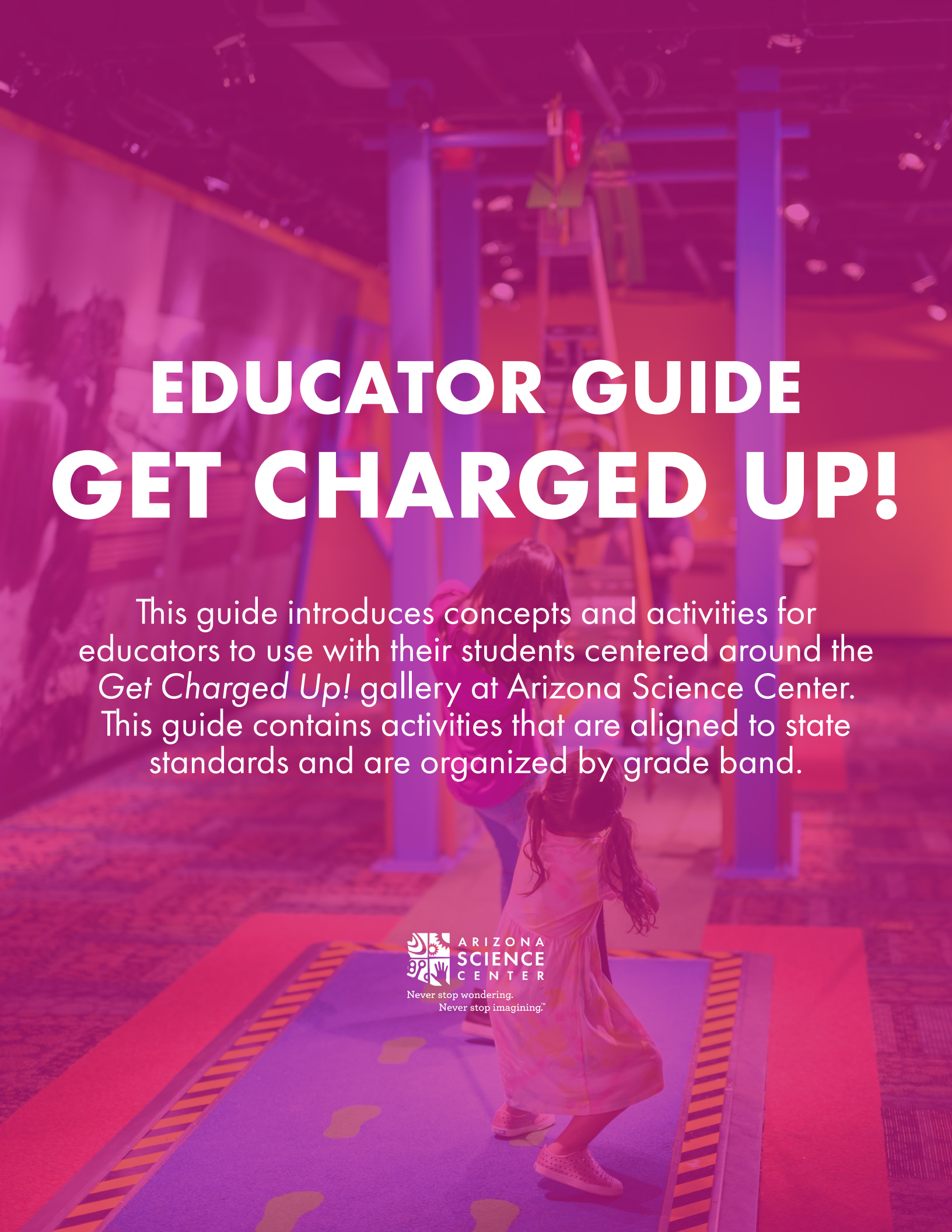


EDUCATOR GUIDE
GET CHARGED UP!

This guide introduces concepts and activities for educators to use with their students centered around the *Get Charged Up!* gallery at Arizona Science Center. This guide contains activities that are aligned to state standards and are organized by grade band.

