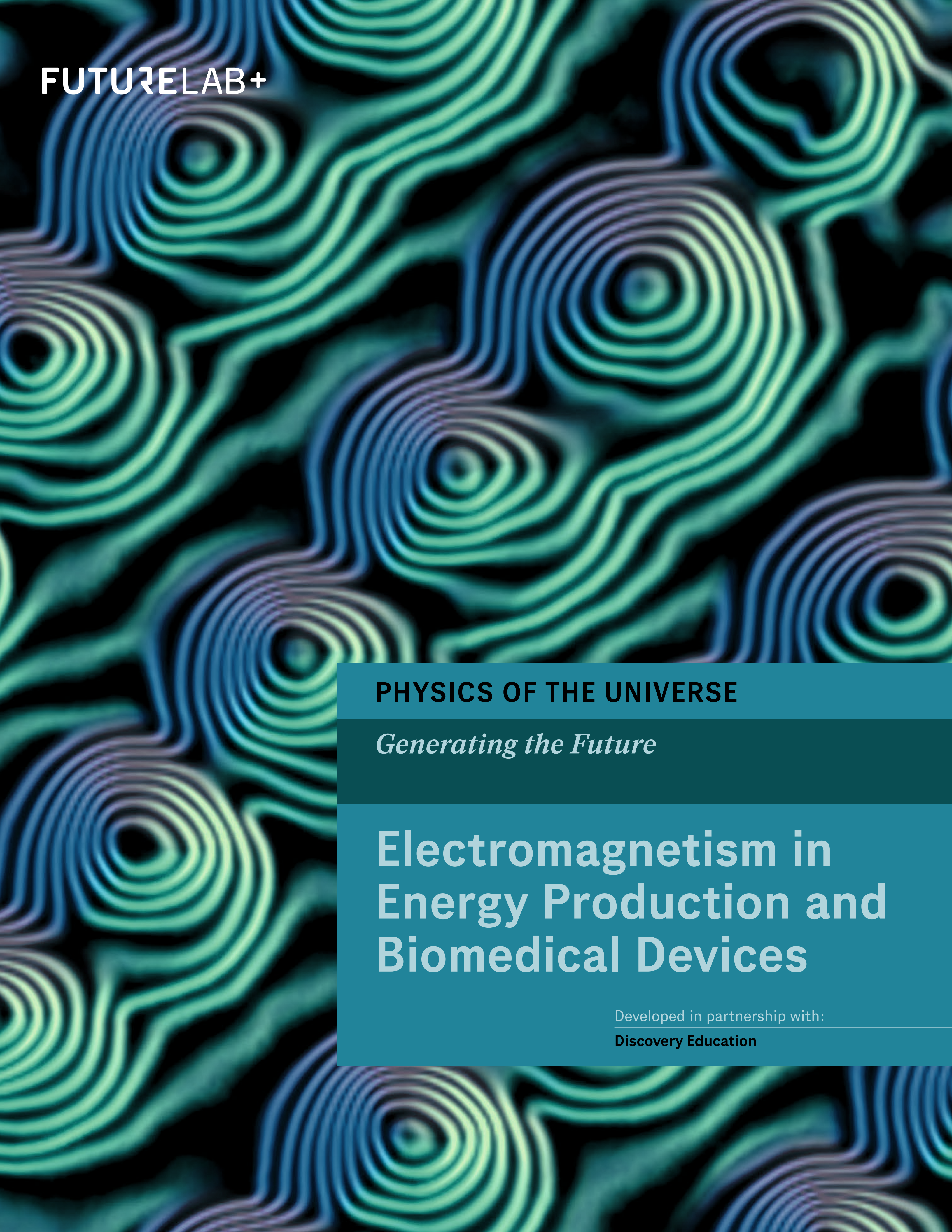


FUTURELAB+

PHYSICS OF THE UNIVERSE

Generating the Future

Electromagnetism in Energy Production and Biomedical Devices

Developed in partnership with:
Discovery Education

In this Lesson Plan:

Print the **Teacher Section** →

Print the **Student Section** →

This document is separated into two sections, For Teachers [T] *and* Student Resources [S]*, which can be printed independently.*

Select the appropriate printer icon above to print either section in its entirety.

Follow the tips below in the Range field of your Print panel to print single pages or page ranges:

Single Pages (use a comma): T3, T6

Page Range (use a hyphen): T3–T6

Cover Image
Image of magnetic flux lines around nickel nanodots.

