

# Solar

educator guide

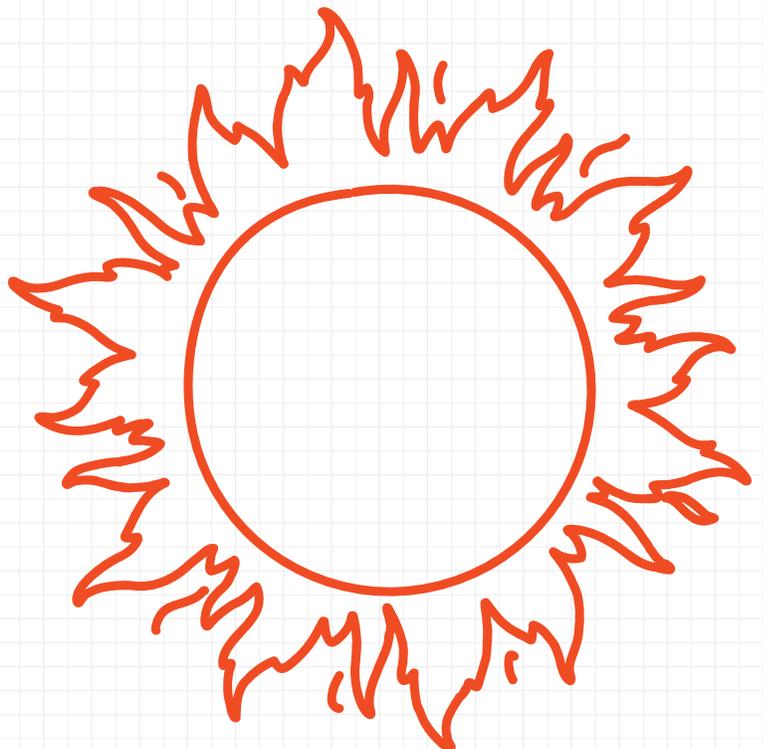
# WELCOME TO THE SOLAR Educator Guide!

**This guide contains information and additional resources that you can use to amplify the activities inside the Learning Lunchbox that each of your students have received.**

**Each box contains three activities equaling to about five hours of STEAM content centered around the Sun, the science of light, magnetism, and eclipses! The supplies to complete each of the activities are inside of the box, along with a pair of solar glasses, so that you can safely watch the next solar eclipse!**

**Inside the Educator Guide, you'll find Grade Banded Learning Standards aligning to each of the activities. You will also find a QR Code linking you to COSI Connects, an online universe of science through videos, activities and so much more! This site also includes a section called Community Connects, a digital hub for resources from museums, cultural institutions and other nonprofits that are available in-person and online.**

**For additional resources, including book recommendations, and video instructions for completing each of the activities inside your box be sure to check out [COSI.org/Kits](https://www.cosi.org/kits).**



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**Dear Educators, Parents, and Caregivers:**

**We know education is important now more than ever, and COSI stands ready to be your partner with this COSI Connects Kit. Together, we will engage, inspire, and transform our students and youth in science, technology, engineering, art, and math (STEAM) at school and at home. These activities correlate directly to Ohio's Learning Standards - the same key learning goals that schools, educators, parents and caregivers use.**

**This box is full of experiences designed to engage learners of all ages! As you look through the Activity Sheets, you will find step-by-step instructions, interactive questions that will promote critical thinking, and explanations of the science behind each activity. If you want to dig deeper into science, additional experiences are available through our free Connects digital platform. In this Educator Guide, you will find the Ohio Learning Standards and Next Generation Science Standards that correspond to each of the activities in this box.**

**These guidelines are provided to prepare educators for using our kits with students. The information included is meant to amplify your experience and assist in the use of the kit. Whether it is your first time facilitating an education experience or your 30th year of teaching in a classroom, we hope this Educator Guide is valuable! We welcome any feedback you may have; simply fill out the questionnaire included in the introduction of the Educator Guide.**