ARIZONA SCIENCE CENTER

Never stop wondering.
Never stop imagining.™

EXHIBITS OVERVIEW AND CONCEPTS

BALL LAUNCHER
Planets follow a curved path through space. Five hoops can be arranged to mimic this curve so a ball flies through them!
Concepts: *Launch Trajectory, Gravitational Potential Energy*

BED OF NAILS
Lie down on a bed containing thousands of nails—without injury!
Concept: *Mass and Weight Distribution*

BERNOULLI BLOWER
Air pressure suspends four balls in midair! Their height can be changed by covering up certain holes.
Concepts: *Bernoulli's Principle, Air Pressure, Lift*

COLOR MIXING
Prisms are used to divide white light into a color spectrum.
Concepts: *Light Spectroscopy, Refraction*

DANCING IRON DUST TREES
81 electromagnets change their strength and orientation in time to music, while magnetic iron dust follows along and provides an exciting visualization.
Concept: *Electromagnets*

DISAPPEARING GLASS RODS
When submerged in a clear liquid, all but one glass rod disappear. When a magnifying glass is submerged, the image through it becomes clear.
Concepts: *Refraction, Shell's Law*

DOWNHILL RACER
Two identical wheels with radially adjustable weights can change their speed and win, lose or tie!
Concepts: *Angular Momentum Conservation, Moment of Inertia*

ELECTRIC CIRCUITS
Assemble an electrical circuit using various components.
Concept: *Electric Circuits*





ELECTRIC MOTOR

Press a button to send an electrical pulse into coils, repelling magnets and spinning the motor.
Concept: *Magnetic Induction*

FORCES IN ACTION

Compare your weight at the *Weigh Yourself* exhibit to your weight as you climb the *Weight Wall* to see how your weight differs when you are standing upright vs. at an incline.
Concepts: *Normal Force, Gravity*

GIANT LEVER

A giant upright pulley can be pulled from either side by ropes. The height of the rope determines how easy the tug-of-war is.
Concepts: *Torque, Leverage, Simple Machine*

MAGNETIC BALL WALL

A series of tubes can be arranged vertically to allow plastic balls to follow their obstacle course to the floor.
Concept: *Gravitational Potential Energy*

PULLEY POWER (PULLEY CHAIRS)

Three different arrangements of pulleys offer varying levels of difficulty as Guests try to hoist themselves up.
Concept: *Simple Machines*

STROBE STRING

Try to match the speed of the strobe light to the rotation of the string! This creates the illusion that the string is not moving.
Concepts: *Photo Illusions, Light, Zoetrope Effect*

TAKE A SPIN (MOMENTUM MACHINE)

A rotating platform houses a sturdy pole whose spin rate changes depending on the weight distribution of the spinner.
Concepts: *Conservation of Angular Momentum, Lenz's Law, Power Generation, Magnetic Induction*

ESSENTIAL QUESTIONS

These four questions provide the framework for guiding learning through *Get Charged Up:*

1. If you push open a door from the middle of the door, why does it take more work?
2. If you are in a building or underground, a compass might not work. Why?
3. Why does a heavy moving object require more force to stop?
4. Find two cans of different soup with identical weight. Why will one roll faster down a slope than the other?

EDUCATOR RESOURCES ALIGNED TO EXHIBIT STANDARDS



INTRODUCTION TO MAGNETISM FOR KIDS



HOW TO CREATE AN ELECTROMAGNET



CREATE CIRCUITS WITH ELECTRIC PAINT



BUILD A SIMPLE CIRCUIT USING A PIZZA BOX



NEWTON'S LAWS INTERACTIVES



EASY OPTICS ACTIVITIES FOR KIDS

EXHIBIT STANDARDS BY GRADE LEVEL
2018 ARIZONA SCIENCE STANDARDS

GRADE 1
1.P3U1.3 Plan and carry out investigations which demonstrate how equal forces can balance objects and how unequal forces can push, pull, or twist objects, making them change their speed, direction, or shape.