PHYSICS OF THE UNIVERSE / DETECTING THE UNKNOWN

Electromagnetism in Energy Production and Biomedical Devices

DRIVING QUESTION

How can I create the strongest electromagnetic generator?

OVERVIEW

Some medical machines, like pacemakers, are implanted in patients' bodies. These little computers control a patient's heartbeat and help prevent cardiac irregularities. Until recently, pacemakers were designed to operate off of batteries that needed to be replaced every 7–8 years. Now, engineers are starting to build pacemakers that do not require batteries. Instead, they derive power from a patient's own ions, particles, and fluids through a generator. Generators are devices that create electricity out of a source of energy (wind, water, and solar electricity, for example, are made by generators). Engineers are constantly trying to improve the performance of generators in order to transform more energy into electricity. In this lesson, students learn how generators are built by participating in a design challenge: build an electromagnetic generator that generates the most electrical output out of anyone in the class. To do this, students learn about how generators create electricity through electromagnetic induction. Then, they complete a simulation with an electromagnetic generator in order to identify the four variables that affect a generator's electrical output. Next, students individually sketch a generator design and present their design to their group. In order to create an effective design, students must use the four variables to

Continues next page >

ACTIVITY DURATION

Three Days (45 minutes each)

ESSENTIAL QUESTIONS

How does electromagnetic induction generate electricity?

What are four variables that impact electromagnetic induction?

How can the variables be manipulated to increase electrical output?

OBJECTIVES

Students will be able to:

Explain how a generator creates electricity through electromagnetic induction.

Identify the four variables of electromagnetic induction and explain how they impact electrical output.

Design and build an electromagnetic generator that optimizes electrical output using their understanding of the four variables that impact electromagnetic induction.

Predict electrical output based on how the four variables of electromagnetic induction are seen in electromagnetic generator designs.

OVERVIEW (CONTINUED)

justify their design ideas. From these initial design sketches, the groups use materials provided by their teacher to build their electromagnetic generator. Finally, students participate in a gallery walk where they review other groups' generators and make predictions ranking the generators from lowest to highest electrical output based on the four variables that impact electromagnetic induction. Finally, the teacher tests the generator designs using a galvanometer and students reflect on the results. As an extension, students explore implantable battery-less biomedical devices and present their findings to the rest of the class.

STUDENT TASKS

Day 1	*Day 2*	*Day 3*
Students learn about electromagnetic induction in order to explain how an electromagnetic generator creates electricity. Students perform a lab where they identify the variables that impact electromagnetic induction.	Students individually design a sketch of an electromagnetic generator. Student groups build an electromagnetic generator.	In a gallery walk showcase of the class electromagnetic generators, students analyze the different generator designs using their knowledge of the variables that impact electromagnetic induction and rank the designs from lowest to highest electrical output. After the generators are tested using a galvanometer, students reflect on their predictions using the electrical output data from each design.

MAKE CONNECTIONS!

How does this connect to careers?

Electrical and electronics engineers design and build electrical equipment—everything from computers to airplanes!

Mechatronics Systems Engineers develop cutting edge technologies to improve biological research, save lives, and ultimately, to advance the biotech and health science outcomes. They can design and create previously impossible applications that will be used in biotech industries, biomedical engineering, artificial intelligence, and molecular biology.

Biomedical research and development engineers are responsible for developing and implementing new products using established biotech design control processes and good engineering practices. They use specialized knowledge of product design and development and the design control process to test, analyze and solve biotechnical problems and design cutting-edge biotech products.

Cardiologists diagnose and treat medical conditions related to the circulatory system. They are responsible for prescribing and implanting pacemakers for patients who need them.

EKG technicians take recordings of the heart's electrical signals. These signals help medical professionals determine if a patient's heart is working properly.

How does this connect to our world?

Electromagnetism is the driving force behind technological advancements in modern times

What imaging allows us to do in healthcare, thanks to EMR

EMR can lessen our reliance on fossil fuels

Pedagogical Framing

Instructional materials are designed to meet national education and industry standards to focus on in-demand skills needed across the full product development life cycle—from molecule to medicine—which will also expose students and educators to the breadth of education and career pathways across biotechnology.

Through this collection, educators are equipped with strategies to engage students from diverse racial, ethnic, and cultural groups, providing them with quality, equitable, and liberating educational experiences that validate and affirm student identity.

