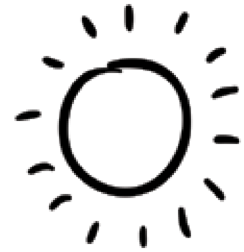
IT'S STILL DEBATABLE!

USING SOCIOSCIENTIFIC ISSUES TO DEVELOP SCIENTIFIC LITERACY

K–5

Sami Kahn

NSTA press
National Science Teaching Association



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Dedication

This book is dedicated to teachers—current and future—who wake up each morning and choose to change the world … one student at a time.

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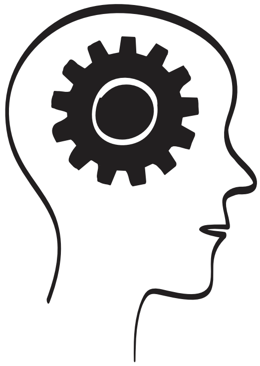
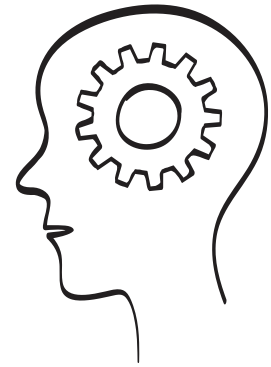
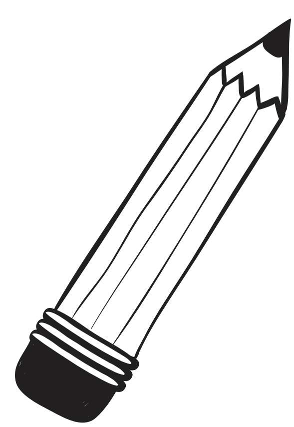




About the Author

Dr. Sami Kahn is a 30-plus-year veteran science educator with extensive experience in classroom teaching, professional development, and curriculum development. She is proud to share that she has taught science to students in almost every grade, from kindergarten through college. Dr. Kahn currently serves as Executive Director of the Council on Science and Technology at Princeton University where she works to promote scientific literacy for all through STEM education research, course development, and outreach. An award-winning teacher and scholar, she uses her background in science education and law to inform her research and teaching on inclusive science practices, socioscientific issues (SSI), argumentation, and social justice. Dr. Kahn has authored numerous journal articles, including several in *Science and Children*, and has coauthored three books on enhancing scientific inquiry experiences for children and adults, including the NSTA Press book *It's Debatable! Using Socioscientific Issues to Develop Scientific Literacy, K–12* (2014). Her service to the field includes leadership positions with the National Science Teaching Association and the Association for Science Teacher Education. Dr. Kahn holds an MS in ecology and evolutionary biology from Rutgers University, a JD in law from Rutgers School of Law, and a PhD in curriculum and instruction with a specialization in science education from the University of South Florida, where she served as a presidential doctoral fellow. Before coming to Princeton, Dr. Kahn held positions at Ohio University, Collegiate School in New York City, and Rutgers University.



Acknowledgments

One point that is definitely *not* debatable is that it takes the contributions of many highly talented individuals to develop a successful book. I am grateful to have had the assistance of such a group in the development of *It's Still Debatable!*

First, I thank the outstanding team at NSTA Press. Under the inspired leadership of Claire Reinburg, the exceptional editorial staff gave me immeasurable guidance and support. Special thanks to Andrea Silen for her expertise and patience!

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Prelude

"A Cup of Inspiration"

I had just settled in at my desk, cup of coffee in hand, when one of my fourth graders who had arrived early at school approached and asked what seemed like a very simple question: "Ms. Kahn, is coffee good for you?"

Now, I have to confess that the first thing that came into my mind was "Of course! It's what keeps me sane!" But the science teacher inside me quickly kicked in, and I replied, "Well, coffee contains substances called antioxidants that help cells do their jobs well. It definitely has some health benefits."

"So, should kids drink coffee?" he queried.

And there it was—a "should" question. On its surface, it seemed innocent enough, but "should" questions aren't always easy, and they often aren't answerable by science alone. In this case, I knew that science could *inform* my answer but not necessarily determine it. Should I simply respond with a *safe* answer like "It's up to children's parents whether they should or shouldn't drink coffee"? I decided to keep the conversation going.

"Well, the other thing about coffee is that it contains caffeine, which is a type of stimulant. It can make people nervous and make it harder for them to fall asleep at night. So a lot of people are against giving coffee to children."