1.P2U1.1 Plan and carry out investigations demonstrating the effect of placing objects made with different materials in the path of a beam of light and predict how objects with similar properties will affect the beam of light.

GRADE 2
2.P1U1.1 Plan and carry out an investigation to determine that matter has mass, takes up space, and is recognized by its observable properties; use the collected evidence to develop and support an explanation.

GRADE 4
4.P2U1.3 Develop and use a model to demonstrate magnetic forces.

4.P4U1.2 Develop and use a model that explains how energy is moved from place to place through electric currents.

4.P4U1.1 Develop and use a model to demonstrate how a system transfers energy from one object to another even when the objects are not touching.

GRADE 5
5.P4U1.6 Analyze and interpret data to determine how and where energy is transferred when objects move.

GRADE 6
6.P1U1.2 Plan and carry out an investigation to demonstrate that variations in temperature and/or pressure affect changes in state of matter.

6.P4U2.5 Analyze how humans use technology to store (potential) and/or use (kinetic) energy.

GRADE 7
7.P2U1.1 Collect and analyze data demonstrating how electromagnetic forces can be attractive or repulsive and can vary in strength.

GRADE 8
8.P4U2.5 Develop a solution to increase efficiency when transferring energy from one source to another.

8.P4U1.3 Construct an explanation on how energy can be transferred from one energy store to another.

PRE-VISIT ACTIVITY

LIGHT IT UP!

GRADES K-2

LIGHT IT UP!

OVERVIEW

In this lesson, students will engage in investigations in order to demonstrate the effects of placing objects made with different materials in the path of a beam of light.

BACKGROUND

Our five senses help us experience the world! Specifically, our sense of sight helps us carry our everyday life functions and allows us to see what is happening around us. In order to use our sense of sight, our eyes not only detect light but also let light into our eyes. Objects that we see either give out or reflect light that our eyes can detect. Due to the properties of various materials, light can pass through very easily or not at all.

ARIZONA STANDARDS

1.P2U1.1 Plan and carry out investigations demonstrating the effect of placing objects made with different materials in the path of a beam of light and predict how objects with similar properties will affect the beam of light.

MATERIALS

- Access to classroom light switch and windows
- Clear water bottle (1 per classroom)
- Notebook (1 per classroom)
- Flashlight (1 per group)
- Plastic wrap (1 sheet per group)
- Wax paper (1 sheet per group)
- Thick fabric (1 square/piece per group)
- Light It Up! handout (1 per student)
- Colored pencils/crayons (1 set per group)
- Pen/pencil (1 per student)
- Science journal (1 per student)

LIGHT IT UP!

5E LEARNING CYCLE

ENGAGE

Prompt students to use their sense of sight to look around the room, including in front, behind, above and below them. Ask students to share what they see with the class.[1]
Possible student responses: I see... the classroom walls, the windows, tables, chairs, books, carpet, lamps, fans, people, etc.

Next, prompt students to think about what they will see if you were to turn off the classroom lights and close the window blinds. Prompt students to then share their ideas with the class.
Possible student responses: I think I'll see the same things in the room; I'll see nothing because it will be dark; I'll see things next to me but not in the back of the room.

Time to investigate! Turn off the classroom lights and close the blinds. Prompt students to use their sense of sight to look around, and think about what they can see this time. Provide students with a minute or two to look around the room, including in front, behind, above and below them.

Prompt students to then share what they see with the class this time. ***Possible student responses:*** I can't see anything; I can see what's on my desk but not in the front or back of the classroom.

Turn the classroom lights back on and open the blinds. Prompt students to think about how they are able to see around them, and then share their ideas with the class. ***Possible student responses:*** I use my eyes to see things; I use the light in the room to see things.