Units are designed to be problem-based and focus on workforce skill development to empower students with the knowledge and tools to be the change in reducing health disparities in communities.

SOCIAL-EMOTIONAL LEARNING

In this lesson, students will have opportunities to present their learning to their peers, as well as critically, yet respectfully, engage with their peers' presentations and participate in the design and building of an electromagnetic generator. Students will exhibit responsible choice-making, communication, and cooperative skills as they work in student groups. There are opportunities to practice social awareness and self-management skills by making responsible choices, negotiating solutions to conflict with peers, and seeking help when needed.

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

This lesson applies culturally and linguistically responsive instruction to student research into the variables that impact electromagnetic induction and how they can be manipulated to increase electrical output. Strategies include those that allow culturally and linguistically diverse students to voice their ideas in a non-threatening space within small groups. This lesson also uses responsive strategies to allow students to create an electromagnetic generator with a group, to make sure concepts are understood and learning can be demonstrated.

COMPUTATIONAL THINKING PRACTICES

As students learn about electromagnetic generators, they utilize the computational thinking strategies of collecting data, building models, and finding patterns. These skills are valuable to professionals who work in electricity generation, and they will be essential in shifting global energy consumption to renewable sources.

ADVANCING INCLUSIVE RESEARCH

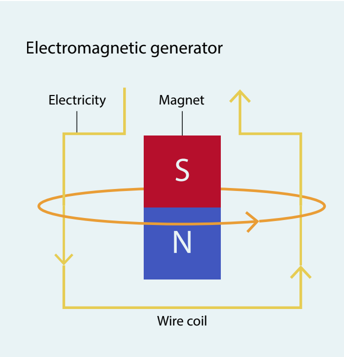
By recording their observations and testing their assumptions, students are practicing an important part of advancing inclusive research: mitigating bias. Researchers' inherent bias can skew the results of a trial and lead to faulty results. By practicing identifying bias in this lesson, students can learn how to apply the skill in other contexts.

CONNECTION TO THE PRODUCT LIFE CYCLE

Electromagnetic generators are in the "manufacture" phase of the product life cycle. Many different kinds of electromagnetic generators, such as water turbines, steam turbines and wind turbines are being made across the world to lessen our reliance on fossil fuels.

Day 1

Slides 1–13



Slides 1–13	
As a class, generate a list of student questions about electromagnetic induction. (20 minutes)	
1	Show the physical model of an electromagnetic generator to students. Have students record their observations in the *Electromagnetic Generator Observation and Questions* capture sheet. Ask students to share their observations using a *Pick a Stick* equitable calling strategy. Have the electromagnet power on an LED light.
2	Have students write down their questions in the *Electromagnetic Generator Observation and Questions* capture sheet. Have students share their questions, again with the *Pick a Stick* strategy, and add them to the Electromagnetism Need to Know List on a large piece of poster paper.
3	Now introduce the Driving Question for the lesson to the students: *How can I create the strongest electromagnetic generator?*
4	Use the driving question to introduce the final design challenge where each team will build an electromagnetic generator in order to see which one is the strongest.
5	Have students write down any new questions they have about the challenge. Have students share their new questions and add them to the Electromagnetism Need to Know List.
6	Ask students: *Which question(s) do we need to know first from the list?* Use a *Raise a Righteous Hand* to solicit volunteers to answer. Guide this conversation to introduce the following question: *What is Electromagnetic Induction?*

COMPUTATIONAL THINKING IN ACTION

As students think about the knowledge they have to collect in order to build their electromagnetic generator models, they are using the computational thinking strategy of collecting data in order to prioritize the information they need to know.

Continues next page >

Day 1

Continued

INDUSTRY AND CAREER CONNECTIONS

Electrical engineers design and build generators, motors, turbines, and other machines that use electricity.

Slides 11–14

Slides 11–13

Students are Introduced to electromagnetism and electromagnetic induction.

1. Use *Electromagnetic Induction* to introduce the topic to students.

2. Sketch a model of the electromagnetic generator and display the model sketch for students to see. Make sure to label the different parts of the model.

3. Provide the *Electromagnetic Induction* resource to students. Have them define the words in the word bank provided with a *Turn and Talk* with a partner. Then, as individuals, they will write a summary explaining how the generator creates electricity through electromagnetic induction to light the LED light on the *Electromagnetic Induction Summary* Capture Sheet. Have them use the sketch of the electromagnetic generator and the word bank provided on the capture sheet to help.