**Kit:** <https://cosi.org/connects/kits/solar-kit.php>

**Resources:** <https://cosi.org/connects/kits/solar-kit-resources.php>

**Connects:** <https://cosi.org/connects>

# Facilitating STEAM Learning with Kits

## Kits Overview

COSI Connects Kits contain carefully designed hands-on STEAM activities that support fun, engaging learning about a topic or theme. Each box comes with:

- **Supplies:** all necessary materials for all 3 activities in the box
- **Activity book:** provides directions for setting up and completing activities, explains relevant STEAM content knowledge and skills, and offers discussion prompts to deepen the learning experience
- **Instructional videos:** Each kit has a QR code linking you to short videos demonstrating how to complete different steps of the activities. If you cannot scan the QR code, you can find the videos online at <https://cosi.org/connects/kits/>. Click on your kit, then click the "Parent/Educator Resources" tab.

## Goals for Using Kits

At COSI, we know science is everywhere and for everyone. To reinforce this message, we've designed our kits to do so much more than just teach STEAM content knowledge. Every kit, regardless of the content or topic, also provides important non-content learning opportunities such as:

- Engaging with STEAM in fun, inspiring, and creative ways
- Making sense of scientific observations
- Seeing oneself as a capable, welcome, and valued STEAM community member
- Practicing a growth mindset by valuing effort and learning over ease and knowing
- Bonding with peers, family, and educators over shared experiences and excitement

## Techniques for Facilitating COSI Connects Kits

Decades of research show that learning is rarely as straightforward as receiving information. This is especially true when the goal is to understand and apply information, not simply recognize and repeat it. Learning and understanding requires the student to make sense of the information for themselves: Have they heard anything like that before? Does it make sense? Does it support or contradict something they already know? Is it useful or interesting enough to warrant the effort to learn and remember it?

When helping your learners accomplish the goals of using a COSI Connects kit, you'll want to ask more questions than you answer (unless they're practical or logistical questions about the directions).

Why? For a few reasons:

- 1) If learners have a question in mind before doing an activity, or before doing a step of the activity, they'll be primed to notice information that is useful for sense-making or question-asking.
- 2) This technique helps you model the process of science for your learners. Instead of assuming what they do or don't know and thus what you need to tell them, you are being curious, collecting data (their knowledge and ideas) and interpreting those data to decide how to most effectively help them.
- 3) This invites critical thinking: you can follow most questions with things like, "Why do you think that?" or "What did you observe during your activity that makes you think that?"
- 4) It shows your learners that you are interested in their experiences, and that you find them valuable and interesting to know.
- 5) If something isn't working, it can help you troubleshoot the issue: Did they skip a step? Use a different material? Was the reaction really fast or really subtle and they missed it?

Make sure you ask your questions with curiosity and openness: you are asking the question because you want to learn your learners' answers, not because you will try and change their minds (even if you do want to!). This will help them feel more comfortable sharing, which will deepen and sustain their conversations and learning.

Technique	Examples of Effective Questions
<p><b>Model the scientific method before, during &amp; after</b>            Scientists work together to collect information (evidence) they can use to answer questions about how things work, why things happen, or even if/when things will happen!</p> <p>They collect this evidence by learning from their peers, making observations, and conducting experiments. Additionally, scientists are never "done" learning: experiments often leave scientists with more questions than answers, which is exciting!</p>	<ul style="list-style-type: none"> <li>• What questions could we answer by doing this activity?</li> <li>• What information could we collect to answer that question? What changes or results could we look for?</li> <li>• What do you think will happen? Why?</li> <li>• What information or knowledge did you use to come up with your answer?</li> <li>• What new questions do you have? What about those questions is interesting to you? How would you collect evidence to answer your questions?</li> </ul>
<p><b>Focus on ideas rather than terminology</b>            If a learner is having a hard time with a particular word or phrase (pronouncing, understanding – anything!), help them find other words to use instead. It's more important for learners to learn by making sense of ideas and practicing skills than it is for them to use terminology correctly.</p>	<ul style="list-style-type: none"> <li>• What are other words that mean the same thing?</li> <li>• How would you explain it to a younger sibling?</li> <li>• Can you act out the word, or draw the word?</li> <li>• Is there a similar word that means something different, and that's making this feel confusing?</li> <li>• How can you remember the information/skill even if you forget the specific word(s)?</li> </ul>