My student nodded rather somberly, but then, showing a bit of glint in his eye, he asked, "But what about *decaf*? Why don't my parents let me drink decaf?"

I wondered … could my eager young student be trying to get me to contradict his parents? But might he also be genuinely interested in the science behind the bean? Although I felt the pull of quicksand drawing me in ever deeper, I was also intrigued.

"Even decaf has caffeine," I answered. "Maybe that's why your parents don't want you to have it. Have you ever asked them why?"

He paused for a moment, looking rather circumspect before replying: "Nope, I didn't ask because I know when it's a *maybe* no versus a *definite* no. This was a *definite* no!"

Sensing his disappointment and wanting to take advantage of a teachable moment, I said, "Why don't we both learn a bit more about this coffee subject? I'm curious!"

We proceeded to scour some online articles about the pros and cons of coffee, how coffee actually gets decaffeinated (something I never really thought about), and how caffeine affects children and adults. As we searched, I found myself naturally talking to him about the difference between sources like medical journals or university websites (we noticed the .edu and .org extensions) and Wikipedia. We even found information on coffee companies' websites, sources that, my student astutely noted, "might be trying to sell us on it." Our takeaway from our brief perusal was that there is fairly solid evidence that coffee can lower risks for several different diseases, including type 2 diabetes, Parkinson's disease, and some cancers. But it can also harm tooth enamel, leach calcium from bones, and cause anxiety and insomnia. And adding sugar, cream, and flavors (and whipped cream!) contributes empty calories and fat.

My student and I had a great time learning together by weighing the copious and somewhat confusing information about this everyday product. I was quite surprised by how much science content we discussed in a short time, and we touched on issues such as determining the trustworthiness of sources, how and why different studies might yield different results, and the tentativeness of scientific knowledge. This brief interlude added to my deep belief in the use of debatable socioscientific issues (SSI) in science teaching, especially for elementary-age students, as they are developing the habits of mind that will last a lifetime. They are at an age when their thoughts, feelings, and beliefs about science are being solidified.

Soon, I heard the voices of his classmates arriving, so I turned to my student and said, "We've seen some arguments for and against coffee. What do you think about it?"

He confidently replied, "I'm going to wait until I'm older to try it, just in case it's not good for me. I have a feeling there'll be LOTS more research by then!"

That night, my student shared our findings with his parents, who had, in fact, nixed coffee for the reasons we had identified but hadn't articulated those reasons to their son. He now felt empowered because he could engage in an informed discussion on this subject and could even understand and appreciate his parents' decision, whether he ultimately agreed with it or not. It was on that day that I decided an elementary-level sequel to *It's Debatable!* was needed. And in case you were wondering, it was also on that day that I decided to continue drinking my morning cup of coffee!

—Sami Kahn

Lesson 2

Swingy Thingy

What Makes a Great Playground?

Suggested Grade Levels

K–2

Driving Question

- How do pushes and pulls affect the speed and direction of objects?

Lesson Overview

Students explore the way pushes and pulls affect the speed and direction of objects using both playground swings and model swings that they build and test. After a read-aloud about a girl's dream playground, students vote to determine the features of a class dream playground and collaboratively develop blueprints, a class model, and a list of playground rules. By engaging in collaborative planning and rule making, students apply their knowledge of forces to support their arguments for safe and enjoyable playground design while modeling civic engagement.

Connecting to the *NGSS*

(See full alignment in Table A.2 on p. 503.)

- PS2.A: Forces and Motion
  - Pushes and pulls can have different strengths and directions. (K-PS2-2)
  - Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it. (K-PS2-2)
- ETS1.A: Defining and Delimiting Engineering Problems

- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions. (K-2-ETS1-1)

Societal Issues

Land Use, Accessibility, Fair Negotiations

Nature of Science

- Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
    - Scientists use drawings, sketches, and models as a way to communicate ideas.
    - Scientists search for cause-and-effect relationships to explain natural events.
- Science Addresses Questions About the Natural and Material World
    - Scientists study the natural and material world.

CCSS Connections

- English Language Arts
    - R.K.1. With prompting and support, ask and answer questions about key details in a text.
    - W.K.2. Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic.
- Mathematics
    - MP.2. Reason abstractly and quantitatively. (K-PS2-1)
    - K.MD.A.1. Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. (K-PS2-1)

- K.MD.A.2. Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute, and describe the difference. (K-PS2-1)

NCSS Connections

- Theme 3: Individual Development and Identity
  - Explore factors that contribute to personal identity, such as physical attributes, gender, race, and culture.
- Theme 6: Power, Authority, and Governance
  - Examine issues involving the rights and responsibilities of individuals and groups in relation to the broader society.
- Theme 10: Civic Ideals and Practices
  - Ask and find answers to questions about how to plan for action with others to improve life in the school, community, and beyond.