Slide 14

Students identify the four variables that affect electromagnetic induction. (25 minutes)

1. Set up the four stations around the classroom for students to rotate through. For stations 1–3, have a computer with the *Phet Faraday's Electromagnetic Lab*. In the simulation, click the tab titled "generator." This is the simulation that students will interact with at stations 1, 2, and 3. For station four, set up a physical electromagnetic generator with a galvanometer and different types of metal cores: iron, aluminum, steel.

2. Place a sign at each station indicating the title and the station's experiment question. Note: Station signs are included in Educator Resources.
   - **Station 1:** Number of Loops
     Experiment Question: How does the number of loops of an electromagnet generator affect the electricity output?
   - **Station 2:** Wire Loop Area
     Experiment Question: How does the wire loop area of an electromagnet generator affect the electricity output?

Continues next page >

Day 1

Continued

Slide 14

- **Station 3:** Current Strength
  Experiment Question: How does the Bar Magnet strength of an electromagnetic generator affect the electricity output?
- **Station 4:** Metal Core
  Experiment Question: How does the type of metal core of an electromagnetic generator affect the electricity output?

3 Split the class into four groups. Have students explore the experiment question for each station using the *Electromagnetic Generator Station Guide* capture sheet.

Day 2

INDUSTRY AND CAREER CONNECTIONS

EKG operators create reports on patients' hearts that doctors use to diagnose disease. They do this by observing and recording the electrical signals created by a patient's heart. As students observe the different types of generators set up around the classroom and monitor electricity output, they simulate the monitoring done by an EKG technician.

COMPUTATIONAL THINKING IN ACTION

By building their electromagnetic generators, students are utilizing the computational thinking strategy of building models.

Slides 15–24

Slides 15–17

Students review the Electromagnetism Need to Know Questions. (5 minutes)

Review the Electromagnetism Need to Know Questions with students.

1 In their groups, have students review the questions from the list and identify questions they can answer based on the content and work from the previous day.

2 Ask students to identify what new questions they have and add them to the list.

3 Remind students of the Driving Question for the lesson. Now, ask students to identify the questions from the list they need to answer next in order to get close to solving this challenge. Use this discussion to transition to the next section of the class.

Slides 18–24

Students build their Electromagnetic Generators. (40 minutes)

Teacher Note > *Prepare in Advance. Place the materials for the generators into paper bags; one bag for each group. Materials include:*

- LED light
- Iron nails
- 2 D batteries
- Paperclips
- Copper wire
- Cardboard
- Ceramic bar magnets of various sizes
- Magnet
- Wire cutters
- Galvanometer

1 Have students use a *Think, Pair, Share* to discuss what they think are the four variables and how they impact voltage output based on the lab from the previous day. Use this discussion to review the four variables that affect electromagnetic induction. Use the physical electromagnetic generator to help demonstrate these variables.

2 Tell students they will use the following materials to create the strongest electromagnetic generator that will power an LED light.

Continues next page >

Day 2

Continued

Slides 18–24

CULTURALLY AND LINGUISTICALLY RESPONSIVE INSTRUCTION

Using a Plus/Delta strategy to evaluate individual design elements allows small groups to combine any elements from members' designs in such a way that all contributors have an equitable chance of being represented in the final design consensus.

3	To build their generator, tell the students they need to first individually sketch a design in Part 1 of the *Electromagnetic Generator Design* Capture Sheet.
4	Students share their design ideas with their group members.
5	Have groups use these ideas and a *Plus/Delta* strategy to evaluate the individual design ideas and come to a consensus on how to build their physical electromagnetic generator.
6	Have them build their generator using the materials in the bags you prepared in advance.
7	When complete, have students create a final sketch of their electromagnetic generator in Part 2 of the *Electromagnetic Generator Design* Capture Sheet.

Day 3

Slides 25–32

Slides 25–27	
As a class, review the Electromagnetism Need to Know Questions. (5 minutes)	
1	In groups, have students review the questions from the list and identify questions they can answer based on the content and work from the previous day.
2	Ask students to identify what new questions they have and add them to the list.
3	Remind students of the Driving Question for the lesson. Now, ask students to identify the questions from the list they need to answer next in order to get close to solving this challenge. Use this discussion to transition to the next section of the class.