<p><b>Help learners see themselves as scientists by challenging negative misconceptions</b></p> <p>Importantly, “science” is a process, not a product - science is not simply a collection of information or facts. Science is a process of asking questions, making observations to collect information, and thinking carefully to make sense of the information.</p> <p>The goal of science is not to “prove” that a certain idea is “right,” or to get “the correct result” from doing an experiment. If an experiment produces an outcome that suggests a scientist’s idea was wrong, that’s great because there is something new to be learned!</p> <p>A “good” scientist is not somebody who is already very smart, works all by themselves without any help, and never makes mistakes. A “good” scientist is curious, collaborative, and learns from their mistakes.</p>	<ul style="list-style-type: none"> <li>• What does the word “science” mean to you?</li> <li>• Do you think science is interesting? Fun? Exciting? Scary? Boring? Why?</li> <li>• How do we use science to learn about things?</li> <li>• How does science help us understand things?</li> <li>• How do you use science to understand things?</li> <li>• What does the word “scientist” mean to you?</li> <li>• What does a scientist do?</li> <li>• What makes somebody a “good scientist” or “good at science”?</li> <li>• Do you think you can be a scientist?</li> <li>• How are you like a scientist every day?</li> <li>• What attributes make you a good scientist?</li> <li>• Why do you think it’s more important for a scientist to learn from mistakes than to never make mistakes?</li> <li>• Have you ever made a mistake that helped you learn something really useful?</li> </ul>
<p><b>Invite sense-making and peer discussion</b></p> <p>It’s great for learners to have questions because that means they’re curious, and they have the opportunity to learn something new! Ask your learners to share what kit activity information and experiences they’re curious or confused about and want to understand better. Ask other learners in your group to share how they figured something out.</p> <p>This is especially helpful when you have learners who want to work more quickly than others: capitalize on their energy and help them engage more deeply!</p>	<ul style="list-style-type: none"> <li>• Was any part of the kit activity surprising, strange, or even counterintuitive to what you expected?</li> <li>• Why do you think that was surprising/strange/counterintuitive – what made you think that something else would happen?</li> <li>• Did any part of the kit activity not make sense?</li> <li>• Did you see or try anything in the kit activity that helped something make sense?</li> <li>• Do you have any other information or experiences from before the kit activity that helped something make sense?</li> </ul>
<p><b>Explore real-world connections</b></p> <p>Learners are more likely to value the effort required to learn or complete a task if they believe the results will provide something useful and relevant. Personal connections can also help learners see themselves as capable STEAM community members and practitioners.</p>	<ul style="list-style-type: none"> <li>• Is this something you’ve ever wondered about?</li> <li>• Would a friend or family member find this interesting?</li> <li>• How could you use something you learned from this activity in your own life?</li> <li>• How could you use something you learned from this activity to help someone else?</li> </ul>
<p><b>Reflect on progress and experiences</b></p> <p>At the end of each activity, or even after a step within an activity, ask your learners questions that help them see things like:</p> <ul style="list-style-type: none"> <li>• They learned a new fact or skill</li> <li>• They had a fun/cool/interesting experience</li> <li>• They overcame an obstacle and achieved success</li> <li>• They are scientists and they’re doing science</li> <li>• They changed their mind with new information</li> <li>• They turned a “mistake” into a learning opportunity</li> <li>• They wondered new and interesting questions</li> </ul>	<ul style="list-style-type: none"> <li>• What is the most interesting thing you learned?</li> <li>• Was anything confusing at first, but now you understand it better?</li> <li>• Was anything frustrating at first, but it helped you learn something?</li> <li>• Why was it confusing at first? How did you get to understand it better?</li> <li>• What is something you learned that you want to tell a friend or family member?</li> <li>• What is something you learned that you want to use in your everyday life?</li> </ul>

# Kit Accessibility Tips

This is an additional resource to support the success of learners. Below are tips and tools from COSI's accessibility experts that can be used when adapting for learners.