Explain to students that we use our sense of sight to see things. We are able to use our sense of sight to let light into our eyes. This helps us see the world around us! Without light, just like when we made the classroom dark, we are not able to see things very well because there is no light or not a lot of light to help us see.

EXPLORE

Reiterate how light helps us see objects around us, but these objects around us are different from one another. They look different, feel different and are made of different things. These characteristics, like what an object feels like or looks like, are called properties. All objects have properties that make them unique or different from one another. Hold up the clear water bottle and notebook as examples, and prompt students to think about their properties.[2]

LIGHT IT UP!

EXPLORE

Pass around the items for students to touch them. Prompt students to think about the properties of the clear water bottle and then the notebook, and then share their ideas with the class. ***Possible student responses:*** The notebook is hard and feels like a book; The notebook has different colors on the front; The water bottle is hard and I can see through it.

Validate student observations and explain how all objects have properties, just like the notebook and water bottle! Then, prompt students to think about how light will act when shown on objects with different properties. Ask students what they think would happen If we shine a flashlight onto materials with different properties.

Model what a shining flashlight looks like to students by briefly aiming the light beam of a flashlight onto a table. Prompt students to think about what will happen to the light if a flashlight is aimed at materials with different properties. Then, prompt students to share their thoughts with a partner or group.

Once students have discussed their ideas with a partner or group, randomly select several students to share their ideas with the class. ***Possible student responses:*** I think the light will bounce off some materials; I think the light will go through some things; I think the light will shine on top of the materials.

Divide students into groups of three. Distribute the *Light It Up!* handout to each student and the following supplies to each group: Plastic wrap, wax paper, fabric and a set of colored pencils/crayons.

Prompt students to observe the properties of the plastic wrap, wax paper and fabric. What do these objects feel and look like? Have students record their thoughts on the *Light It Up!* handout in the squares next to each material.

Prompt students to take turns exploring the three materials with their hands and eyes. Then, invite them to discuss with their groups, and record the properties of the materials on the *Light It Up!* handout through words and/or drawings. Have students use colored pencils/crayons in their recordings. ***Possible student recordings:*** The plastic wrap feels smooth and is see-through; The wax paper feels kind of smooth and is kind of see-through; The fabric feels soft and bumpy and is not see-through.

Monitor groups during this time in order to guide student exploration of materials and discussions.

LIGHT IT UP!

EXPLORE

Once students have recorded the properties of each material, prompt them to reflect on the investigation question: If we shine a flashlight onto each of the materials, what do you think will happen to the light? Why? Prompt them to think about the properties of each material, then have them draw their ideas on the bottom of the handout in the square for each material.

Prompt students to discuss their ideas with their groups. Then, prompt students to record their ideas on the handout using drawings and/or words, using colored pencils/crayons in their recordings. ***Possible student recordings:*** The light will go through the plastic wrap and wax paper because they are see-through; The light will just shine on top of the fabric because it is big/soft, and not see-through.

Monitor groups during this time in order to guide student discussions, then move into the material investigation process.

Distribute a flashlight to each group and provide the following instructions: Each of you will get to test a material. Decide in your groups who is testing which material!

- **Plastic Wrap:** If you are testing the plastic wrap, turn on the flashlight by clicking the On/Off button. Do not shine a flashlight into your eyes or another students' eyes! Just shine it at the table. Have one group member hold the plastic wrap so that it is a little bit above the table. Hold the flashlight in your hand and point it at the plastic wrap. Look at what the light is doing. Then, turn the flashlight off by clicking the same On/Off button. Work with your group to record what you saw on the second page of the *Light It Up!* handout in the square next to the plastic wrap using your colored pencils/crayons.
- **Wax Paper:** If you are testing the wax paper, turn on the flashlight by clicking the On/Off button. Do not shine a flashlight into your eyes or another students' eyes! Just shine it at the table. Have one group member hold the wax paper so that it is a little bit above the table. Hold the flashlight in your hand and point it at wax paper. Look at what the light is doing. What happened to the light? Where did it go? Turn the flashlight off by clicking the same On/Off button. Work with your group to record what you saw on the second page of the *Light It Up!* handout in the square next to the wax paper using your colored pencils/crayons.
- **Fabric:** If you are testing the fabric, turn on the flashlight by clicking the On/Off button. Do not shine a flashlight into your eyes or another students eyes! Just shine it at the table. Have one group member hold the fabric so that it is a little bit above the table. Hold the flashlight in your hand and point it at the fabric. Look at what the light is doing. What happened to the light? Where did it go? Turn the flashlight off by clicking the same On/Off button. Work with your group to record what you saw on the second page of the *Light It Up!* handout in the square next to the fabric using your colored pencils/crayons.