Slides 28–32	
Students use galvanometers to test each group's generator output. (40 minutes)	
1	First, have teams display their electromagnetic generators on tables around the room. Give each team's generator a letter label starting with "A."
2	Then, have a *Gallery Walk* so that each group rotates between each generator. For each generator they visit, students need to make a sketch of the model and record their observations of the four variables that affect output: number of loops, loop area, metal core, and battery strength or magnet size. Have students record these observations in the column titled "Design Observations" of the *Electromagnetic Generator Challenge* capture sheet.
3	Then, have students predict which generator will produce the highest voltage on the galvanometer in the column titled "Predictions" on the capture sheet.
4	Now, test each group's Electromagnetic Generator using the galvanometer. Have students record the readings in the column titled "Voltage Output" on the capture sheet.

Continues next page >

Day 3

Continued

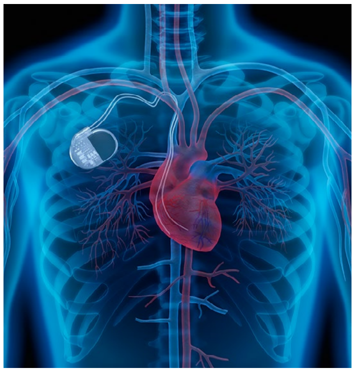
Slides 28–33

5	Finally, have students answer the reflection question in the *Electromagnetic Generator Challenge* Capture Sheet about their predictions. Have them explain why the generator that produced the most electricity did so, using the four variables of voltage output that were seen in the generator's design.

Extension: Slide 33	
1	Ask students what they know about biomedical devices. How are these devices powered?
2	Pass out the "The Promise of Electromagnetism" capture sheet for students to review. Explain to students that they will research how electromagnetism has contributed to battery-less biomedical devices.
3	Divide students in groups of 3–4 students and have them visit the various research stations to learn more about biomedical devices.
4	Students will use *"The Promise of Electromagnetism" presentation template* to create their group's presentation.
5	Once complete, have students present their findings to the class.

Day 3

Continued



Extension: Slides 34–35

Slides 34–35		
Small Groups (45 minutes)		
Ask students what they know about biomedical devices. How are these devices powered?		
1		Pass out the *Electromagnetism in Biomedical Devices* Capture Sheet for students to review. Explain to students that they will research howelectromagnetism has contributed to battery-free biomedical devices.
2		Divide students in groups of 3–4 students and have them visit the various research stations to learn more about biomedical devices.
	a.	*Battery-free Implantable Medical Device*
	b.	*Power Approaches for Implantable Medical Devices*
	c.	*Wireless System Can Power Devices Inside the Body*
3		Students will use *The Promise of Electromagnetism Presentation Template* to create their group's presentation.
4		Once complete, have students present their findings to the class. Another option is to have students upload their video presentations to *Flip* to view and provide feedback.

National Standards

Next Generation Science Standards

Science Engineering Practices (SEP)

Planning and Carrying Out Investigations

Students should have opportunities to plan and carry out several different kinds of investigations during their K–12 years. At all levels, they should engage in investigations that range from those structured by the teacher—in order to expose an issue or question that they would be unlikely to explore on their own (e.g., measuring specific properties of materials)—to those that emerge from students' own questions.

Developing and Using Models

Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system.

Disciplinary Core Ideas (DCI)

PS2.B Types of Interactions

Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.

PS3.A Definitions of Energy

Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.

Crosscutting Concepts (CC)

Energy and Matter

Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

Educator Resources

Station Signs

Directions

Print these signs and post them around the classroom. Students should walk around the room as they explore the experiment question for each station using the Electromagnetic Generator Station Guide Capture Sheet.

Station 1

Number of Loops

Experiment Question:

How does the number of loops of an electromagnet generator affect the electricity output?

Continues next page >

Educator Resources

Station Signs

Continued

Station 2

Wire Loop Area

Experiment Question:

How does the wire loop area of an electromagnet generator affect the electricity output?

Continues next page >

Educator Resources

Station Signs

Continued

Station 3

Current Strength

Experiment Question:

How does the Bar Magnet strength of an electromagnetic generator affect the electricity output?

Continues next page >

Educator Resources

Station Signs

Continued

Station 4

Metal Core

Experiment Question:

How does the type of metal core of an electromagnetic generator affect the electricity output?

Continues next page >

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Electromagnetic Generator Observation and Questions Capture Sheet

Directions

Write down your observations from the demonstration.