## Fine Motor Adaptations

- Get creative! When completing a movement required activity, think of different ways to accomplish it, like moving an object by attaching it to a wheelchair.
- If an object is too small to handle, swap for similar but larger objects, like switching a bouncy ball for a basketball. You can also attach the smaller object to a larger one to make it easier to hold.
- Use hand over hand to support students when completing fine motor tasks.
- For the writing portions, provide notepaper to give extra space for writing.

## Blind and Low Vision Adaptations

- Use puffy paint on the activity book images to create additional tactile images.
- Use manipulatives (objects) for students to touch when explaining how something works to help students process what is happening.
- Use the camera on a phone or tablet to magnify the words and images in the activity book.

## Deaf Adaptations

- Utilize COSI's demonstration videos with closed captioning when completing an activity.
- Visually demonstrate the activity steps.

## Cognitive Adaptations

- Break the activity into smaller steps to make processing easier.
- For harder to understand concepts use manipulatives (objects) to explain or relate to a practical process.
- Model the steps for the child to follow and complete at the same time.
- Ask leading questions to help students problem solve. For example: "How could you change the shape of the wings to make it fly better?"

## Speech Adaptations

- Have students present in alternate ways, like with drawings or by demonstrating what they did.

# Standards Alignment and Extension Questions

The following pages will include Ohio Learning Standards and Next Generation Science Standards that are aligned with each activity in the kit. In addition to these standards, you will find extension questions to scale up or scale down the content of each activity according to your students' abilities or grade level. These extension questions are arranged in grade level bands of Kindergarten – Second Grade, Third – Fifth Grade, and Sixth – Eighth Grade. Each set of these questions are also aligned with both Ohio Learning Standards and Next Generation Science Standards.

Throughout the kit activities, your students will find opportunities to write down their scientific findings and connect to digital learning resources through COSI Connects. This aligns with the Ohio English Language Arts, Technology, and Digital Literacy Learning standards listed below.

## Kindergarten – 2<sup>nd</sup> Grade

- K-2.ICT.3.b.: Use visuals found in digital learning tools and resources to clarify and add to knowledge.
- W.K.2: Use a combination of drawing, dictating, and writing to compose informative/explanatory texts that name what is being written about and supply some information about the topic.
- W.1.8: With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.
- W.2.8: Recall information from experiences or gather information from provided sources to answer a question.
- K-2.ST.2.a.: Communicate and collaborate using several digital methods.

## Third Grade – Fifth Grade

- 3-5.ICT.1.a.: With guidance, identify and use digital learning tools or resources to support planning, implementing and reflecting upon a defined task.
- W.3-5.10: Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
- 3-5.ICT.4.d.: Produce and publish information appropriate for a target audience using digital learning tools and resources.

## Sixth Grade – Eighth Grade

- 6-8.ICT.4.b.: Select and use a variety of media formats to communicate information to a target audience.

# Vocabulary List

- **Aurora:** Colored lights that appear in the sky when small particles from the sun hit small particles in Earth's atmosphere. Auroras are usually seen in the North and South Poles.
- **Corona:** The outermost layer of the Sun's atmosphere. During a solar eclipse, this is the part of the Sun that is visible.
- **Infrared Light:** A wavelength of light that we cannot see with our eyes. We feel infrared light as warmth.
- **Lunar Eclipse:** When the Earth passes between the moon and the sun, casting a shadow on the Moon.
- **Magnetic Field:** Every magnet has an invisible magnetic field around it. Magnetic objects inside that magnetic field will experience a push or a pull.
- **Particle:** A very small piece of matter.
- **Solar Eclipse:** When the Moon passes between the Earth and the Sun and casts a shadow on the Earth.
- **Solar Wind:** A stream of charged particles that come from the Sun's Corona.
- **Space Weather:** The effects of the Sun on Earth and space. Space weather happens when the sun sends out light and particles into space. Solar wind is one example of space weather.
- **Ultraviolet Light:** A wavelength of light that we cannot see with our eyes. UV light helps our bodies produce vitamin D. It also can give us sunburn.
- **Visible Light:** A wavelength of light that we can see with our eyes. This includes all the colors of the rainbow: red, orange, yellow, blue, indigo, and violet.
- **Wavelength:** The distance between two hills on a wave.



