered windshields, and in the case of deer collisions, an antler through the hood. The average price of these damages is $2,500. The main reason for these accidents is a dark road.

Hypothesis

If we illuminate the road with native plants that have reflective properties, then we will be able to prevent a considerable number of accidents and save lives.

Research

Our testing method requires us to plant multiple native grasses that possess reflective properties. We will test these specimens using a visual test and using an app that measures the lumens coming off the plant.

Procedure

Testing Plant Reflectivity by First Using Paper

We will be testing the amount of light reflected off surfaces on a scale from 0-10, 0 being black paper and 10 being white paper.

Triticale (rye-wheat cross) is a 7 on the visual reflective scale when measured on the app *Light Meter Pro*.

Black paper has the lowest amount of reflected lumens, white is the highest amount and all the other colors are in between.

1. Plant multiple species of native grasses known to grow well in this region of Texas from seedlings.
2. Water the plants with 50 mL water every day.
3. Plant seeds of blue grama, sideoats grama, and other light-colored seed tuft plants in cups and water them every other day with 25 mL of water.
4. Once they are 5 inches tall, measure the amount of reflected light coming off the various plants using an app meter.
5. Record results in lumens.
6. Prepare data tables and graphs.
7. Analyze the reflectivity of native grasses and make recommendations for seed dispersal along roadways.

Materials

- Triticale *(Triticosecale*) rye-wheat hybrid
- Sideoats grama (*Bouteloua curtipendula*)
- Blue Grama (*Bouteloua Gracilis*) native grass
- Little Bluestem (*Schizachyrium scoparium*)
- Big Bluestem (*Schizachyrium aldous*)
- Galleta Grass (*Pleuraphis jamesii*)
- Measuring tape
- Potting Soil
- Plastic Cups
- Plastic Bowls
- Measuring Cups
- Shovel
- Cardboard box
- Plastic wrap
- Plastic containers
- Thermometer
- Paper towels
- Sharpie marker
- Tape
- Colored construction paper
- Water
- Lux Light Meter App
- Smart phone

Results

Visual Test

Scale for Visual Determination:
Black-0
White-10

Triticale: 7

Side oats Grama: 5

Blue Grama: 2

Galleta Grass: 6

Little Bluestem: 6

Big Bluestem: 3

Table Demonstrating
Reflective Colors and Corresponding Numbers

0	1	2	3	4	5	6	7	8	9	10
										

Average Lumens Measurement

Triticale: 26264

Side Oats Grama: 1586.4

Blue Grama: 917.8

Galleta Grass: 2154

Little Bluestem: 3074.6

Big Bluestem: 6547

Conclusion

After testing, it was determined that big bluestem and little bluestem were the native grasses with the greatest potential for use on roadways due to their highly reflective nature. With an average amount of light reflected of 6547 and 3075 lumens, they can increase the amount of light on the roadway by 30% and allow a driver a quicker reaction time for spotting wildlife thanks to increase visibility.

Variables

Independent Variable:

Different seeds used and different plants used

Dependent Variable:

Total quantity of visible light emitted by the plant (in Lumens, lm)

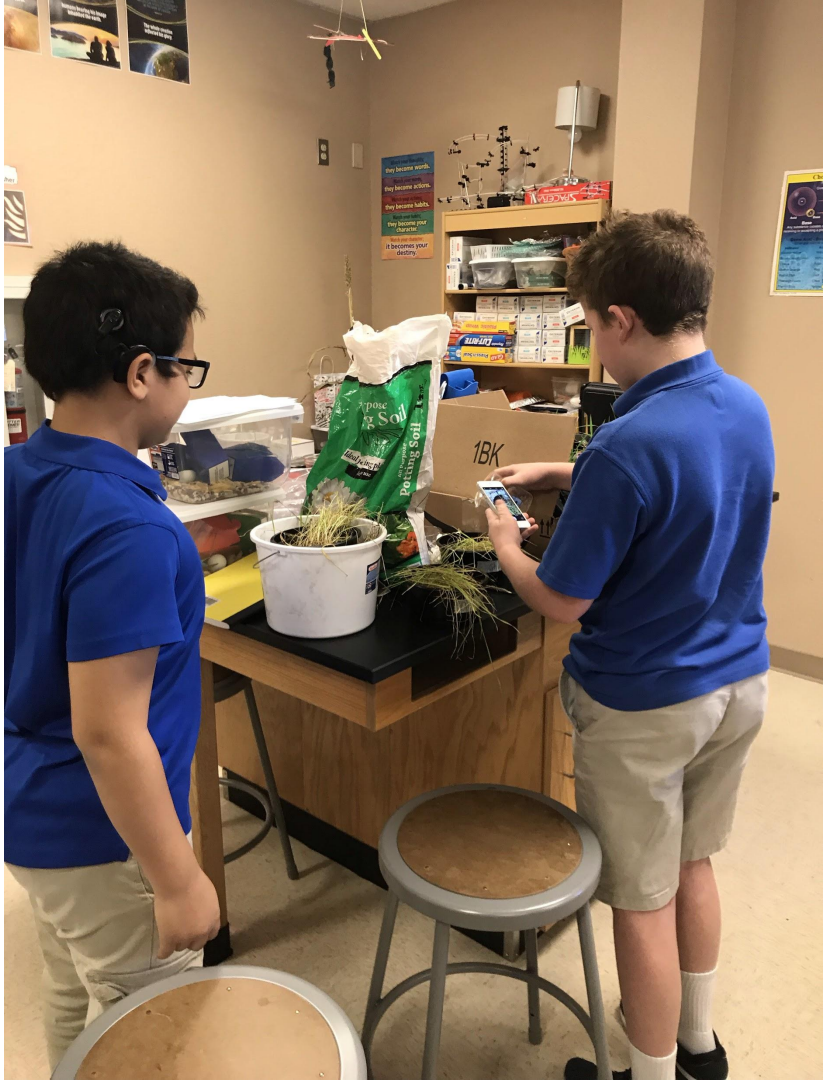
Constant Variables:

Amount of water, light, and temperature

Learning to use a luminance meter to determine retroreflectivity

Testing the lums coming off a highway sign

Testing various colors for the amount of reflection using instruments with TX DOT supervisors



Measuring lums of native grasses - big bluestem grown near Waco.

Taping the greenhouse to trap moisture inside

Creating a homemade greenhouse to help triticale...

Signage acts as a warning but deer-car collisions continue to increase 7% annually since 2012

Starting native grasses from seed ...

COLLISION AND TRANSPORTATION EXPERTS

A collection of interviews and collaborations between the team and regional experts

Questions Answers Teamwork Photos Lab Experiences Advice

OH DEER

ECYBERMISSION 2019

INTERVIEWS & COLLABORATIONS

- Texas Department of Transportation TXDOT
- Michael Wittie, Area Engineer TXDOT
- Shelley Harris, Design Engineer
- Jeremy Dearing, Traffic Engineer
- Edvin Hartfield, Environmental Inspector, TXDOT
- Karen Bradshaw, Environmental Specialist, TXDOT
- Laura Wilbanks, Wildlife Biologist, Texas Master Naturalist
- Pat Pearson, Range Botanist, Bamert Seed Company
- Dr. Michael Hickey, Physicist, Southcrest Christian School

TEXAS DEPARTMENT OF TRANSPORTATION

Interviews with the Texas Department of Transportation

Members of Tx.dot shows how to use a reflectometer.

Testing the retroreflectometer as a team.

Aaron Uses the reflectometer

Isaiah uses the reflectometer

Caleb use the reflectometer

Greenhouse for Triticale

Designing a greenhouse

Color and Reflectivity Experiment

Oh, Deer!
A 7th Grade STEM Research Team

Experiment Purpose

We designed an experiment to test the reflective properties of color using paper of various shades. We utilized a color scale with black paper as a zero and white paper as a ten with gradual number changes by color that was determined by shining white light onto the paper and measuring its brightness.

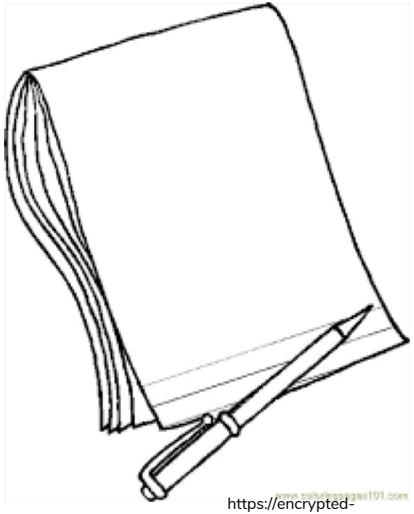
Variables

- Controlled Variables:
  - Distance standing from the paper.
  - Same kind of light source.
- Independent Variables
  - Colors of the paper.
- Dependent Variables
  - The visibility of the paper

Materials

- Flashlight for a light source
- Paper of various colors
- Dark room
- Notepad
- Pencil

The paper emits a level of light which we rate the colors that are the most reflective.