	My Observations	My Questions
1		
2		
3		
4		
5		

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Electromagnetic Induction Summary Capture Sheet

Directions

Write a summary explaining how the generator creates electricity through electromagnetic induction to light the LED light. Use the sketch of the electromagnetic generator and the word bank below to help.

Word Bank

Eddy Current	Inductors
Faraday-Henry Law	Transformer
Generator	Loops
Voltage	Wire
Magnet	Magnetic field

How does the generator create electricity through electromagnetic induction to light the LED light?

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Electromagnetic Generator Station Guide Capture Sheet

Directions

Write down your observations from the demonstration.

Station 1	**Number of Loops**
	Experiment Question: How does the type of metal core of an electromagnetic generator affect the electricity output?

Prediction	How do you think the number of loops that are in an electromagnetic generator affects the amount of electricity it generates?

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Simulation Observations

Procedure			Your Observation
Step A	1	In the simulation, click the "Reset All" button.	
	2	Set the bar magnet strength to 50%.	
	3	Set the loop area to 50%.	
	4	In the simulation, adjust the water flow bar all the way to the right so the maximum amount of water is flowing out of the tap.	
	5	Record your observations of the amount of light produced.	
Step B	1	Now increase the number of loops to 3.	
	2	Record your observations of the amount of light produced.	
Step C	1	Now, decrease the number of wire loops to zero.	
	2	Are the issues and concerns valid? Why or why not? Cite evidence.	

Continues next page >

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Conclusion	Did your observations of the simulation support your prediction? How does the amount of loops impact the voltage output?

Continues next page >

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Station 2	Wire Loop Area
	How does the wire loop area of an electromagnet generator affect the electricity output?

Prediction	How do you think the wire loop area of an electromagnet generator affects the electricity output?

Continues next page >

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Simulation Observations

Procedure			Your Observation
Step A	1	In the simulation, click the "Reset All" button.	
	2	Set the bar magnet strength to 50%.	
	3	Set the loop area to 50%.	
	4	Set the number of loops to 2.	
	5	Now, adjust the water flow bar all the way to the right so the maximum amount of water is flowing out of the tap.	
	6	Record your observations of the amount of light produced.	
Step B	1	Now increase the number of loops area to 100%.	
	2	Record your observations of the amount of light produced.	
Step C	1	Now, decrease the loop area to 20%.	
	2	Record your observations of the amount of light produced.	

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Conclusion	Did your observations of the simulation support your prediction? How does the amount of loops impact the voltage output?

Continues next page >

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Station 3	Current Strength
	How does the bar magnet strength of an electromagnetic generator affect the electricity output?

Prediction	How do you think the bar magnet strength of an electromagnetic generator affects the electricity output?

Continues next page >

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Simulation Observations

Procedure			Your Observation
Step A	1	In the simulation, click the "Reset All" button.	
	2	Set the bar magnet strength to 50%.	
	3	Set the loop area to 50%.	
	4	Set the number of loops to 2.	
	5	Now, adjust the water flow bar all the way to the right so the maximum amount of water is flowing out of the tap.	
	6	Record your observations of the amount of light produced.	
Step B	1	Now increase the number of loops area to 100%.	
	2	Record your observations of the amount of light produced.	
Step C	1	Now, decrease the bar magnet strength to 0%.	
	2	Record your observations of the amount of light produced.	

Continues next page >

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Conclusion	Did your observations of the simulation support your prediction? How does the amount of loops impact the voltage output?

Continues next page >

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Station 4	Metal Core
	How does the type of metal core of an electromagnetic generator affect the electricity output?

Prediction	How do you think the type of metal core of an electromagnetic generator affects the electricity output?

Continues next page >

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Simulation Observations

Procedure			Your Observation
Step A	1	Wrap the wire around the nail.	
	2	Connect the galvanometer to the generator and record your observations of the voltage level.	
Step B	1	Replace the nail with the aluminum rod.	
	2	Connect the galvanometer to the generator and record your observations of the voltage level.	
Step C	1	Replace the nail with the steel rod.	
	2	Connect the galvanometer to the generator and record your observations of the voltage level.	

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Electromagnetic Generator Station Guide Capture Sheet

Continued

Conclusion	Did your observations of the simulation support your prediction? How does the amount of loops impact the voltage output?