# Solar

## ACTIVITY 1 : Light from the Sun

Explore ultraviolet light with the help of UV beads.

### Ohio Learning Standards

**1.ESS.1:** The sun is the principal source of energy.

### Next Generation Science Standards

**K-PS3-1:** Make observations to determine the effect of sunlight on Earth's surface.

GRADES  
K-2

#### Extended Learning Questions:

- 1) Find two different objects: one that is clear (see-through) and one that is not clear. Describe both objects. Then, go outside. Use one object to cover the beads on the pipe cleaner and wait for one minute. Look at the beads. Did they change color? If so, how much? Repeat the process with the second object. Which object did a better job of blocking UV light?

#### Ohio Learning Standards:

**Kindergarten Science K.PS.1:** Objects and materials can be sorted and described by their properties.

**K – 2<sup>nd</sup> Grade Technology K-2.DT.2.a.:** Observe and describe details of an object's design.

#### Next Generation Science Standards:

**1-PS4-3:** Plan and conduct investigations to determine the effect of placing objects made with different materials in the path of a beam of light.

**K-2-ETS1-3:** Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

GRADES  
3-5

#### Extended Learning Questions:

- 1) How does UV light impact humans? Why is it important to have things like solar glasses, sunglasses, and sunscreen to protect us from UV light?
- 2) Think about the stars that you see at night. Why does the Sun, our solar system's star, look so much brighter than the stars that you see at night?

#### Ohio Learning Standards:

**3<sup>rd</sup> Grade Science 3.PS.3:** Heat, electrical energy, light, sound and magnetic energy are forms of energy.

**5<sup>th</sup> Grade Science 5.ESS.1:** The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.

#### Next Generation Science Standards:

**3-ESS3-1:** Make a claim about the merit of a design solution that reduces the impacts of weather-related hazards.

**5-ESS1-1:** Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.

GRADES  
6-8

#### Extended Learning Questions:

- 1) Find two different objects around you, one dark-colored and one light-colored. Place these two objects next to each other in direct sunlight and wait 10 minutes. Feel the objects. Does one object become warmer than the other? Why do you think this is?
- 2) Different colors absorb light in different ways. Why might this be an important thing to consider in the design process of an object? (Hint: Think about something like the connection between asphalt and rising global temperatures.)

#### Ohio Learning Standards:

**7<sup>th</sup> Grade Science 7.PS.4:** Energy can be transferred through a variety of ways.

**6<sup>th</sup> – 8<sup>th</sup> Grade Technology 6-8.DT.2.e.:** Identify and explain why effective designs develop from non-linear, flexible application of a design process.

#### Next Generation Science Standards:

**MS-PS4-2:** Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

**MS-ETS1-2:** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.



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# Solar

## ACTIVITY 2: Create a Corona

Use a mini explosion to create beautiful artwork of the Sun's corona!

### Ohio Learning Standards

- 2.PS.1: Forces change the motion of an object.
- 8.PS.2: Forces can act to change the motion of objects.

### Next Generation Science Standards

- 3-PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

GRADES  
K-2

#### Extended Learning Questions:

- 1) Was the antacid tablet a solid, liquid, or gas before your experiment? What did it become after it was placed in water?
- 2) How do you think scientists know when a solar eclipse is going to happen?

#### Ohio Learning Standards:

- Kindergarten Science K.PS.1:** Objects and materials can be sorted and described by their properties.
- Kindergarten Science K.ESS.2:** The moon, sun, and stars can be observed at different times of the day or night.

#### Next Generation Science Standards:

- 2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 1-ESS1-1:** Use observations of the sun, moon, and stars to describe patterns that can be predicted.

GRADES  
3-5

#### Extended Learning Questions:

- 1) Did the addition of dye tablets create a new substance? What about the addition of the antacid tablet? Why or why not?
- 2) After it launches into the air, what force causes your film canister to come back down? How did this same force cause the dyed water to create your piece of art?