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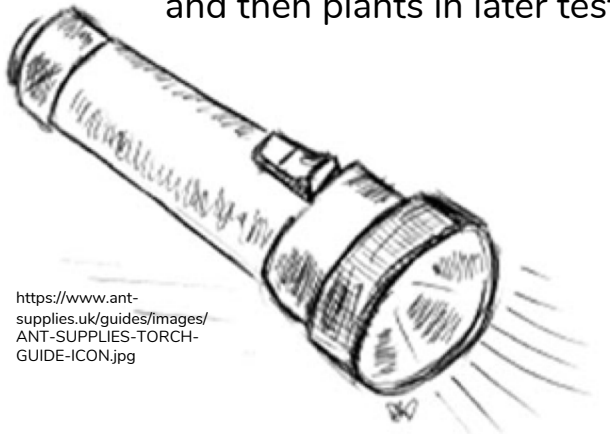
Flashlight shines on the paper and then plants in later tests ...



https://www.ant-supplies.uk/guides/images/ANT-SUPPLIES-TORCH-GUIDE-ICON.jpg

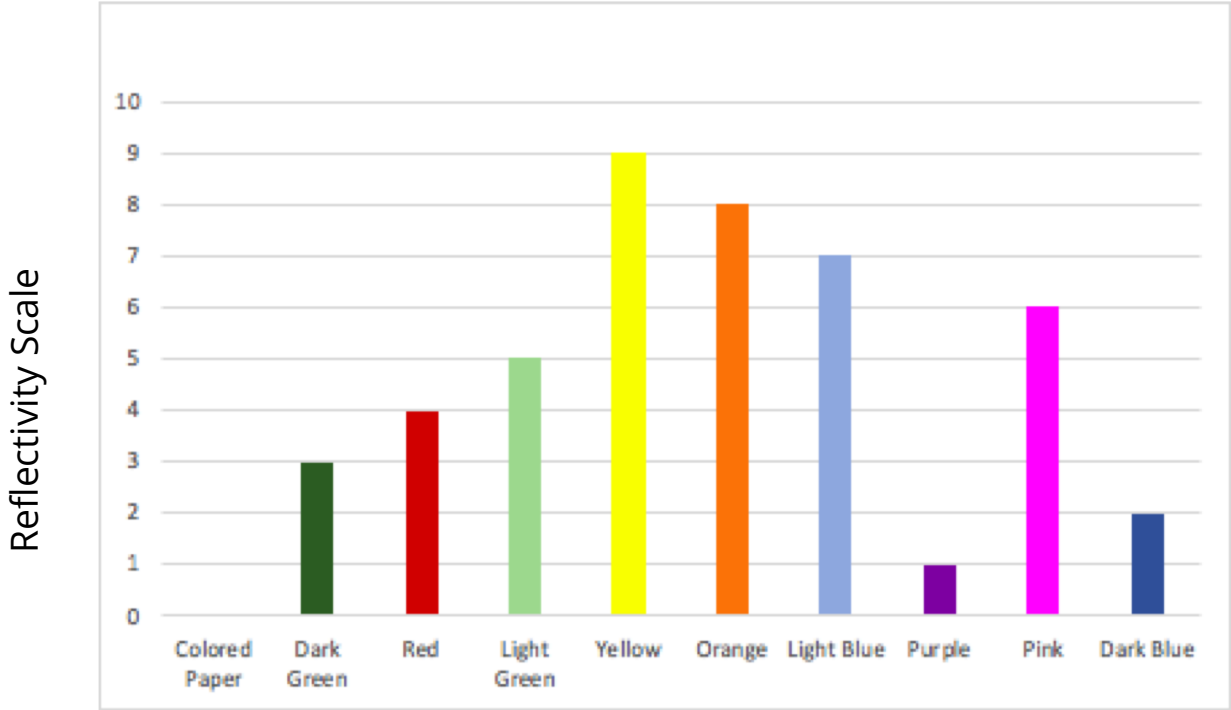
Plant reflects the light...

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRRXhF3_UYWf4RSonp_mCDE6b9HNa03_dMz7897pXvQp5tPiezgAQ

Data from Paper Reflectivity Testing

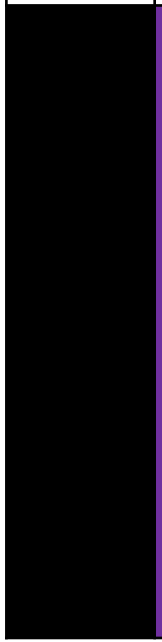
Colored Paper	Average Reflectivity by Visual Observation
Dark Green	3
Red	4
Light Green	5
Yellow	9
Orange	8
Light Blue	7
Purple	1
Pink	6
Dark Blue	2

Graph of Colors following Reflectivity Test



Colors and how much light is Absorbed

Table Demonstrating Reflective Colors and Corresponding Numbers Least Reflective to Most Reflective

0	1	2	3	4	5	6	7	8	9	10
										

Results

Based upon the testing, we determined the shades used in this investigation go in order from most absorbent black to most reflective white. The colors in between are purple, dark blue, dark green, red, light green, pink, light blue, orange, yellow. These shades were then used to create a visual comparison chart for ranking plants informally, followed by the use of a lumens app on phones to get exact measurements of reflection.

Investigation #3: Plants and Reflectivity

Oh, Deer!

A 7th Grade STEM Research Team

Ecybermission 2018 - 2019

Experiment Purpose

We designed an experiment to test the visibility of a native plant's reflective properties on paper with the paper standing for the animal.

Experiment Procedure

1. Utilize a color scale with black paper as a zero and white paper as a ten with gradual number changes by color in between.

2. This scale was determined by conducting an experiment using white light and its ability to reflect off various colors.

3. Once we learned which was most reflective, the colors were ordered from 0 to 10 and the scale was then used to record reflectivity of plants.

4. Place each of the native grasses and shine white light on each one.

5. Use the visual color scale to determine basic reflective properties for each.

6. Repeat for accuracy and and find the average for tables and graphs.

Variables

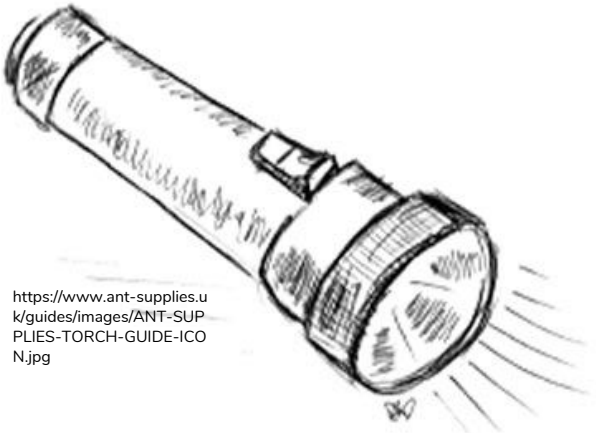
- Controlled Variables:
  - Distance standing from the plants.
  - Amount of water, soil, and seeds planted.
  - Same kind of light source.
- Independent Variables
  - Colors of the paper.
- Dependent Variables
  - The visibility of the paper depending on color.

Materials

- Triticale seeds (Triticosecale)
- Blue grama
- Sideoats grama
- Galleta grass
- Little bluestem
- Big bluestem
- Flashlight for a light source
- Paper for the independent variables
- Water
- Soil

Flashlight shines on the plant...

The paper emits a level of light which we rate the colors that are the most reflective.



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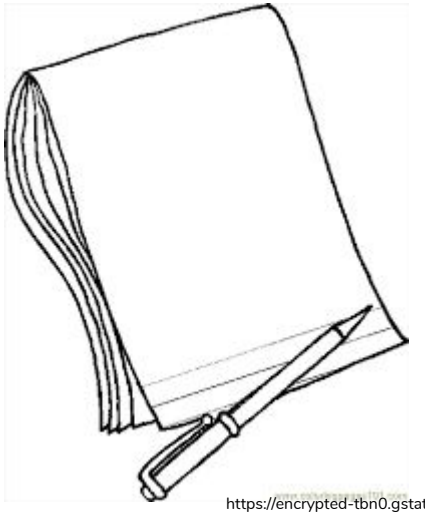

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Plant reflects the light...

https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRRXhF3_UYWf4RSonp_mCDE6b9HNa03_dMz7897pXvQp5tPiezgAQ

Data from Paper Reflectivity Testing

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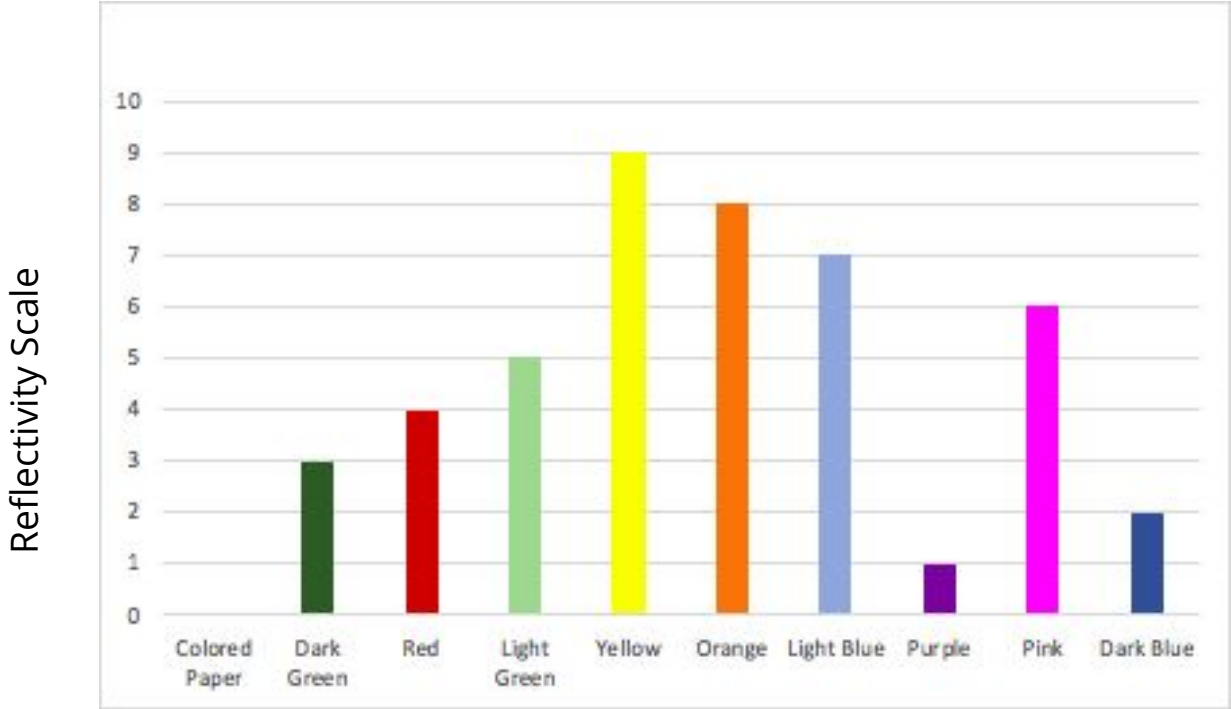
Graph of Colors following Reflectivity Test