LIGHT IT UP!

EXPLAIN

Once all groups have recorded their final observations, facilitate a class discussion of significant findings. During this time, encourage listening students to contribute by respectfully agreeing or disagreeing with student responses, based on their findings. Ask students:

- What happened to the light when you shined the flashlight onto the plastic wrap? Where did the light go? ***Possible student responses:*** The light went through it; I saw the light go through it and onto the table.
- Based on the plastic wrap's properties, why do you think this happened?
  Possible student responses: The light went through it because it is see-through.
  - ***Tell Students:*** I agree—I also observed the same thing! It seems like the light went through the plastic wrap and onto the table because of its properties. For example, the plastic wrap is clear. You can completely see through it! Due to the properties of materials, like plastic wrap, let light pass through them very easily! That is why you can see the light shine through the plastic wrap and onto the table.
- Let's move on to the wax paper! What happened to the light when you shined the flashlight onto the wax paper? ***Possible student responses:*** The light kind of went through it; I saw some of the light go through it and onto the table.
- Based on the wax paper's properties, why do you think this happened?
  Possible student responses: The light kind of went through it because it's kind of see-through.
  - ***Tell Students:*** It seems like this time, some of the light went through the wax paper and onto the table because of its properties. For example, the wax paper is thin and you can sort of see through it, but not as well as the plastic wrap. Due to the properties of materials, like wax paper, let some light pass through them! That is why you can see some of the light shine through the wax paper and onto the table.
- Finally, let's discuss the fabric. What happened to the light when you shined the flashlight onto the fabric? ***Possible student responses:*** The light didn't go through it; I didn't see the light go through it and onto the table.
- Based on the fabric's properties, why do you think this happened?
  Possible student responses: The light didn't go through it because it is not see-through.
  - ***Tell Students:*** When testing the fabric, none of the light went through it and onto the table because of the properties of the fabric. For example, fabric is very thick to the touch and cannot be seen through at all. Due to the properties of materials, some materials like fabric, do not let light pass through them! That's why you can't see the light shine through the fabric and onto the table.

As we can see, depending on the properties of materials, light can pass through easily or not at all!

LIGHT IT UP!

EXTEND

Draw and label a three-column chart on the board for students to copy in their science journals with the following headings:

- Light Passes Through
- Some Light Passes Through
- No Light Passes Through

Once students have copied the chart, prompt the same student groups to go on a scavenger hunt around the classroom to find examples of these types of materials. Encourage students to explore the properties of materials before testing them by using their sense of sight and touch.

Prompt students to take turns using the flashlight to test materials they find. Students will record their findings in their science journals through drawings and/or words.

Once students have recorded their examples, facilitate a class discussion of their findings, encouraging listening students to respectfully agree or disagree with student responses, based on their findings.[3]

EVALUATE

Prompt students to take a few days to discuss ideas with peers/adults in home and school settings to find examples of materials we use that let light pass through differently.

Once students have had a few days to find and record these examples, facilitate a class discussion of their findings, encouraging listening students to respectfully agree or disagree with student responses, based on their findings. ***Possible student responses:*** My mom and I use measuring cups in the kitchen when we bake. The cups are see-through and let all the light pass through so that we can see and measure how much of something we need; My windows at home don't look like the ones here. My dad said that they are "frosted" windows. They look kind of like wax paper. The windows look like this because we wanted windows that let some light in but not all of it so it isn't too bright; We wear clothes. Clothes are like fabric because they are not see-through. Clothes are like this to keep us safe from the weather outside.