C3 Framework

- Dimension 4: Taking Informed Action
  - D4.8.K-2. Use listening, consensus-building, and voting procedures to decide on and take action in their classrooms.

UDL Toolkit

Multiple Means of Engagement	Multiple Means of Representation	Multiple Means of Action and Expression
Students are introduced to the topic through a charades game, KLEW chart, and an outdoor activity.	Playground Charades involves auditory, visual, and kinesthetic presentation of information.	Students choose the type of playground apparatus they'd like to build.
Students are provided with a series of challenges in their STEM engineering activity that can be extended.	Information on forces is presented through pictures, words, and hands-on experiences.	Students express their individuality by drawing their ideal playground.
Students engage in small groups, whole-class activities, and individually to maintain interest and provide a variety of experiences.	Use of a KLEW chart, playground equipment bar graph, and playground blueprint map presents information in an interactive and organized way.	Students express their learning through writing, talking, creating models, and drawing.

Suggested Schedule and Sequence

- Day 1: **Engage** with Playground Charades and Swingy KLEW Chart and **Explore** and **Evaluate** with Swingy Science
- Day 2: **Explain** with *Move It! Motion, Forces, and You* read-aloud and **Explore, Explain,** and **Evaluate** with Model Swing STEM Challenge
- Day 3: **Elaborate** with *My Dream Playground* read-aloud and Our Dream Playground graph
- Day 4: **Elaborate** with Build a Class Playground Model
- Day 5: **Evaluate** with My Dream Playground scene

Materials

For Swingy Science (outdoor activity)

(per team of 2–3)

- Playground swings
- Clipboards (optional)
- Pencil

For Model Swing STEM Challenge

(per team of 2–3)

- 7 paper straws (uncut)
- 3 paper straws cut in half (6 half-sized straws)
- 5 pipe cleaners cut in half (10 half-sized pipe cleaners that will serve as connectors)
- 2 cupcake liners
- Hole punch
- Scissors
- Small toys to place in the seats
- Straw swing set instructions from the Craft Train: *www.thecrafttrain.com/straw-swing-set*

For Class Playground Model Equipment (e.g., swings, slides, monkey bars, merry-go-rounds)

(per team of 2–3)

- Craft supplies such as craft sticks, pipe cleaners, string or yarn
- Cardboard
- Paper straws
- Aluminum foil
- Marbles
- Scissors
- Paper towel or toilet paper tubes
- Tape
- Chart paper
- Sticky notes

(per student)

- Safety glasses or goggles

Student Handouts

- Swingy Science
- Model Swing STEM Challenge
- My Dream Playground

Safety Notes

1. All students must wear safety glasses or goggles during the setup, hands-on, and takedown phases of the activity.
2. Use caution when working with sharp tools or materials to avoid cutting or puncturing skin.
3. Immediately pick up any items dropped on the floor to avoid a slip-and-fall hazard.
4. Wash hands with soap and water after completing this activity.

Media

Books

- *Move It! Motion, Forces, and You,* by Adrienne Mason
- *My Dream Playground,* by Kate M. Becker

Background for Teachers

Playgrounds are not only great places for children to exercise and socialize, but they are also excellent laboratories for studying forces and motion. Swings, slides, seesaws, and merry-go-rounds all demonstrate *motion,* which is the movement of something from one place to another. Motion requires *forces,* or *pushes and pulls,* to occur. Forces can change the speed or direction of an object: more force (bigger pushes or pulls) leads to faster movement, while applying force from a different direction can change the direction of an object. Children can observe these basic principles by pushing and pulling a swing. By applying more force to the swing, the swing moves back and forth for a longer period of time. If the person on the swing pumps his or her legs, this applies even more force to keep the swing moving. Of course, if the person on the swing gets tired and stops pumping his or her legs, the swing will eventually stop. Why? Because there is *friction* between the swing and the air (and even the point where the swing's chain is attached to the swing frame). Friction is a force that slows things down when they rub together. Another force at work when observing a swing is *gravity,* which is a force that pulls objects toward the center of Earth. When someone pushes you on a swing, you go up, but then you come back down because of gravity. Another important concept students can observe with swings is that they can push a swing sideways to change the direction of the swinging motion. They can even twist swings around to make them spin!