Colors and how much light is Absorbed

Table Demonstrating Reflective Colors and Corresponding Numbers Least Reflective to Most Reflective

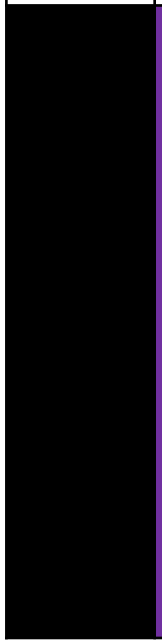
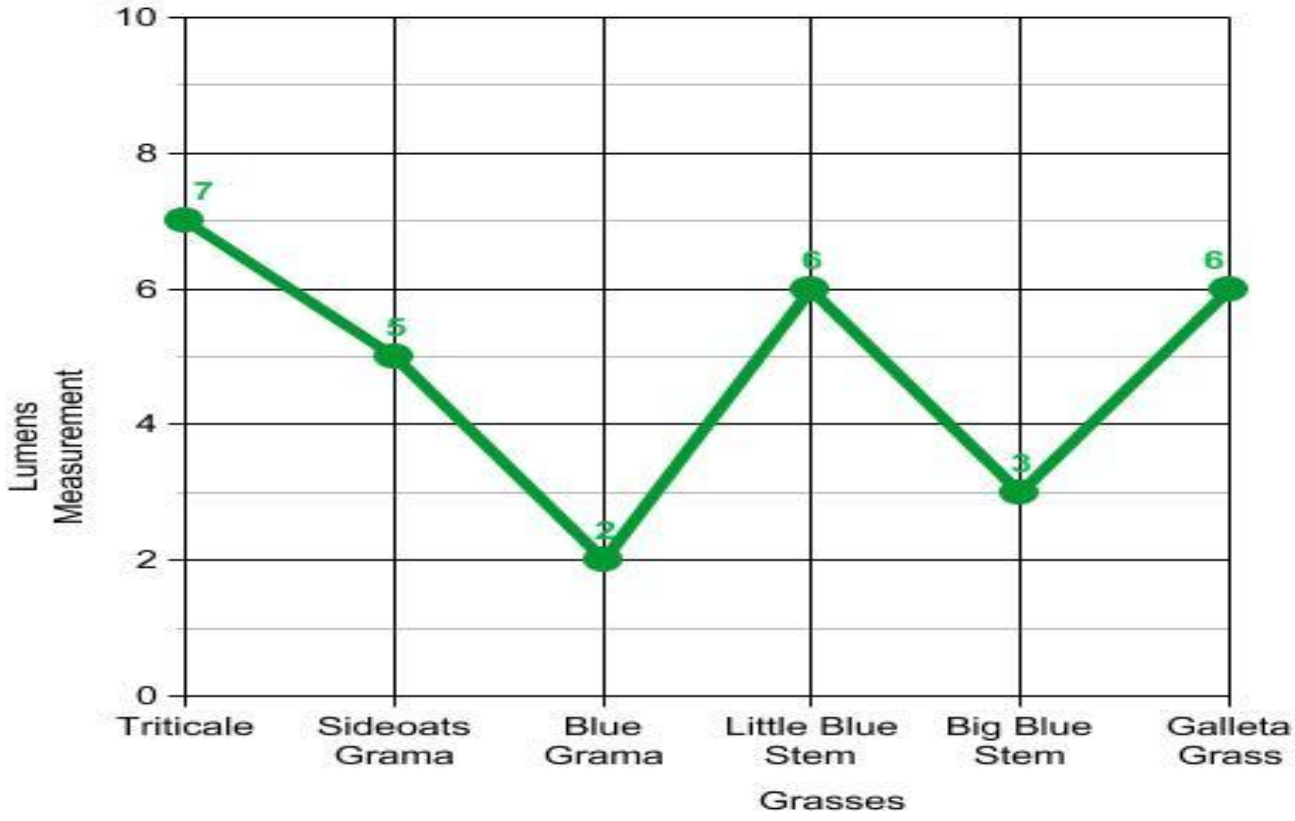
0	1	2	3	4	5	6	7	8	9	10
										

Chart of Data from Plant Reflectivity Testing

Grasses	Test 1	Test 2	Test 3	Average
Triticale	6	8	7	7
Sideoats Grama	5	5	5	5
Blue Grama	2	3	2	2.3
Galleta Grass	6	6	6	6
Little Bluestem	5	6	5	5.3
Big Bluestem	3	2	3	2.7

Visual Graph of Plant Reflectivity



Results

Based upon the testing, we determined that triticale had the highest reflective number with an average of 7 out of 10 on the visual scale. Triticale is a grain and although it has a great reflective index, it could be attractive to deer as a food source since it is a hybrid cross between rye and wheat. The next highest reflective value is Next to the Triticale, the next two with the highest reflectivity are Galleta grass and Little Bluestem. These native grasses would be ideal for planting on roadsides to shine reflected light onto the roadway. The two lowest in reflectivity were Blue Grama with a reading of 2 and Big Bluestem with a reading of 3.

Plants and Reflectivity in the Field

Oh, Deer!
A 7th Grade STEM Research Team
eCYBERMISSION 2018-2019

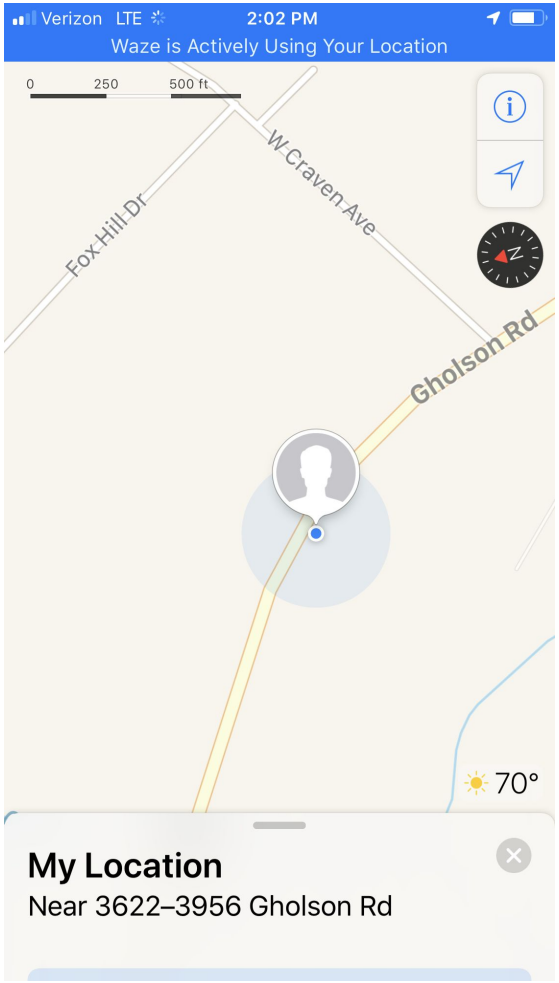
Procedure

We decided to test our hypothesis in the field. We did two separate studies -- one in Waco, Texas and one in Lubbock, Texas. To properly test our theory, we chose three separate plant locations and measured the lumens five times in each site both during the day and at night.

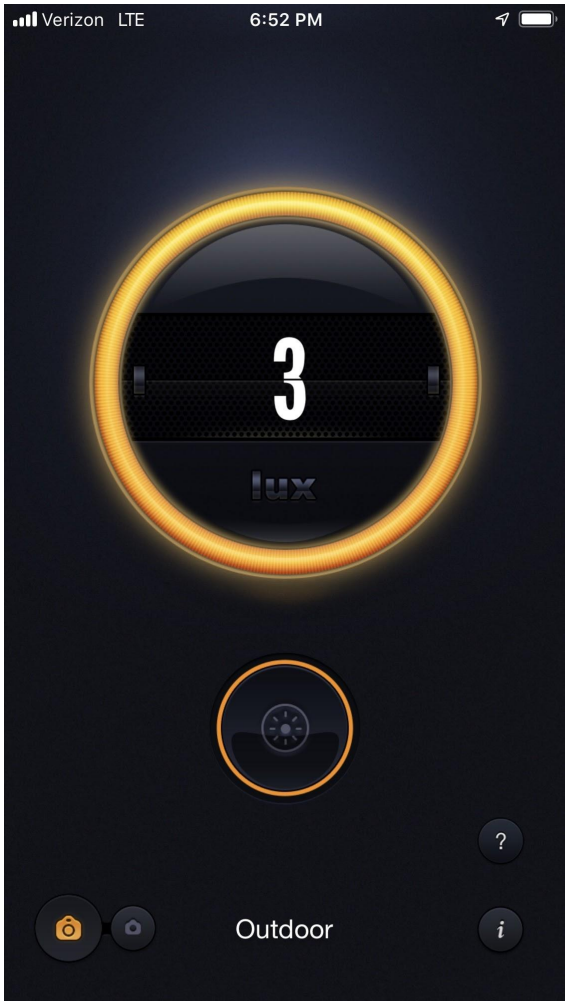
Waco Testing Procedure

Caleb Cole-Smith's family happened to be in Waco over Christmas break, which provided an opportunity to test and gather samples of live grass. We found three areas by the side of the highway and tested lumens five times in the day and in the night. We gathered a grass sample at each of the three sites, brought them back to our school lab, planted them and then prepared them for further testing.