LIGHT IT UP!

DIFFERENTIATION SUGGESTIONS

1. Provide students with a list or pictures of items around the room. Ask students to mark which objects they are able to see with the lights on, and which items they are able to see with the lights off.

2. Provide students with a list of properties to refer to throughout the investigation (e.g., smooth, soft, stretchy, etc.).

3. Provide students with sentence starters to use during the discussion. For example:
   - I agree with _____ because _____.
   - I want to expand on _____ point about _____.
   - I respectfully disagree with _____ because _____.
   - Another way to look at this is _____.

PRE-VISIT ACTIVITY

TOOLS OF THE TRADE

GRADES 3-5

TOOLS OF THE TRADE

OVERVIEW

In this lesson, students will explore how to make a circuit, then identify and classify a selection of items as either conductors or insulators of electricity. After predicting whether an object will conduct an electric current, they will use a bulb and battery circuit to test their predictions.

BACKGROUND

An electric circuit is an unbroken loop of conductive material that allows electrons to flow continuously. If a circuit is "broken," its conductive elements no longer form a complete path, and continuous electron flow cannot occur. Conductors are materials that electricity can flow through easily. These materials are made up of atoms whose electrons can move freely. Insulators are materials that are the opposite of conductors. The atoms in insulators are not easily freed and are very stable, therefore preventing or blocking the flow of electricity.

MATERIALS

- 3 pieces of wire (stripped at the ends)
- 1 D Battery
- 1.5 volt bulb and socket
- Paper fasteners
- Variety of materials that are either conductors or insulators; enough for each group to have ten items (examples: metal paper clip, paper, eraser, aluminum foil, rubber band, pencil, coin, hairclip, key, bobby pin, bottle cap [plastic or metal], nail, toothpick, string, cardboard square, wax paper, etc.)
- Science journals (1 per student)

ARIZONA STANDARDS

4.P4U1.2 Develop and use a model that explains how energy is moved from place to place through electric currents.

TOOLS OF THE TRADE

5E LEARNING CYCLE

ENGAGE

Divide students into groups of 2-3. Give each group a D battery, 2 wires stripped at the ends and a bulb. Ask them to use their critical thinking skills to see if they can figure out a way to get the bulb to light up. Once each group is successful, have them draw a diagram of their circuit.[1]

EXPLORE

Prepare students to experiment with various objects and materials to see which ones will conduct electricity in their circuits, and which ones will not.

Give each group a bag of 10 items (a mix of conductors and insulators). Have each group predict which items they think will conduct electricity and which will not. Prompt students to record their predictions in their science journals.

Give each group a third stripped wire (alternatively, have them cut one of the wires they already have into two pieces and strip the newly cut ends themselves). Have the groups test each item for conductivity, and make a list of which items do complete the circuit successfully and those that do not.[2]

EXPLAIN

Once groups have completed making their lists, facilitate a class discussion about their findings. Ask students:

- After seeing which items work to complete our circuit and which do not, what conclusions can we make?
- What kinds of materials conduct electricity?
- What kinds of materials don't conduct electricity?

Explain that things that conduct electricity are called conductors and things that don't conduct electricity are called insulators. Then, guide students in creating a definition for conductors and insulators that is agreed upon by the class. Add each word to the class word wall or a whiteboard.

EXTEND

Prompt students to think of examples of things they see in their house or at school that are conductors and insulators.[3]

EVALUATE

Have students draw a picture of their testing set-up in their journals, and make a list of the items that were conductors and the items that were insulators.

DIFFERENTIATION SUGGESTIONS

1. Facilitate a class discussion. Call on students to share their diagrams and describe what their circuit looks like. Draw a diagram of a complete circuit on the board or on chart paper for students to reference, as needed.