Although this lesson focuses on swings, you can apply many of these same concepts to other playground equipment. For example, gravity is the reason that you go down a slide. Slides have polished surfaces to reduce the friction so that children can slide down quickly. Monkey bars provide opportunities for children to pump their feet in order to swing, pull themselves up by exerting enough force to overcome gravity, or drop down to the ground, again thanks to gravity. Seesaws are a bit more complicated but also demonstrate these concepts well. Seesaws show how forces can be balanced if the riders are roughly the same weight and seated the same distance from the center pivot point, called a *fulcrum*. In this situation, gravity is pulling the same amount on each side. But if one rider pushes down on the ground with his or her feet (exerting a force), this rider can disrupt the equilibrium, raising himself or herself and lowering the other rider. This position doesn't last long, though, because gravity soon pulls the rider back down toward Earth. Children intuitively figure out that if one person is significantly heavier than the other, the heavier rider can easily keep the lighter rider's side of the seesaw up in the air. However, moving the heavier person closer toward the fulcrum and the lighter person away from the fulcrum allows the lighter rider to keep the heavier rider up in the air because of a turning force known as *torque*. One final concept explains why none of the equipment on a playground moves unless someone (or a very big wind) moves it: *Inertia* is the tendency of things to stay in one place unless a force acts on them.

In this lesson, students apply forces (pushes and pulls) to make swings move. They test how the strength of the force they exert makes swings move for a longer time and observe that they can change the direction of swings by pushing or pulling from a different direction. They experiment with swings on the playground and model swings that they build in a STEM challenge. The STEM challenge has the added criterion of working with given materials to develop a successful design that can swing in concert with a friend's swing; this requires students to adjust their swings and their pushes and pulls to meet the challenge. Finally, the development of a class playground model requires students to apply their knowledge of forces and motion to create working models of playground equipment. This demands thoughtful planning, collaboration, discussions about accessibility, and negotiation to create a whole-class playground display, along with playground rules, that models real-world community projects.

Additional Resources

Book on forces and motion for teachers

- Robertson, W. C. 2002. *Force and motion: Stop faking it! Finally understanding science so you can teach it.* Arlington, VA: NSTA Press.

Article on teaching playground science to students with visual impairments

- Fast, D., and T. Wild. 2018. Traveling with science. *Science and Children* 55 (5): 54–59.

Article on designing playground equipment using 3-D printing

- Wendt, S., and J. Wendt. 2015. Printing the playground. *Science and Children* 52 (5): 43–47.

5E Lesson Plan

Engage: Playground Charades and Swingy KLEW Chart

1. Begin by asking students to imagine that they are on a playground, playing on their favorite playground equipment. Explain to students that instead of telling the class what their favorite playground equipment is, they are going to act out their activity on the equipment, allowing the class to guess, like a game of charades. Call on four or five volunteers to come up one at a time and act out their favorite playground activity. As students correctly guess, write or draw the playground equipment on the board (e.g., swing, slide, seesaw, monkey bars). When all the favorite activities on playground equipment have been named, explain to students that they're going to focus on swings today.

2. Draw a KLEW chart like the one in Figure 3.2 (see p. 17) and ask, "What do we think we Know about swings?" List their responses under the "K." The idea of using pushes to make swings move will likely come up, but if students don't volunteer it, prompt them with the question "How do swings move?" Once all answers have been added to the chart, inform students that they will be building on this knowledge by going out to the playground to explore swings!

Explore: Swingy Science

1. Distribute the Swingy Science handout (p. 92) to students, along with clipboards and pencils. Assign partners (or groups of three if needed) and head out to the playground.

2. Explain to students that they are going to test the number of times their partners swing with (1) a pull, (2) a pull and a push, and (3) a pull, a push, and pumping their legs. Model the investigation for students with a student volunteer who is seated on a swing. Explain that Partner 1 (the student) sits on the swing without pumping legs while Partner 2 gives one pull. They should count the number of times the swing comes back to Partner 2 before it stops. Show students where on the sheet they should enter their data. Also demonstrate a pull and a push, then a pull, a push, and leg pumping. (Demonstrate the start of each, but don't count the number of swings.) After they have counted using each method, partners should switch roles.

3. Allow students to work on this activity for several minutes. Students will quickly notice that when their partners are pumping their legs, the swings don't stop. Have students record that in their own words (e.g., does not stop, goes forever, keeps swinging).