Location of first sample in Waco

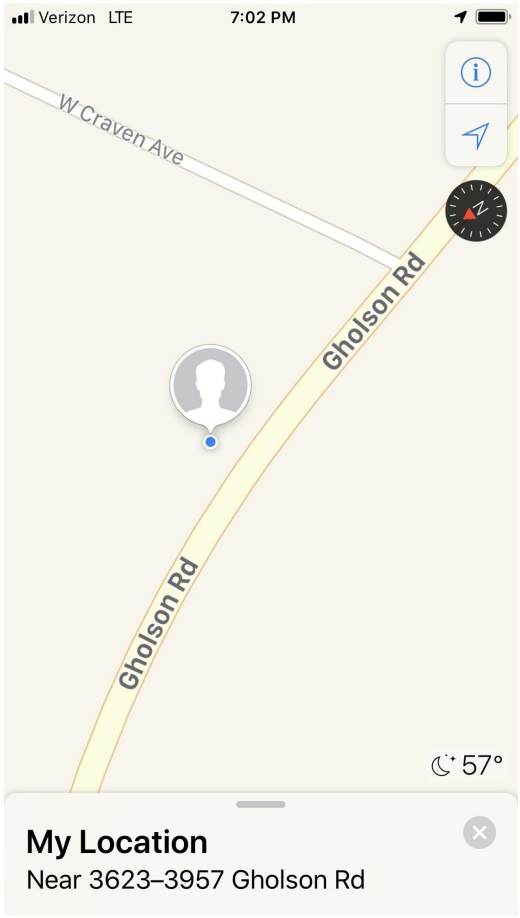


Retrieving sample from first location

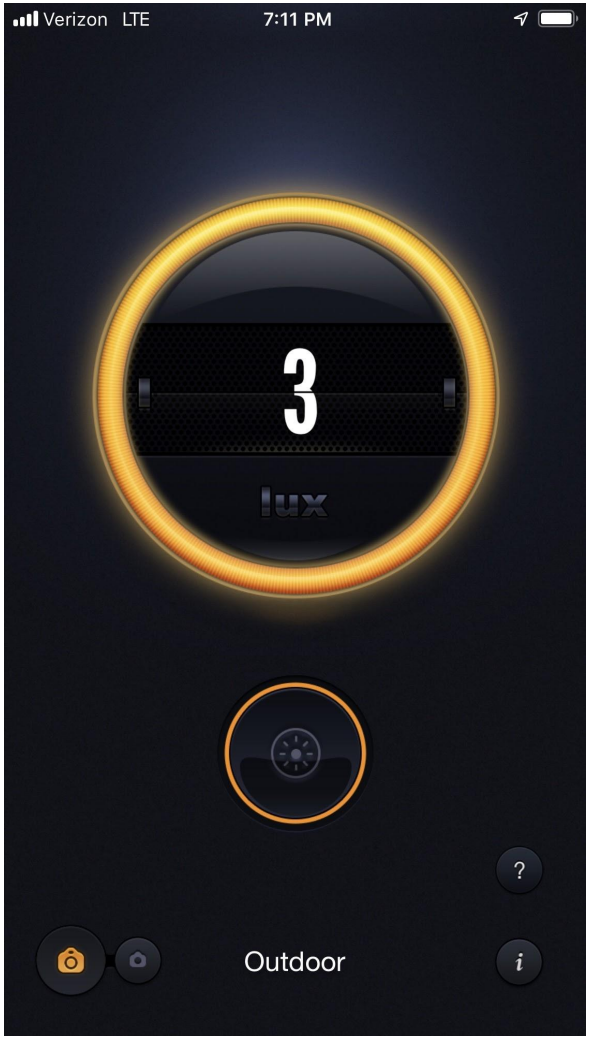


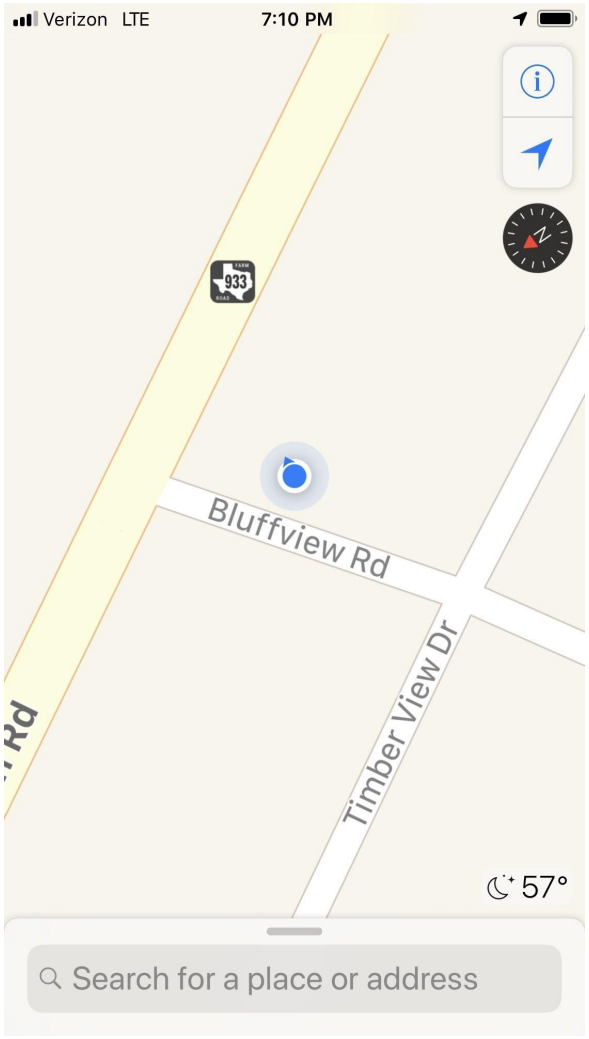
Lumens measurement of second sample at nighttime.

Location of second sample.



Lumens measurement of third sample





Location of third sample

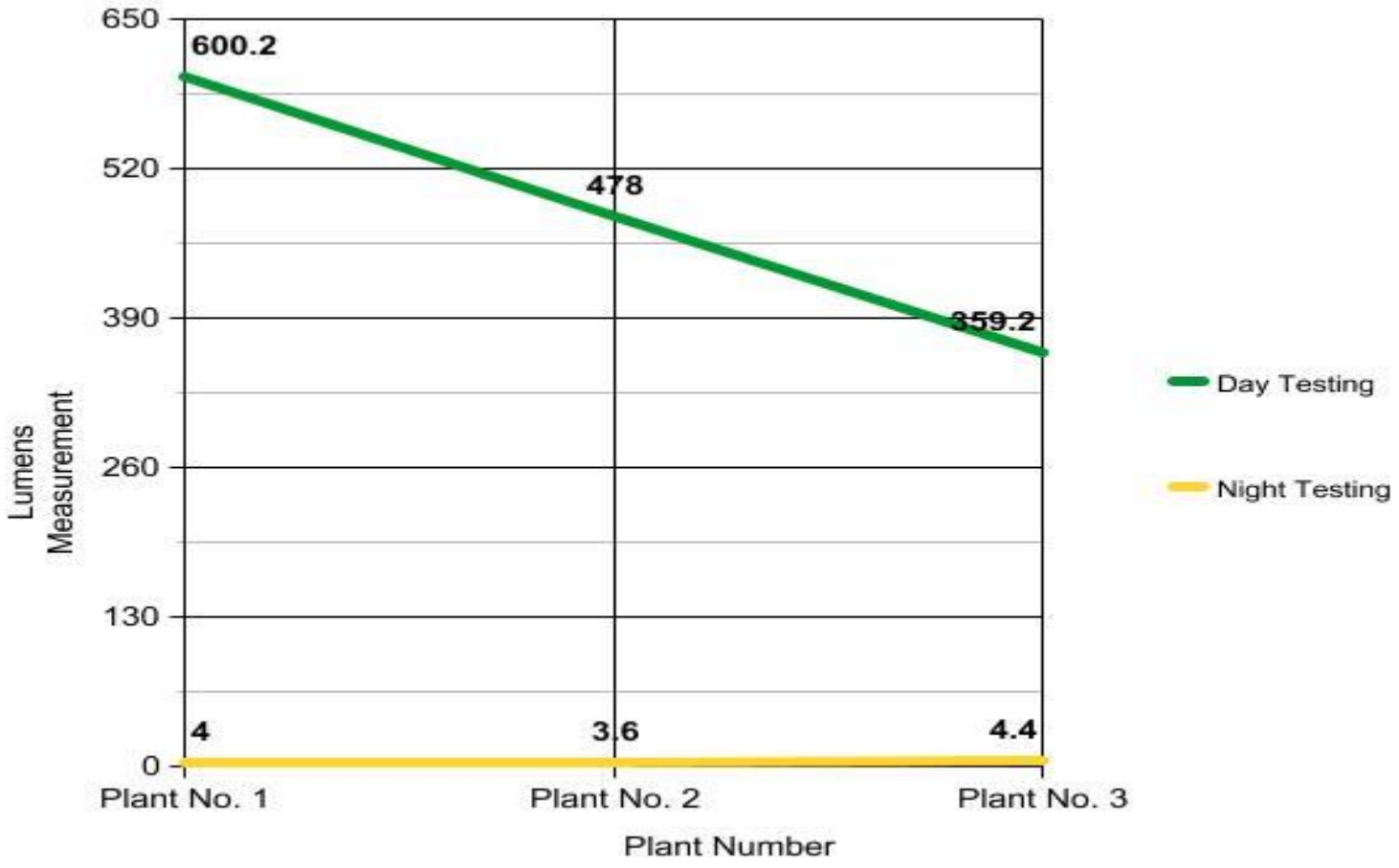
Data from Waco Daytime Test

Plant	Test	Test 1	Test 2	Test 3	Test 4	Test 5	Average
Plant 1		663	675	594	537	532	600.2
Plant 2		441	463	531	467	488	478
Plant 3		312	385	374	403	322	359.2

Data from Waco Nighttime Testing

Plant	Testing	Test 1	Test 2	Test 3	Test 4	Test 5	Average
Plant 1		5	5	4	4	5	4
Plant 2		3	3	4	3	3	3.6
Plant 3		5	3	4	5	5	4.4