2. Draw a table with two columns on the board for students to copy into their science journals. Label the first column "Item" and the second column "Does It Conduct Electricity? (Yes/No)". Have students complete the table while engaging in the activity. For additional support, create and copy the table before the lesson for students to use. In column one, include a list or pictures of each material that students will test.

3. Show students a picture of a room in a home (e.g., living room, bedroom, kitchen, etc.). Using their definition, and the list of conductors students identified during the Explore phase, ask students to circle the items they see that are conductors.

PRE-VISIT ACTIVITY

YOU REALLY MOVE ME

GRADES 6-8

YOU REALLY MOVE ME

OVERVIEW

In this investigation, students will predict and test how a magnet will affect the motion of an object at a distance.

BACKGROUND

Forces have the ability to cause changes to an object's motion, even when not touching. For example, magnets act on magnetic objects at a distance through the production of a magnetic field: The area around a magnet where the force of magnetism causes changes to a magnetic object's motion.

ARIZONA STANDARDS

7.P2U1.1 Collect and analyze data demonstrating how electromagnetic forces can be attractive or repulsive and can vary in strength.

MATERIALS

- South magnets
- Cardboard strips
- Cardboard box top
- Scissors
- Tape
- Science journal
- Repulsive Maze Challenge Example Maze
- Magnetic metal washer (1 per group)
- Magnetic metal nut (1 per group)
- Ruler (1 per group)
- 6 cm piece of string, pre-cut (1 per group)
- You Really Move Me! Predictions handout
- You Really Move Me! Investigation Set-Up handout
- Writing utensil (1 per student)
- Whiteboard (1 per classroom)
- Whiteboard markers (1 set per classroom)

5E LEARNING CYCLE

ENGAGE

Distribute the metal nut, metal washer and the *You Really Move Me!* handout to students.

Prepare students for the activity by explaining how we'll be focusing on how we are able to move objects by using magnetic forces. Prompt students to observe the characteristics of the metal washer. Ask students what characteristics they notice that may affect the strength of magnetic force on the object.[1] ***Possible student responses:*** The washer is made out of metal which is magnetic; The washer is flat and seems light in weight which might allow it to travel more distances; The washer is round so it may be able to roll a bit easier in one direction.

Validate student observations and point out that some of the observation trends:

- The washer is metal, and as we have learned, some metals are magnetic.
- The washer is flat and light-weight, which could be beneficial in helping it travel more effectively.

Next, prompt students to observe the metal nut. Ask students what characteristics they notice that may affect the strength of magnetic force on the object.[1] ***Possible student responses:*** The metal nut is made out of metal so it could be magnetic; The metal nut is bulkier than the washer, and this might make it harder to be pulled in a specific direction because of its weight; The metal nut does not have flat sides which could make it harder for it to roll towards the magnet.

Explain that, although these two objects are metal, we are able to see that their shape, weight and overall makeup are different. Now, prompt students to apply their knowledge of characteristics to make predictions! On the *You Really Move Me!* handout, have students make a few predictions about how far they think the magnet will move the metal washer and the nut (in inches).[2] Use your observations of each object's characteristics to help you brainstorm a prediction.

Prompt students to record their predictions on the first question on the *You Really Move Me!* handout. ***Possible student responses:*** I think the magnet will move the nut one inch; I think the magnet will move the nut four inches; I think the magnet will move the washer four inches; I think the magnet will move the washer six inches.

YOU REALLY MOVE ME

EXPLORE

Prepare students to work in groups to test their predictions and record their findings. Put students in groups of four, each completing a very specific job. There will be a distance reader, string holder, magnet mover and data recorder in each group. Once students are divided into groups, have them select which job they would like to complete:

- **Distance Reader:** This student will read the ruler to determine the distance both the nut and washer traveled.
- **String Holder:** This student will hold the string with the nut and washer tied to it at the zero mark of the ruler.
- **Magnet Mover:** This student will slowly move the magnet toward the nut and washer to make the nut and washer move.
- **Data Recorder:** This student will record the results of the investigation for the group.