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Electromagnetic Generator Design Capture Sheet, Part 1

Directions

Create a prototype drawing of the electromagnetic generator. Make sure you use and label the materials in the list below in your drawing.

Possible Materials

LED light	Copper wire
Iron nails	Cardboard
2D batteries	Ceramic bar magnets
Paperclips	Wire coat hanger

Electromagnetic Generator Sketch

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Electromagnetic Generator Design Capture Sheet, Part 2

Directions

Create a prototype drawing of the electromagnetic generator. Make sure you label the different parts of the generator and indicate the four variables:

1. *The number of wire loops*
2. *The wire loop area*
3. *Size and strength of the magnet or battery*
4. *Type of metal core*

Electromagnetic Generator Final Design

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Electromagnetic Generator Challenge Capture Sheet

Directions

Circulate around the room to view each group's generator and fill in the table. Then answer the reflective questions on the next page.

1. In the *Design Observations* column, record observations of the four variables that affect output. After observing all designs, use the *Prediction* column to indicate which generator you believe will produce the highest voltage on the galvanometer. Your response will be a number with one being the generator you believe will have the lowest voltage output. Finally, test and record the readings in the *Voltage Output* column.

	Design Observations	Prediction	Voltage Output
A			
B			
C			
D			
E			

Continues next page >

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Electromagnetic Generator Station Guide Capture Sheet

Continued

2. Answer the four reflection questions.

A	How close did you predict the designs from lowest to highest voltage output?	
B	Compare and contrast the design of the highest output to the design of the lowest voltage output. Use the four variables of voltage output to help you answer the question.	
C	Why do you think the generator that produced the lowest electricity did so? Use the four variables of voltage output to help you answer the question.	
D	Why do you think the generator that produced the most electricity did so? Use the four variables of voltage output to help you answer the question.	

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Electromagnetism in Biomedical Devices Capture Sheet

Directions
Research how electromagnetism is revolutionizing biomedicine by exploring three different research stations. At each station, record your findings in the appropriate space in the table below.

1 *Battery-free Implantable Medical Device*

A	Describe the source you are viewing. Is it a scholarly article or a news article? Is it a primary or secondary source?	
B	Outline three of the article's major points.	
C	What is special or new about the technology being described in the article?	
D	What do you see as potential benefits of this technology? What do you see as potential risks?	

Continues next page >

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Electromagnetism in Biomedical Devices Capture Sheet

Continued

2 *Power Approaches for Implantable Medical Devices*

A	Describe the source you are viewing. Is it a scholarly article or a news article? Is it a primary or secondary source?	
B	Outline three of the article's major points.	
C	What is special or new about the technology being described in the article?	
D	What do you see as potential benefits of this technology? What do you see as potential risks?	

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Electromagnetism in Biomedical Devices Capture Sheet

Continued

3 *Wireless System Can Power Devices Inside the Body*

A	Describe the source you are viewing. Is it a scholarly article or a news article? Is it a primary or secondary source?	
B	Outline three of the article's major points.	
C	What is special or new about the technology being described in the article?	
D	What do you see as potential benefits of this technology? What do you see as potential risks?	

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The Promise of Electromagnetism Presentation Template

Directions
Use the template below to design your presentation. Then, build your presentation in a slide deck software such as Flipgrid.

1 Title	
2 Overview One to two sentences that summarize your findings.	

3 Research
Use the Electromagnetism in Biomedical Devices Capture Sheet to share your research.

	Resources	*Battery-free Implantable Medical Device*	*Power Approaches for Implantable Medical Devices*	*Wireless System Can Power Devices Inside the Body*
A	Source Type			
B	Major Points			
C	New or Special Technology			
D	Benefits or Risks			

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The Promise of Electromagnetism Presentation Template

Continued

4 Conclusion One to two sentences that summarize your learnings.	

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The Promise of Electromagnetism Presentation Rubric

Directions

Evaluate the presentation by responding with reflective comments based on the expectations below. Use the space in the center column to share evidence with the group. Use the Feedback column for areas of growth and the Exceeded column for areas that excel.

Feedback How can this presentation be improved?	Baseline How does this presentation meet expectations?	Exceeded How does the presentation exceed expectations?
	Content: presentation is thorough and has lots of good information.	
	Style: presentation is clear and easy to understand.	
	Accuracy: presentation includes facts and cites sources.	
	Format: presentation shows prior preparation and uses a visual tool, such as a video, slide deck, etc.	