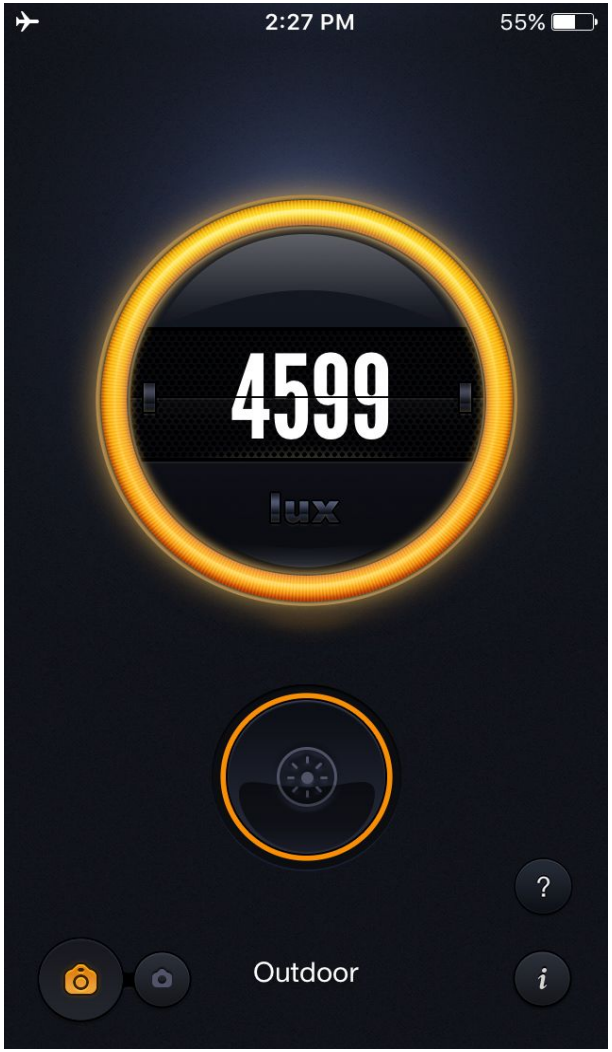
Graph for Day and Night Testing in Waco

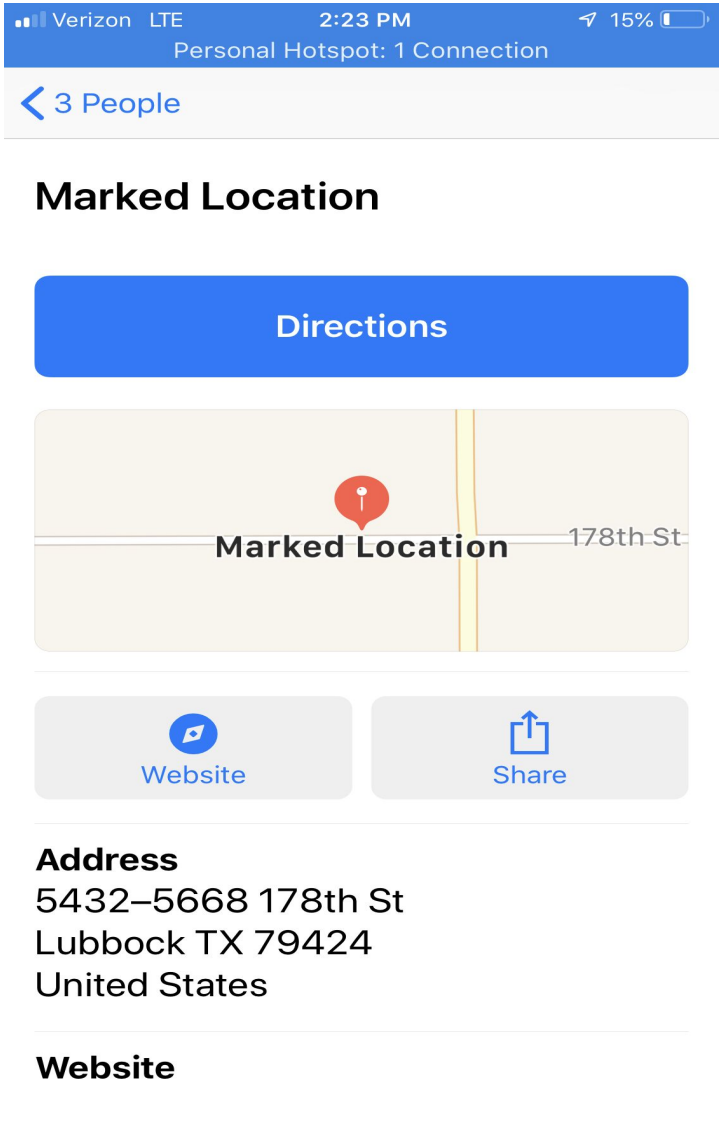


Lubbock Testing Procedure

We did a second field test in Lubbock, our hometown. Three of us were able to meet in an area of Lubbock and conducted a sample during the day. We pintpointed three sites in the area and took five lumens test during the day. Our teammate Aaron Barbee returned in the evening and took lumens measurements for the same sites in the evening. We also took samples at this location which were brought back to the school to continue to grow and conduct further testing.

Sample lumens measurement.





Location of Lubbock site where three samples were obtained in this area.

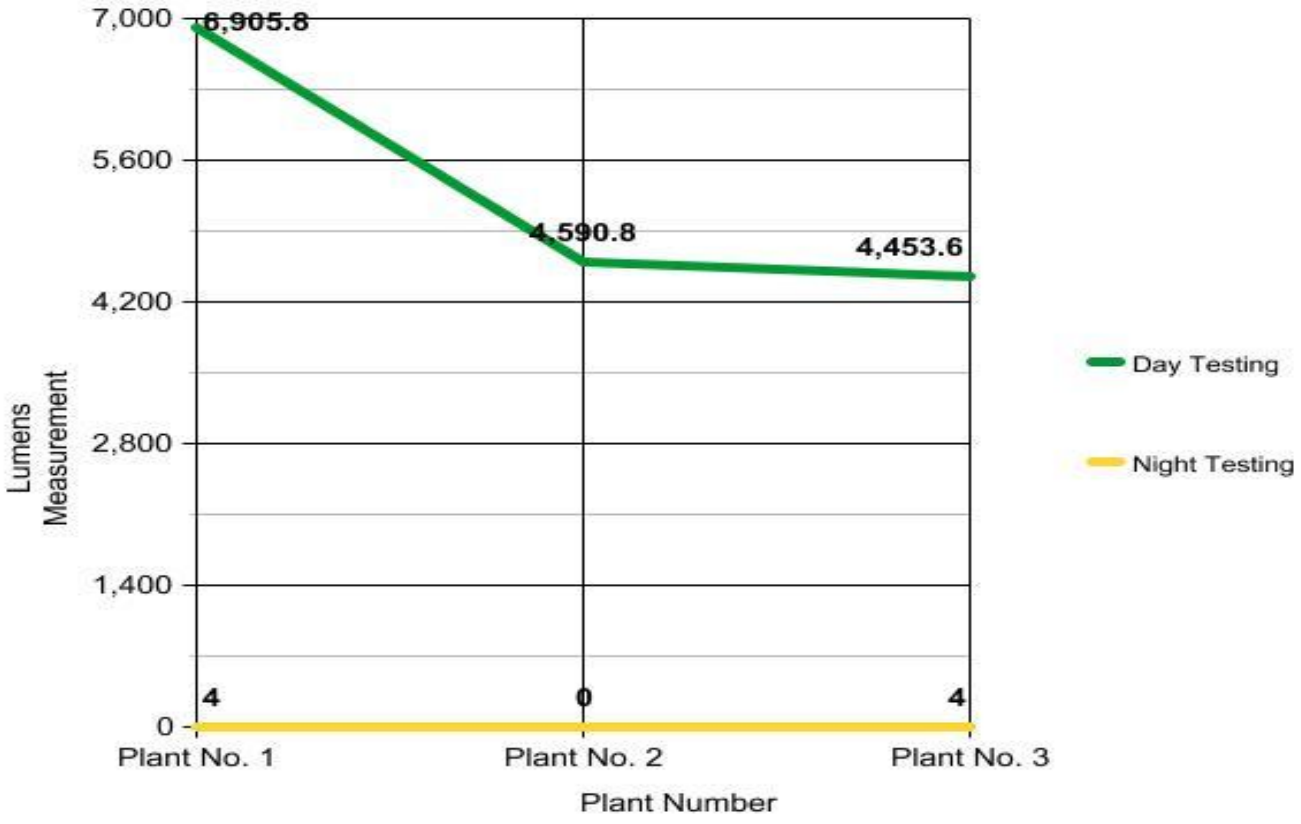
Data from Lubbock Daytime Test

Plant	Test	Test 1	Test 2	Test 3	Test 4	Test 5	Average
Plant 1		7043	6263	6840	7238	7165	6,905.8
Plant 2		4592	4569	4590	4604	4599	4,590.8
Plant 3		5118	5050	4589	3754	3757	

Data from Waco Nighttime Testing

Plant	Testing	Test 1	Test 2	Test 3	Test 4	Test 5	Average
Plant 1		4	4	4	4	4	4
Plant 2		0	0	0	0	0	0
Plant 3		5	3	4	5	5	4.4