Distribute the *You Really Move Me! Investigation Set-Up* handout to each group of students, as well as the string, magnet and ruler to each student group. Read the investigation directions and model how to set up the investigation to the class in order to address any questions before they begin the activity.

Prompt student groups to begin setting up their investigation by following the investigation directions on the *You Really Move Me! Investigation Set-Up* handout. Once student groups have set up their investigation, prompt them to begin testing the nut. Once students have completed their investigation with the nut, prompt them to conduct the same investigation using the washer with the same set of instructions. After testing, prompt students to record the results of the investigation in their science journals.

EXPLAIN

Once groups have completed their investigations, students will use the evidence collected to discuss their findings and determine the cause of the difference between the movement of the nut and washer.

Write the following investigation conclusion questions on the board and prompt students to prepare responses to these questions within their investigation groups:

- What caused the nut and washer to move? ***Possible student responses:*** The magnetic force caused the object to move; The attractive force of the magnet pulled the object towards it causing it to move.

EXPLAIN

- Which item seemed to move the farthest? Why do you think this is? ***Possible student responses:*** We think that the washer moved the farthest because of its light weight and ability to slide on the table easier; We think the washer because it is a more flat service and it was easier for it to connect to the magnetic force because of its size.
- How accurate were your predictions? What evidence do you have to support them? ***Possible student responses:*** My predictions were close but not exact compared to the actual results; My predictions were very off from the actual results.

Validate student observations and reiterate that an object's characteristics really do determine the strength of its magnetism when brought into the magnetic field of a magnet. After completing this investigation, remind students that they were able to answer the big question because we used the process of making predictions, testing predictions, recording results and reflecting on findings to arrive at a conclusion. Magnets have a very strong bond, and we saw how strong and powerful they are!

EXTEND

Invite students to apply what they learned in a challenge! Prompt them to use what they learned about magnetic fields and forces to move a magnet through a maze without touching it.

Distribute the *Repulsive Maze Challenge Example Maze*.

Explain to students that the example on the handout is similar to the maze they will be creating in class today! The guidelines for making the maze are:

- Make the maze as challenging as you would like.
- It must be solvable.
- You must be able to move the magnet throughout the maze without touching it.

Prompt students to begin the first step of building the maze by sketching out the design in their science journals. Monitor students during the planning phase and encourage them to share their sketches with others, discussing similarities and differences in designs.

YOU REALLY MOVE ME

EXTEND

Next, prompt students to build their maze! Distribute the cardboard pieces and tape to student groups:

- Cut out pieces of cardboard into strips.
- Tape the strips of cardboard together to match your design.
- Fix the strips to the cardboard box using tape or glue.

Once the mazes are built, prompt students to test their design! Prompt them to consider how they'll get one magnet through the maze without anyone touching it. Provide students with ample time to build and test their mazes.

EVALUATE

As a result of the class discussions and activities, prompt students to return to their initial predictions on their *You Really Move Me!* handout to provide evidence from the investigation and discussion to support or disagree with their predictions.[3]

DIFFERENTIATION SUGGESTIONS

1. Explain to students that characteristics are specific traits or qualities that make each object unique or different from other objects. Provide students with a list of example characteristics to reference.

2. Hand out rulers to each group. Allow students to use the rulers to help them predict how many inches they think the magnet will move each object.

3. Allow students the option of answering the question in writing or verbally to their teacher and/or classmates. For additional support, provide students with sentence stems or guiding questions to help them fully explain whether their evidence supported or refuted their predictions.

BOOK YOUR FIELD TRIP TODAY!

If you have a group of 15 or more,
you are eligible for group discounts!
To schedule your field trip or group visit, head to
AzScience.Org.

ARIZONA SCIENCE CENTER
Never stop wondering.
Never stop imagining.™