4. When students have completed the handout, allow them a few extra minutes to explore other ways of moving the swing, such as changing directions or stopping it with their feet.
5. When students are done, ask:
   - "How does pushing and pulling affect the number of swings?" (the more pushes and pulls, the higher the number of swings)
   - "Why do you think this is so?" (a push and a pull is stronger than just a pull, so there is more motion)
   - "What happened when your partner pumped his or her legs?" (the swing didn't stop)
   - "Why do you think pumping keeps the swing moving?" (pumping keeps adding pushes and pulls; answers may vary and students will learn about forces in the next activity)
   - "How do you stop swinging?" (putting feet on the ground)
   - "Were you able to find out anything else about moving the swings?" (answers will vary, but students may mention changing directions, going diagonally, or spinning)
6. Revisit the KLEW chart and allow students to contribute what they have Learned in the "L" column. Students will say, for example, that pumping legs helps swings move longer and bigger pushes make them go higher. Introduce the "Evidence" ("E") column and ask, "What Evidence (or proof) do you have for what you've Learned?" Write answers such as "When we pumped our legs, the swing went longer."

Evaluate: Swingy Science

1. Evaluate student work by ensuring that they have recorded their data and correctly interpreted these data in the final question. Students should observe that they are able to change the motion of the swings by changing the direction of pushes and pulls and by adding leg pumping.

Explain: *Move It! Motion, Forces, and You* Read-Aloud

1. Read aloud *Move It! Motion, Forces, and You,* by Adrienne Mason, using the guided reading prompts listed below. (*Note:* Some pages in this book describe activities to demonstrate certain concepts. You can clip these pages in advance

so that they aren't part of your read-aloud, but you can always choose to do them at another time.)

- On pages 6–7, note that the picture shows children playing on a playground and asks students to identify where forces are being used. Ask students, "Do you see any connections between this page and our playground investigation?" (students should recognize that the pushes and pulls that move the swing are forces)
- Similarly, on pages 12–13, the book describes how big forces make things move farther. Ask students, "Do you see any connections between this page and our playground investigation?" (students should recognize that when they gave pushes and pulls, or pushes, pulls, and leg pumping, the swing kept moving)
- On pages 16–17, the book discusses how pushes and pulls can change directions. Ask students, "Do you see any connections between this page and our playground investigation?" (students should recognize that pushing moved the swing in one direction and pulling moved it in another; students may have also noticed that pushing sideways produced a sideways swinging pattern)
- On pages 18–19, the book discusses stopping motion. Ask, "Do you see any connections between this page and our playground investigation?" (students used their feet to stop the swinging motion, and this required force)

Explore and Explain: Model Swing STEM Challenge

1. Explain to students that they are going to have a chance to build and test their own model swings. Show your prebuilt model, demonstrating that it really swings. Ask students to identify any shapes they notice. (the base is a rectangle, the sides are triangles, the swings are rectangles)
2. Show students the materials that they will have available for building (paper straws, pipe cleaners, and cupcake liners). Demonstrate how the pipe cleaners (halves) can be used as connectors between straws by simply pushing a pipe cleaner into one end of a straw, leaving enough outside to add the other straw; then the pipe cleaner can be bent, forming a joint, so that the straws can go in different directions. You can also put two pipe cleaners into one end of a straw so that three straws can be joined.

3. Challenge students to build a swing that is able to hold a small figure or toy in the seat and swing back and forth at least four times with only a pull (only pulling the swing back and releasing it, not pushing). They will count exactly the same way they did on the playground, by counting each time the swing comes back to the starting side.

4. Allow students time to work on their models. *Tip:* If students are struggling, encourage them to create the base (a rectangle) first, and then use the short sides of the base to make triangles for the sides of the model. Then, place one straw across the top. Encourage students to help each other as they finish.

5. When students are finished building, it is time to test the swings. Students may need to make adjustments in how tightly the pipe cleaner is wrapped around the top bar. Encourage students to keep testing until they have a well-functioning swing that is able to accomplish the challenge.

6. Distribute the Model Swing STEM Challenge handout (p. 93), and have students complete the set of challenges on the sheet.

7. When students are done with the challenges, ask:

   - "How did you make your swing move?" (by pushing and pulling)
   - "How are pushes and pulls alike?" (they make things move)
   - "How are pushes and pulls different?" (they move things in a different direction; pushes move things away from us, and pulls move them toward us)
   - "How did you make your swing move the same as your friend's swing?" (start the swings at the same time from the same height)
   - "How did you make the swing move back and forth at least four times with only one pull?" (pull it back very far)

Evaluate: Model Swing STEM Challenge

1. Evaluate students' work on the STEM Challenge through observation of their building and testing, as well as their success with the challenges. Questions 4 and 5 on the STEM Challenge handout require testing and data collection (e.g., counting the number of swings), as well as possibly revising their designs to get the coordinated swinging with their friend's swing and to move back and forth with only one pull.