Results from Lubbock Field Testing



Results from Field Tests

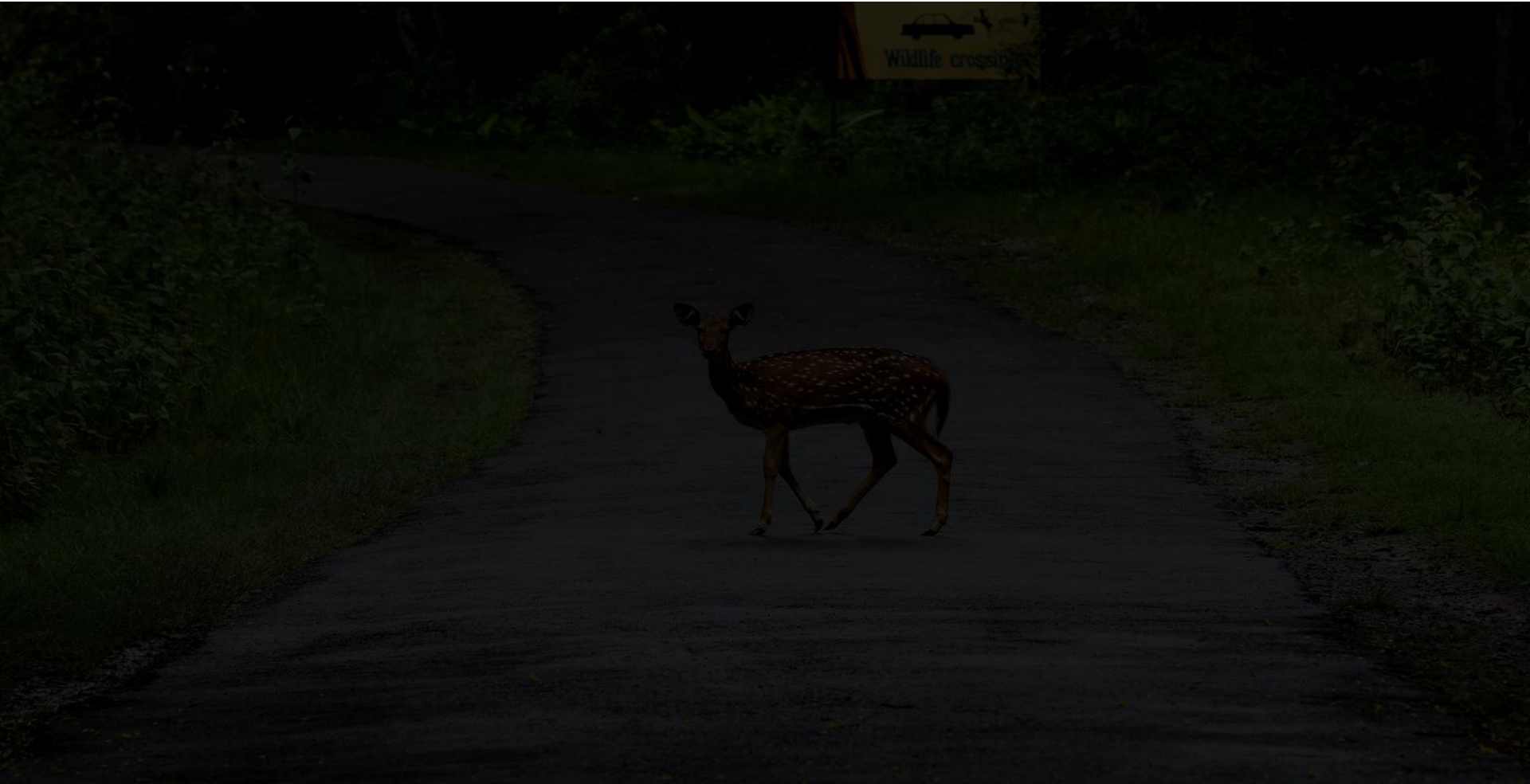
After reviewing the data from the field test in Waco and the field test in Lubbock, we found there is a stark difference in the daytime tests in those locations. Specifically, the lumens measurements in Waco were between 2000-3000 less than Waco. When we examined the samples recovered from Waco, we found that these were Big bluestem. Big bluestem has a significantly lower reflectivity than the other grasses tested. The stems and the seed heads are a dark red color and do not reflect light as well as little bluestem or galleta grass.

In addition, there is a significant difference between the day testing and the night testing in both locations. We attribute this to the skewed reflectivity from the differing light sources including the moon, headlights and surrounding homes.

Wildlife Detection Lighting Investigation and Survey

AVERAGE OF FOUR CLICKS

For each slide below, slowly adjust the lighting on the computer from dark to light and ask the test subject to say when they see the deer.
Record the time it takes them to see the deer and how much light in percentages was used before the person could see it.
Record in a data table and graph results.


Wildlife crossing

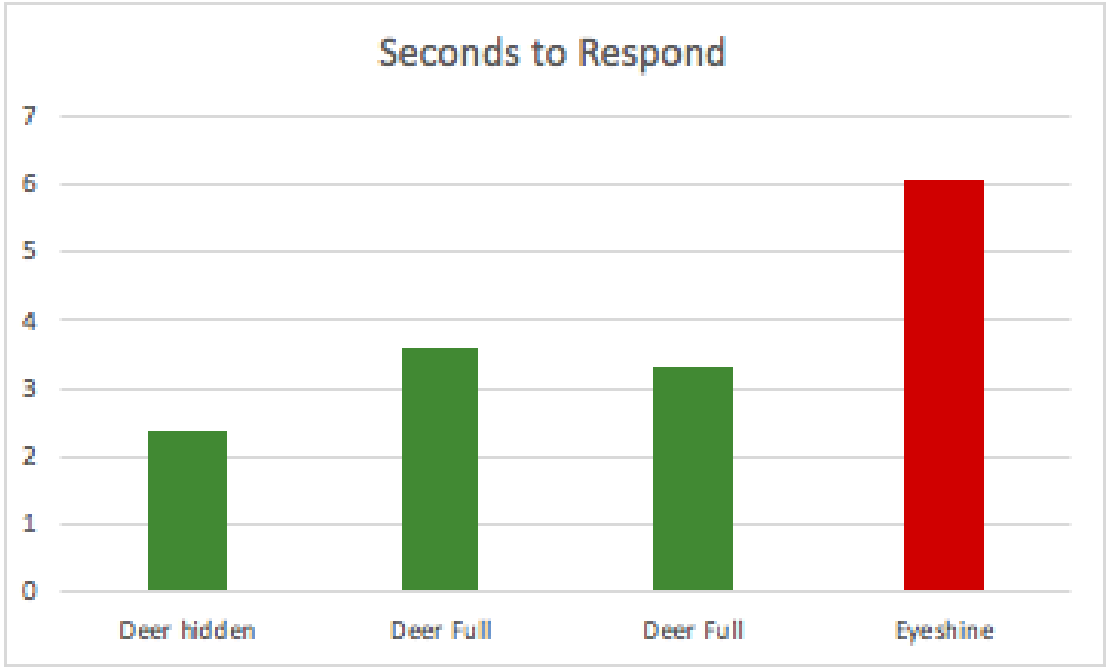
Testing Results By Seconds

Results in grey appear to be unreasonable and statistically would be considered outliers.

The averages if these are not considered are shown in red

Person	Test 1	Test 2	Test 3	Test 4
1	2.32	1.89	2.62	3.13
2	1.70	1.53	1.62	4.56
3	2.40	1.65	1.25	4.42
4	2.75	1.66	4.29	4.23
5	2.69	1.35	3.13	2.26
6	12.1	2.64	3.78	9.69
7	15.29	7.81	2.24	10.4
8	31.66	7.96	5.25	9.92
9	19.67	5.66	5.83	26.94
10	30	17.62	15.42	11.73
Average	12.058 **2.37**	4.977 **3.57**	4.543 **3.33**	8.724 **6.08**

Data Analysis



With outliers removed, the following are average seconds required to spot a deer in these positions and apply the break. If the time is under 4 minutes, this is enough time to brake and avoid a collision. With 20% increase in light from reflected plants, 75% of the drivers were able to spot the deer and stop in time. Our hypothesis was supported.

Results of Deer Crossing Visual Test

Based upon our results, we found that the first and the fourth slide showed a slower reaction rate. We are speculating that the reactive rate is slower in the first slide because the deer is located on the side of the road, unlike the second and third slides where a full body shot is available. We also are speculating that the fourth slide has a slower reaction time because the location of the deer is identified by eye shine, which causes more difficulty in locating the deer.

75% of the time with added light of 20%, drivers could avoid collisions. This lets us know that light is a factor and worth pursuing in the solution. The use of reflective plants that would cast light on the road could make a difference in many communities.

The Purpose of the Materials Tested

Plants	Properties	Reflectivity	Deer Repels
Blue Grama	Yellow tops	Highly reflective	Possible food
Galleta grass	White Seed tops	Reflective	Not likely to eat
Sideoats grama	White stems	Reflective	Possible food
Little bluestem	white stems and tops	Highly reflective	Not likely to eat
Big Bluestem	tall with red stem and tops	Absorbs light	Not likely to eat

Join in protecting wildlife and humans

Oh, Deer!

Prevent deer collisions on roads

Bibliography

"AAA Exchange." *Auto Collision Tips*, 2016,

exchange.aaa.com/automotive/roadside-assistance/auto-collision-tips/.

"Avoid a Deer-Car Collision." *III*, www.iii.org/article/avoid-a-deer-car-collision.

Bartlett, Jeff S. "How to Avoid Collisions With Deer This Fall." *Product Reviews and Ratings - Consumer Reports*,
www.consumerreports.org/car-safety/how-to-avoid-collisions-with-deer-this-fall/.

Bradshaw, Karen. Environmental Specialist. Texas Department of Transportation. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. October 17, 2018.

Clayton, M.K. "Introduced Bluestem Grasses: Management on Native Lands." *Texas A & M Agrilife Extension*, forages.tamu.edu/PDF/ERM036-Introduced-Bluestem-Grasses.pdf.

"Culture of Safety" Driving and Deer vs. Car Collisions. 14 Sept 2017

Deer Weight Chart." *Wildlife-Related Diseases*,
www.pgc.pa.gov/Wildlife/WildlifeSpecies/White-tailedDeer/Pages/DeerWeightChart.aspx.

Deering, Jeremy. Traffic Engineer. Texas Department of Transportation. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. October 17, 2018.

"11 Tips For Avoiding Collisions With Wildlife." *Farmers' Almanac*, Farmers' Almanac, 12 Oct.

2018.

"Facts + Statistics: Deer Vehicle Collisions." *III*, 17 Nov. 2017,

"Galleta Grass (Pleuraphis Jamesii)." *Great Basin Seeds*.

greatbasinseeds.com/product/galleta-grass/.

Harris, Shelley. Design Engineer. Texas Department of Transportation. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. October 17, 2018.

Hartfield, Edvin. Environmental Inspector. Personal Interview by Isaiah Baeir, Aaron Barbee, and Caleb Cole-Smith. October 17, 2018.