#### Ohio Learning Standards:

- 4<sup>th</sup> Grade Science 4.PS.1:** When objects break into smaller pieces, dissolve, or change state, the total amount of matter is conserved.
- 5<sup>th</sup> Grade Science 5.PS.1:** The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.

#### Next Generation Science Standards:

- 5-PS1-4:** Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
- 5-PS2-1:** Support an argument that the gravitational force exerted by Earth on objects is directed down.

GRADES  
6-8

#### Extended Learning Questions:

- 1) Is antacid dissolving in water an example of a physical or chemical reaction? How do you know?
- 2) A dissolution happens when a solute dissolves into a solvent. Are all dissolutions examples of chemical reactions? Why or why not? (Hint: Think about the dissolution of salt in water)
- 3) How did the energy of the chemical reaction transfer in this experiment? How do you know?

#### Ohio Learning Standards:

- 7<sup>th</sup> Grade Science 7.PS.2:** Matter can be separated or changed, but in a closed system, the number and types of atoms remains constant.
- 7<sup>th</sup> Grade Science 7.PS.4:** energy can be transferred through a variety of ways.

#### Next Generation Science Standards:

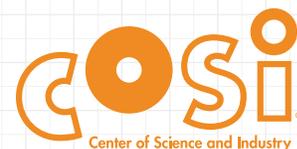
- MS-PS1-2:** Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
- MS-PS3-5:** Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

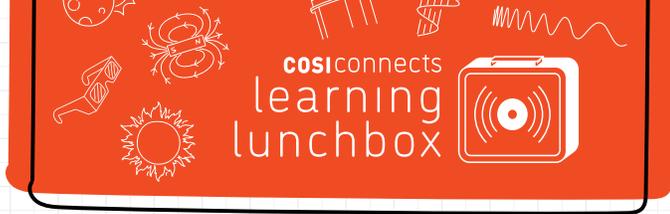


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## ACTIVITY 3: The Sun is a Magnetic Star

Explore magnetic fields with iron filings as you learn about the Sun's dynamic magnetism.

### Ohio Learning Standards

**3.PS.3:** Heat, electrical energy, light, sound and magnetic energy are forms of energy.

### Next Generation Science Standards

**3-PS2-3:** Ask questions to determine cause and effect relationships of electrical or magnetic interactions between two objects not in contact with each other.

GRADES  
K-2

#### Extended Learning Questions:

- 1) Move the magnet around the case of iron filings in different ways and take note of how they are moving. What patterns do you see?
- 1) Find three objects around you that contain metal. Put these objects on your case of iron filings. Do the iron filings move in the same way they did with the magnet? Why or why not?

#### Ohio Learning Standards:

**2<sup>nd</sup> Grade Science 2.PS.1:** Forces change the motion of an object.

**Kindergarten Science K.PS1:** Objects and materials can be sorted and described by their properties.

#### Next Generation Science Standards:

**K-PS2-1:** Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

**2-PS1-2:** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

GRADES  
3-5

#### Extended Learning Questions:

- 1) Brainstorm a list of how magnets are used in your daily life. How are magnets useful? What problems do they solve?
- 2) How does Earth's magnetic field keep us protected from solar wind? Why is that important for us on Earth?
- 3) How do you think scientists can predict space weather?

#### Ohio Learning Standards:

**4<sup>th</sup> Grade Science 4.LS.1:** Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

**5<sup>th</sup> Grade Science 5.ESS.3:** Most of the cycles and patterns of motion between the Earth and sun are predictable.

#### Next Generation Science Standards:

**3-PS2-4:** Define a simple design problem that can be solved by applying scientific ideas about magnets.

GRADES  
6-8

#### Extended Learning Questions:

- 1) Take note of your magnet and iron filings: are these materials directly in contact (touching) at any point? How far away from the iron filings can the magnet be and still make them move?
- 2) What forces can you think of that exist even though the objects are not necessarily touching?

#### Ohio Learning Standards:

**8<sup>th</sup> Grade Science 8.PS.1:** Objects can experience a force due to an external field such as magnetic, electrostatic, or gravitational fields.

#### Next Generation Science Standards:

**MS-PS2-5:** Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.



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