Elaborate: *My Dream Playground* Read-Aloud and Our Dream Playground Graph

1. Explain to students that you are going to read *My Dream Playground,* by Kate M. Becker, a true story about a girl who dreamed about playgrounds because she lived in a place where there weren't any. Note that although the girl's name isn't included in the book itself, the author's note in the back of the book tells us that the story is based on the experiences of a girl named Ashley who lived in Washington, DC. After reading, ask:
    - "Why do you think there weren't any playgrounds in Ashley's neighborhood? The book doesn't tell us so we have to infer." (answers will vary; perhaps the city she lived in didn't have much space or money for playgrounds)
    - "What were some of the things that Ashley wanted to have in her playground?" (slides, swings, monkey bars, trampolines)
    - "What advice did her mom give her?" (never stop dreaming)
    - "Who were some of the people who helped Ashley's playground dream come true?" (her brothers helped her plan, Darell managed the project, Mr. Sid brought sandwiches, Ms. Gonzalez brought the tent, Gregory played music, and hundreds of volunteers helped build)
    - "What lessons do you think the author might want us to learn from this book?" (never stop dreaming, much can be accomplished when people work together for a common goal, everyone can contribute in his or her community, children can make a difference)
2. Announce to students that they are going to design and build a model of a class dream playground. Using think-pair-share, ask students, "What are some questions we need to think about before we can build a model playground?" Give students a few moments to think quietly, then allow them to turn to a partner to discuss, and finally, have them share out. Elicit and prompt questions such as the following:
    - Where would our playground be?
    - How big will it be?
    - What kinds of equipment will it have?
    - Who would use it?

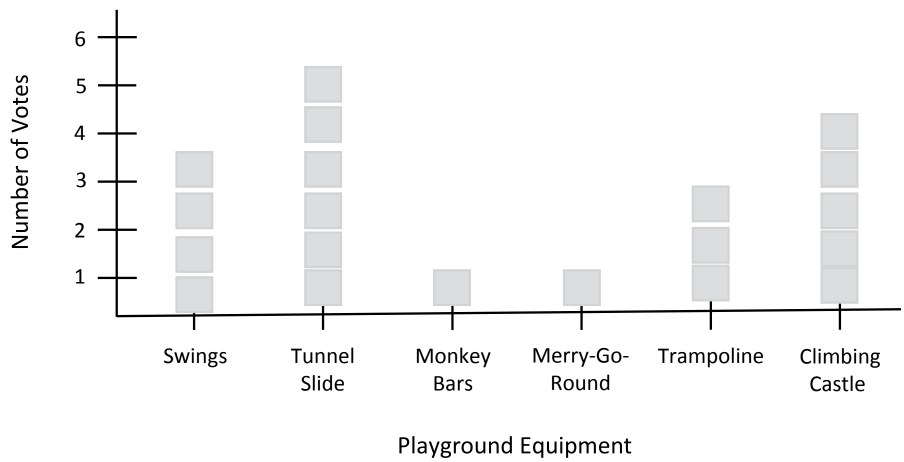
- Should it be *accessible* for children who use wheelchairs or walkers?
- What materials can we use to build it?
- How long do we have to build it?
- Do the equipment pieces have to work?
- Can we have other things, like people or trees, in it?

Write student questions on the board or on chart paper so that they remain accessible throughout the activity.

3. Show students a dedicated area in the classroom for the playground, such as a tabletop or counter space, and place on it a piece of chart paper labeled “Blueprint.” Explain to students that this will be the space where they will create their playground; the blueprint is going to be a layout of their plan.
4. Ask, “How can we decide on what equipment should be in our playground?” (accept all answers, which may include voting for different pieces of equipment, having everyone contribute one idea, or having everyone draft his or her own playground design and voting on the best one) Tell students, “Let’s begin by voting to see what kinds of equipment we might like to have in our playground model.”
5. On chart paper or a board, draw an Our Dream Playground graph, labeling the *x*-axis “Playground Equipment” and the *y*-axis “Number of Votes.” With the class, brainstorm some examples of playground equipment and write them on the *x*-axis. Give each student three sticky notes, and have them write their names and a small drawing of the playground equipment type they want. Then, have students attach their sticky notes to the graph to create a bar graph that looks something like the one in Figure 5.5 (p. 88).