Hasco, Linda. “In Which Pa. Counties Are You Most Likely to Hit Bambi?” *PennLive.com*, PennLive.com, 23 July 2018,

“Hertz.” *Annenberg Learner*, www.learner.org/courses/physics/glossary/definition.html?invariant=hertz.

Hickey, Michael. PhD Physics. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. September 17, 2018.

“Hornet Deer Whistle, Avoidance System Cars.” *A Safer Life Starts Here(R)*, www.safehomeproducts.com/shp2/SM/HORNET-DEER-REPELLER.ASPX.

“In Wyoming, A Solution To Wildlife Traffic Accidents.” *Science Friday*,

“Lewisville Lake Environmental Learning Area.” *Lewisville Lake Environmental Learning Area | LLELA Home*, www.llela.org/about-llela/habitats/prairie-restoration.

Montana Fish, Wildlife & Parks :: Principles of Wildlife Management, fwp.mt.gov/hunting/.

“Mother Neff State Park.” *Texas Parks and Wildlife*, 16 Oct. 2018, tpwd.texas.gov/state-parks/mother-neff/nature.

NTSB Home. *National Transportation Safety Board (NTSB)*, www.ntsb.gov/Pages/default.aspx.

Pearson, Pat. Range Botanist. Bamert Seed Company. Muleshoe, Texas. Personal Interview by Aaron Barbee. October 29, 2018.

“Scientific Facts About How Deer See and Hear.” *Grand View Outdoors*, 30 Nov. 2018, www.grandviewoutdoors.com/big-game-hunting/whitetail-deer/scientific-facts-about-how-deer-see-and-hear.

Stacks, Daniel. “Roadside Vegetation Management Manual.” *Roadside Vegetation Management Manual*, 1 May 2018, onlinemanuals.txdot.gov/txdotmanuals/veg/veg.pdf.

Texas Department of Transportation. “Texas Department of Transportation.” *Texas-Mexico Border Crossings*, www.txdot.gov/.

“Texas Leads States in Deaths from Deer Collisions.” *Insurance Journal*, 4 Nov. 2015,

Pudenz, Jennifer. “How to Hunt Native Warm-Season Grasses | QDMA.” *Quality Deer Management Association*, 18 July 2016, www.qdma.com/hunt-native-warm-season-grasses/.

Parks Canada Agency, and Government of Canada. “Parks Canada.” *Toronto Maple Leafs - History and Culture*, 25
Feb.

Wachtel, Jerry. “REPORT ON DIGITAL SIGN BRIGHTNESS.” *REPORT ON DIGITAL SIGN BRIGHTNESS*, Nov. 2014,

“Wildlife-Vehicle Collision Reduction Study: Report To Congress.” *U.S. Department of Transportation/Federal Highway Administration*,

“White-Tailed Deer.” *National Geographic*, National Geographic, 21 Sept. 2018.

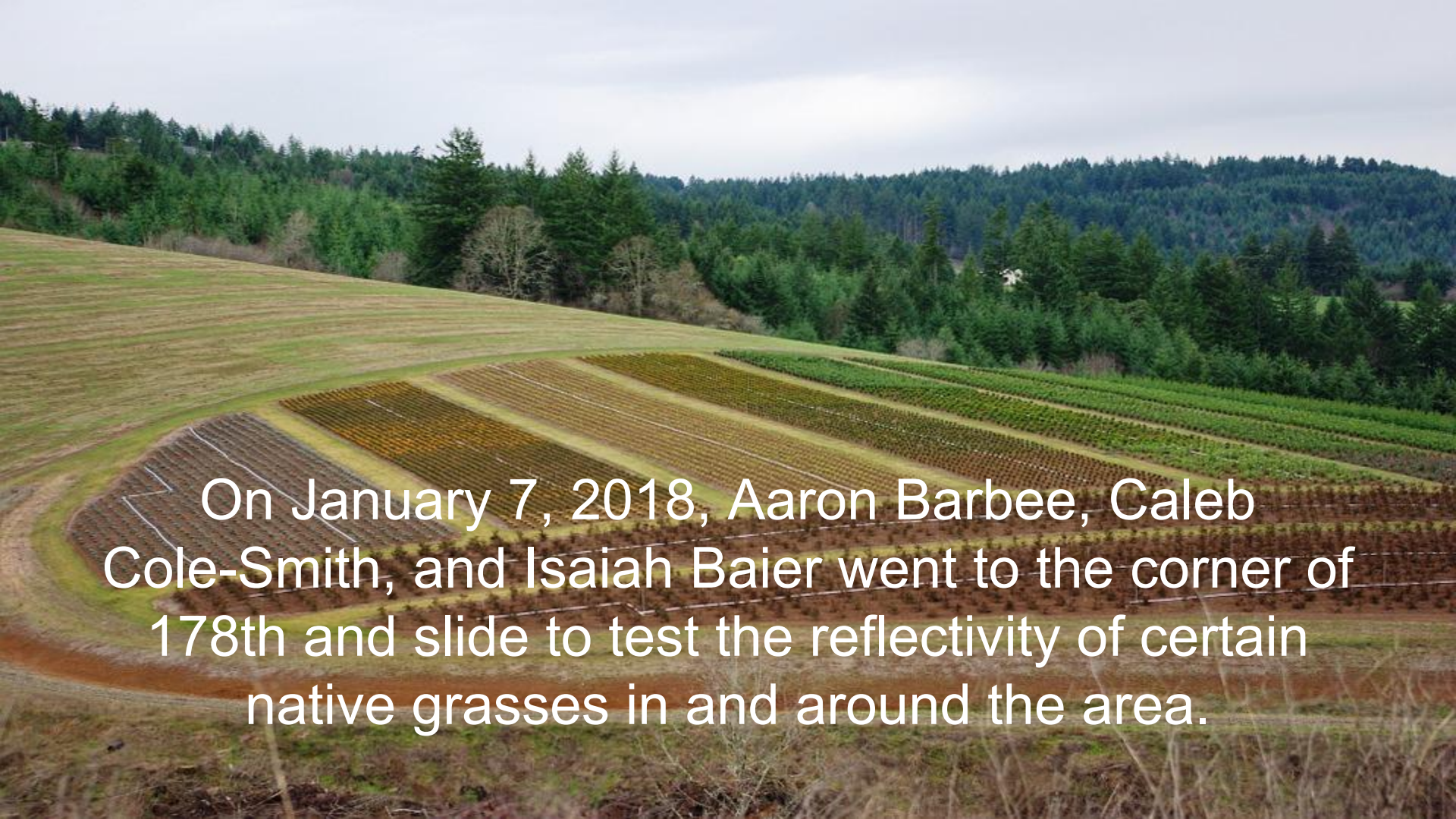
Wittie, Michael. Area Engineer. Texas Department of Transportation. Personal Interview by Aaron Barbee, Caleb Cole-Smith, Isaiah Bauer. October 17, 2018.

West Bend Mutual Insurance Company. “Deer vs. Car Collisions.” *Culture Of Safety*, 5 Apr. 2017,

“Wyoming: A Solution to wildlife traffic accidents may be in the bag”. Science Friday Segments.

FIELD TESTS

Testing the reflectivity of different native plants

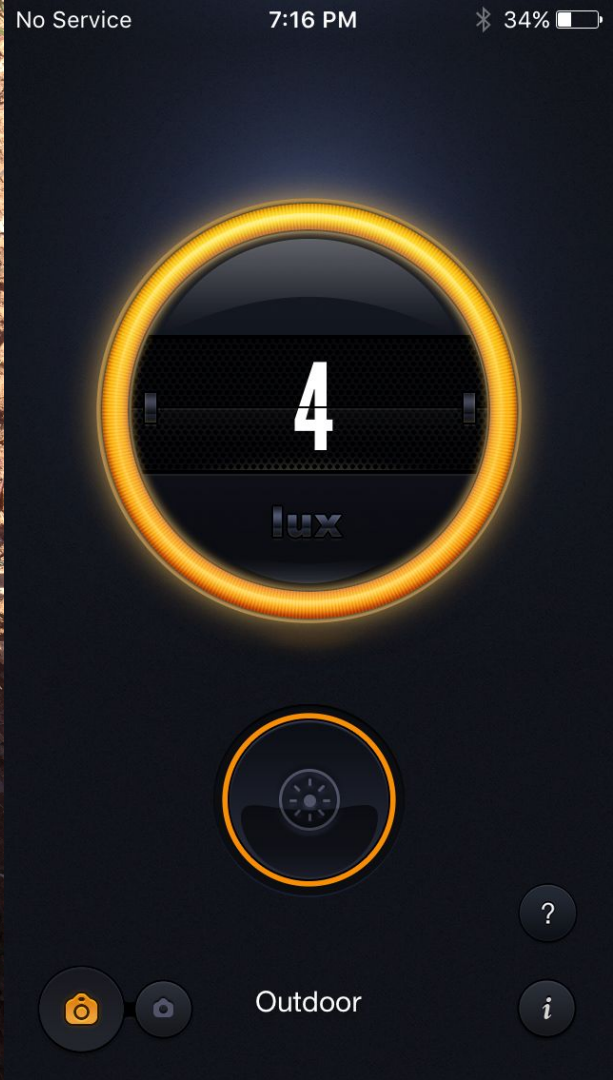

On January 7, 2018, Aaron Barbee, Caleb Cole-Smith, and Isaiah Baier went to the corner of 178th and slide to test the reflectivity of certain native grasses in and around the area.

We tested four plants’ lumes and dug them out. Mrs Barbee gently placed them into a cardboard box that was later brought to the school.

Plant #1:

Plant #1 showed 4

Lumens at night.