FIGURE 5.5.

Sample Our Dream Playground Graph for Sticky Note Voting



6. Ask students to *interpret the data,* or information, on the graph. "What does this graph tell us?" (in the sample shown in Figure 5.5, tunnel slide and climbing castle got the most votes, monkey bars and merry-go-round the least) Ask, "How could we use this information in planning our playground?" (e.g., we might want to have two tunnel slides and castles and just one merry-go-round, or perhaps we want to have a really big castle that would accommodate the interests of the group)
7. Have students respond to the following questions:
    - "How many pieces of equipment can we fit in our playground model?" (allow them to estimate the number and sizes of pieces of equipment)
    - "What materials do we have for building?" (show students the craft materials available)
    - "How much time do we have to build?" (give students time constraints)
    - "Can we make a background and model people for it?" (yes, but you can also allow students to use figurines and other classroom supplies)
    - "Does the equipment have to work?" (yes, equipment that moves, such as merry-go-rounds, swings, and seesaws, must actually move, and equipment like climbing castles and slides have to be able to hold the

weight of the model people and demonstrate the way the equipment is used)

- "Should the playground be accessible for children who use wheelchairs or walkers?" (Explain to students that there are laws that require playgrounds to have accessible pathways and equipment that can allow all children, including children with different physical challenges, to play and have fun. Ask students if they have ever seen playground equipment like swings that accommodate wheelchairs or have high backs to help support children, ramps for accessing bridges or castles, or merry-go-rounds that accommodate wheelchairs. You can show photos of such equipment by searching for "accessible playground" on the internet. Encourage students to think about how they can make pieces of equipment that can allow the greatest number of children of all physical abilities to enjoy them.)
- "How do we decide what goes where?" (Explain to students that they will be working in groups and will need to *negotiate* with each other's work groups to devise a blueprint, or plan, that works for the space available and the equipment that is desired. Teams will draw their pieces of equipment on sticky notes that approximate the size and shape of their equipment. For example, a slide might be two sticky notes long. The team would put the two notes together and draw their slide on them. A climbing castle might be four sticky notes put together into a large square, with the castle drawn on it. Teams will then place the sticky note equipment where they think it should go on the blueprint; other teams can respectfully question and discuss the placement, and teams can come to an agreement on where equipment will go. No building will take place until the class has reached a consensus on the blueprint.)
- "What are some ways we can work out disagreements about what equipment goes where, or who works on what equipment?" (accept all answers; discuss options such as "give and take," where one team might shift the placement of its playground equipment but gets a bigger space; "all in," where all teams get a piece of something they want, such as a part of the space that they want; or "all out," where both teams that want the same space find another spot)

8. Explain to students that they will work in small groups on one *type* of playground equipment, but they may decide to make more than one of that type,

especially if several students are interested in making it. For example, they may decide to have two tunnel slides or two castles. Assist students in dividing into work groups by interest so that all students are working on something that engages them.

9. Give each student group a large piece of chart paper, and explain that they will have to plan their equipment before they start and will need to check in with you when they are ready. They will need to include a list of materials to pick up at the materials table when their plan and the playground blueprint are approved. Distribute some sticky notes to each team so that the teams can position their equipment on the blueprint.
10. As teams draw out their plans and begin to place their ideas on the blueprint, monitor the discussions to ensure that negotiations are productive. When the blueprint includes each team's sticky note equipment drawing, ask the class if they are in agreement on the design. If there is any disagreement, help students compromise on equipment placement and design. Once the blueprint is approved, congratulate students on their good collaboration and negotiation!
11. Allow students to begin building. Remind them that their playground equipment will have to work. This means that moving parts will have to work similarly to a real piece of playground equipment. Nonmoving equipment, such as a climbing castle, will have to withstand the weight of model people. Teams will have to test their equipment, and revise if necessary, until it is a working model. As students are working, ensure that they are collaborating and discussing the material and space constraints.
12. As teams finish, allow them to place their equipment on the playground. If teams finish early, allow them to work on additional aspects of the playground area, such as grass, trees, signage, and paths. Once all teams have finished (or the time is up), have teams present their pieces of playground equipment and demonstrate how they work. Ask teams:
    - "What went well in your planning or building process? What didn't?"
    - "Did you need to revise your plan as you started building? If so, why?"
    - "How well did your team work together? What is one thing that your team did really well? One thing that you could improve on?"
13. Once all teams have presented, tell them that there is still something missing from their playground. Allow them to guess. Then, explain that they need

to develop some rules to post on the playground to make sure that it is a great community place for all children. As a group, brainstorm a list of rules that might be appropriate for the playground, such as "Be kind to everyone," "Be safe: no jumping off the castle," "No pushing: keep your hands to yourselves," "Take turns," and "Say yes if someone asks if he or she can play with you." Write the rules or have students write them as they are suggested.