Sample test #2:

Field test results:

1 2014

383fc

2 3173

290fc

3 3015

370fc

4 3477

373fc

Foot candle	383fc	290fc	370fc	373fc		
lumen count	2014	3173	3015	3477		
plant#	Plant #1	Plant #2	Plant #3	Plant #4		

Night trials for plant #1


Verizon LTE 2:27 PM
Test #1
7288
lux
Outdoor
Verizon LTE 2:27 PM
Test #2
11984
lux
Outdoor
Verizon LTE 2:22 PM
Test #3
1752 fc
lux
Outdoor


Verizon LTE
2:27 PM
Test #4
7196
lux
Outdoor
Verizon LTE
2:27 PM
Test #5
7196
lux
Outdoor
Verizon LTE
2:27 PM
Test #6
7779
lux
Outdoor

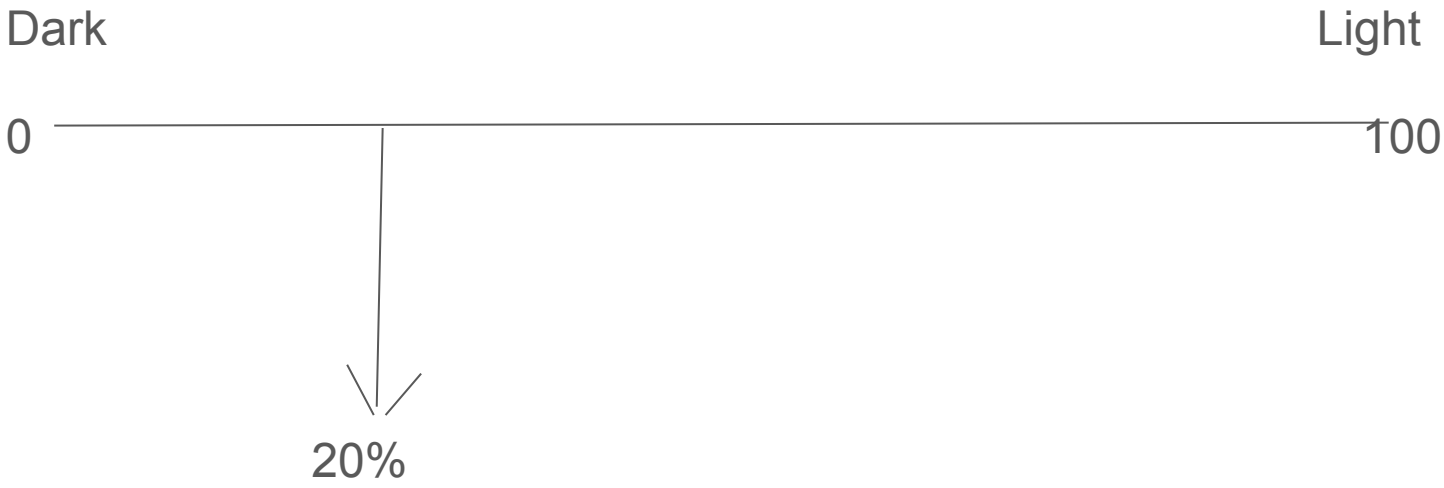

Verizon LTE
2:27 PM
Test #7
7165
lux
Outdoor
Verizon LTE
2:27 PM
Test #8
7238
lux
Outdoor
Verizon LTE
2:27 PM
Test #9
6840
lux
Outdoor


Verizon LTE
2:27 PM
Test #10
7043
lux
Outdoor
Verizon LTE
2:27 PM
Test #11
6263
lux
Outdoor


PLANT #1

“ THE FOUR SECOND RULE”:

Traveling at 60 mph on a rural two-lane road, by the time your headlights hit the deer, you have four seconds to brake. By planting these grasses, we increase the amount of light on the road by 20% which, according to our testing, results in 50% greater chance of drivers to see the deer and avoid collision.



Preventing Animal Related Car Collisions

Logo picture from : http://www.usaeop.com/ecybermissioncompetition

Scientific Design Featuring:

- Native grasses
- Reflective properties

Questions, please contact:
caleb.cole-smith@southcrest.org

Isaiah Baier
Caleb Cole-Smith
Araon Barbee
Dimitre Martinez

For Lubbock → For Texas → For the USA → For the World

RECOMMENDATIONS TO TEXAS DEPARTMENT OF TRANSPORTATION

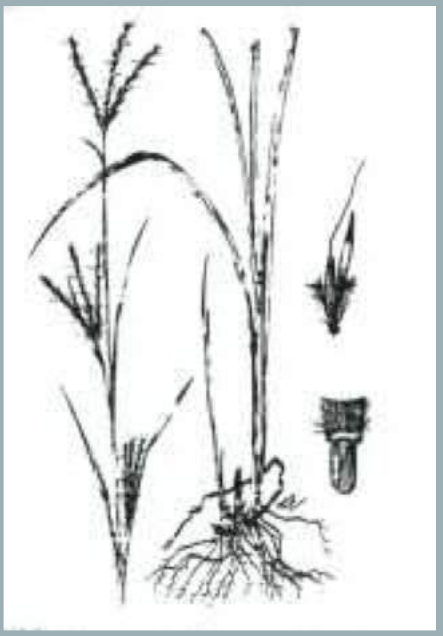
Oh, Deer!

eCYBERMISSION 2018 – 2019

7th Grade STEM Research Team

THE FOLLOWING NATIVE GRASSES WERE TESTED FOR THEIR REFLECTIVE NATURE AND AND USED ON ROADWAYS TO PROVIDE ADDED LIGHT FOR MOTORISTS.

PLEASE NOTICE THEIR LIGHT COLORED STEMS AND TOPS



GALLETA GRASS

PLEURAPHIS JAMESII

BIG BLUESTEM

ANDROPOGON GERARDI

BLUE GRAMA

BOUTELOUA GRACILIS

SIDEOATS GRAMA

BOUTELOUA CURTIPENDULA

5 Ways to Prevent Animal Related Car Collisions

#1: **W**ATCH OUT!! Be cautious, look out for animals. If you see them when there right in front of you, it's too late.

#2: **A**LWAYS keep your headlights on, they will help you see better at night.

#3: **T**URN slowly, their might be a car or a deer around the bend.

#4: **C**AREFULLY drive along roads near woods, you never know when a deer might cross

#5: **H**ELP If you see a deer about to cross as you are driving across, flash your headlights to warn other drivers.

Oh, Deer! Website

Please visit our website to learn more about the use native grasses in YOUR state and how your state department of transportation can implement this innovative solution to lighting America's roadways and reducing the wildlife vehicle collisions.

https://ohdeerscs.weebly.com

QR Code

Oh, Deer!
Photo Essay

A 7th Grade STEM Research Team

eCYBERMISSION 2018 - 2019


W
BLES
ADVENT


Potting Soil
1BK


SOUTHCREST

aeop | Ecybermission
ACCEPT THE CHALLENGE

INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

Student(s) User Name(s): PianoFingers18, britishcommando2, CCS2005, thefunKeecou

Grade: 7 **Team Advisor:** Laura Wilbanks

Team Name: Oh, Deer!

Brief Description of Project:
Plants were used on roadways & the lumens of light reflecting off different kinds are recorded. People will watch powerpoint presentations of different levels of light & deer on the road to see how quickly they "see" the wildlife.

Team Advisor: Please sign here if the project proposed is a viable eCYBERMISSION Project in which neither animals nor humans will be harmed.
Team Advisor Approval Signature: Laura Wilbanks **Date:** 9-1-18

IRB Waiver of Written Informed Consent for Human or Animal Participation

The IRB may waive the requirement for documentation of written informed consent/assent/parental permission if the research involves **only minimal risk *and* anonymous data collection *and* if it is one of the following**: (NOTE: This statement only applies to providing the written certification mentioned in 1a or 2a above).

- Research involving normal educational practices.
- Research on individual or group behavior or characteristics of individuals where the researcher does not manipulate the subjects' behavior and the study does not involve more than minimal risk.
- Surveys, questionnaires, or activities that are determined by the IRB to involve perception, cognition, or game theory and do NOT involve gathering personal information, invasion of privacy or potential for emotional distress.
- Studies involving physical activity where the IRB determines that no more than minimal risk (Daily Activity) exists and where the probability and magnitude of harm or discomfort anticipated in the research are not greater than those ordinarily encountered in DAILY LIFE or during performance of routine physical activities.

If there is any uncertainty regarding the appropriateness of waiving written informed consent/assent/parental permission, it is strongly recommended that documentation of written informed consent/assent/parental permission be obtained.

HUMAN or ANIMAL SUBJECTS	
Permission Slips needed? (see above to determine) (Scan and attach slips to Mission Folder)	Yes ☐ No ☒
Check-up of Human or Animal Subjects required by Doctor, school nurse or Veterinarian? (see above to determine)	Yes ☐ No ☒
If yes, Doctor's, Nurse's or Veterinarian's (before and after experimentation) current evaluation report must be attached to Mission Folder.	

APPROVALS –

Susie Hassell — Principal / Administrator Signature — Date Reviewed 9-1-18

W Dunn M.D. — Doctor or Medical Professional Signature — Date Reviewed 9-1-18

Vanessa Baldree — Science Fair Coordinator or other Science Teacher Signature — Date Reviewed 9-1-18

aeop | eCYBERMISSION
ACCEPT THE CHALLENGE

eCYBERMISSION Survey Approval Form**

eCYBERMISSION team name: Oh, Deer!

Team Advisor name: Laura Wilbanks

Team Advisor email: sciencerocksu@yahoo.com

Team Advisor phone: 806-891-1034

Student usernames: PianoFingers18, britishcommando2, CCS2005 thufunkeecou

School name: Southcrest School

School address: 3801 S. Loop 289 Lubbock, TX 79423

Describe the survey your team will conduct:

People will watch a presentation & report when they see a deer. Survey questions will ask the difference they feel with and without lighting conditions.

Describe the participants you plan to distribute your survey to:

Licensed drivers 18 + over will take the survey

Project approved by school administration?

☑ Yes ☐ No

Approved by: Susie Driscoll

Title: Principal

Date approved: 09/01/2018

Signature, School Administrator: Susie Driscoll

*Please have form completed, signed and dated BEFORE surveys are administered.

**As of August 2017, an IRB approval form (below) must be completed for all surveys as well as the information requested above.