Evaluate: My Dream Playground Scene

1. Distribute the My Dream Playground handout (p. 94) to each student. Explain to students that they can draw any kind of dream playground they can imagine, but it must include the following two elements:

    - A push that is changing the direction or speed of an object
    - A pull that is changing the direction or speed of an object

    Assess the drawings based on the presence of these two elements or students' ability to explain their drawing in a way that conveys these two elements.

Going Deeper

- Students can survey playground equipment at school and in their neighborhood and create class maps and graphs of what they've found.
- Students can interview parents and other adults about their favorite playground equipment and childhood memories.
- Students can interview people with disabilities about playground access.
- Students can contact school, town, or city administrators about getting new playgrounds or accessible equipment in a playground.
- Students can research the history of playgrounds (see "How We Came to Play: The History of Playgrounds" at *https://savingplaces.org/stories/how-we-came-to-play-the-history-of-playgrounds/#.W3B_POgzo2*).
- Students can make connections between this lesson and simple machines.

Name: ____ Date: _______________

Swingy Science

How many times does Partner 1 swing with ...

1. a pull? _____________
2. a pull and a push? _____________
3. a pull, a push, and pumping legs? _____________

How many times does Partner 2 swing with ...

1. a pull? _____________
2. a pull and a push? _____________
3. a pull, a push, and pumping legs? _____________

We found that ________________ gives the most swings (circle one):

a pull   a pull and a push   a pull, a push, and pumping legs

Name: ______________________________ Date: ______________

Model Swing STEM Challenge

1. Can you build a swing that can hold a figure or toy in the seat?

☐ yes ☐ no

2. Can you make your swing move back and forth when you push it?

☐ yes ☐ no

3. Can you make your swing move back and forth when you pull it?

☐ yes ☐ no

4. Can you make your swing move back and forth at the same time as a friend's swing?

☐ yes ☐ no

5. Can you make your swing move back and forth at least four times with only one pull? (Count one for every time the swing comes back to the starting side.)

☐ yes ☐ no

My Dream Playground

By: ______________________________

Use your imagination to draw your dream playground. Remember to include (1) a push that is changing the speed or direction of an object and (2) a pull that is changing the speed or direction of an object.

Index

IT'S STILL DEBATABLE!

USING SOCIOSCIENTIFIC ISSUES TO DEVELOP SCIENTIFIC LITERACY

K–5

It's Still Debatable! encourages scientific literacy by showing you how to teach the content and thinking skills K–5 students need to explore real-world questions like these:

- Is football too dangerous for kids?
- Do we need zoos?
- Should distracted walking be illegal?

At the core of the exploration is the Socioscientific Issues Framework. It uses debatable, science-related societal questions, or socioscientific issues, to address science content, help children learn to apply the content, and encourage them to become informed citizens. The book supports the *Next Generation Science Standards*; links to the *Common Core State Standards*, *National Curriculum Standards for Social Studies*, and *C3 Framework*; and is developmentally appropriate for diverse elementary classrooms. It also includes a chapter especially for use in methods courses and professional development programs.

The framework gives students practice in the research, analysis, and argumentation necessary to grapple with difficult questions with roots in life, physical, Earth, and environmental science. After introducing the framework and explaining how it supports the standards, the book shows you how to implement the concept through 14 lessons.

"All educators have an obligation to develop a new generation of informed, ethical, engaged decision makers who are able to apply science in their everyday lives and in society."

—Author of *It's Still Debatable!*

Because the book is specifically for elementary grades, the author made it a teach-ready resource that integrates science into your packed school days. You get clear and accessible background information, practical guidance on how to use the lessons, and developmentally appropriate assessments and handouts. You even find out how to develop your own socioscientific issues curriculum.

Both practical and content-rich, *It's Still Debatable!* doesn't shy away from controversy. Instead, it encourages you and your students to confront just how messy the questions raised by science (and pseudoscience) can be. After all, as the author notes, when science feels real to students, "They are invested in their learning because they feel real connections to questions and want to make a difference in the world, and in their own lives."

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Grades K–5

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