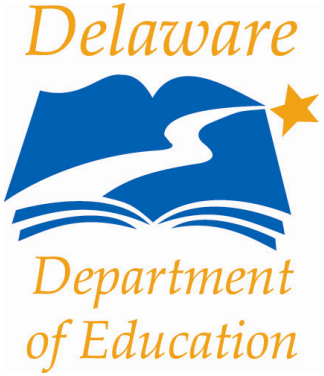
Delaware Science Coalition

Grade 4 Magnetism and Electricity Unit Template



Preface: This unit has been created as a model for teachers in their designing or redesigning of course curricula. It is by no means intended to be inclusive; rather it is meant to be a springboard for teacher thought and creativity. The information we have included represents one possibility for developing a unit based on the Delaware content standards and the Understanding by Design framework and philosophy.

Brief Summary of Unit:

In this unit, students explore permanent magnetism, electric circuits (series/parallel), and electromagnetism through free exploration and systematic investigations. They observe and compare electric and magnetic phenomena, and organize their observations on a graph. They apply their knowledge to design a telegraph.

Stage 1: Desired Results
Delaware Science Content Standards

Delaware Science Content Standards

This course focuses on the Delaware Science Content Standards and Grade Level Expectations in Standards 1, 2, and 3 found on the following web site: http://www.doe.k12.de.us/programs/ci/content_areas/science.shtml

Standard 1: Nature and Application of Science and Technology

Understandings and Abilities of Scientific Inquiry

Students should know and be able to;

1. Understand that: Scientific investigations involve asking a focused scientific question. Investigations differ depending upon the question being asked.
    - Be able to: Generate focused questions and informed predictions about the natural world.
2. Understand that: Fair test design supports the validity of the investigation. Sometimes it is not possible to know everything that will have an effect on the investigation or control all conditions.
    - Be able to: Design and conduct simple to multi-step investigations in order to test predictions. Keep constant all but the condition being tested.
3. Understand that: The purpose of accurate data collection is to provide evidence to compare with the prediction.
    - Be able to: Accurately collect data using observations, simple tools and equipment. Display and organize data in tables, charts, diagrams, and bar graphs or plots over time. Compare and question results with and from others.
4. Understand that: The body of scientific knowledge grows as scientists ask questions, conduct investigations, develop explanations and compare results with what is already known.

- Be able to: Construct a reasonable explanation by analyzing evidence from the data. Revise the explanation after comparing results with other sources or after further investigation.

5. Understand that: The purpose of communicating is to share and justify results. Scientists communicate their results to others, including the details that allow others to replicate the results.
    - Be able to: Communicate procedures, data, and explanations to a variety of audiences. Justify the results by using evidence to form an argument.
6. Understand that: The use of mathematics, reading, writing, and technology are important in conducting scientific inquiries.
    - Be able to: Use mathematics, reading, writing, and technology when conducting scientific inquiries.

Science, Technology, and Society
Students should know that:

1. Science and technology are related. Technology provides the tools needed for science to investigate questions and may provide solutions to society's problems, wants, or needs. Not all technological solutions are effective, uniformly beneficial, or equally available to everyone.

Students should be able to:

- Using books, computers, and other resources, search for ways that people use natural resources to supply energy needs for lighting, heating, and electricity. Report your results by making a poster, written report or oral presentation.

Science Standard 2 Materials and Their Properties
Properties and Structure of Materials
Students should k now that:

1. Observable physical properties can be used to classify materials. These physical properties may include solubility, mass, magnetism, and electrical conductivity. Tools such as graduated cylinders, balances, rulers, magnifiers, simple circuits, and magnets are used to study the physical properties.

Students should be able to :

- Test objects for their conductivity and classify the objects based on whether they conduct electricity (conductors) or do not conduct electricity (insulators).
- Test objects for their magnetism and classify objects based on whether they are attracted to a magnet or not attracted to a magnet.

Science Standard 3 Energy and Its Effects

The Forms and Sources of Energy
Students should know that:

6. The energy obtained from electrical outlets is electrical energy that was produced at an electrical power plant.

7. Electrical energy can be generated and then transmitted over great distances. Batteries are portable sources of electrical energy.

Students should be able to:

- Identify, as basic forms of energy; light, heat, sound, electrical, and energy of motion.

Forces and the Transfer of Energy

Students should know that:

1. Force is any push or pull exerted by one object on another. Some forces (e.g., magnetic forces and gravity) can make things move without touching them.

Students should be able to:

- Recognize magnetism as a force that attracts or repels a variety of common materials and identify the physical property of materials that makes them attracted to magnets.

6. The energy of electricity is transferred to electrical devices through simple closed circuits (simple series or simple parallel circuits).

Students should be able to:

- Identify the basic components (i.e., battery, wires, bulbs, switch) of an electric circuit and understand their function. Draw an example circuit and label the important parts. Relate that circuits must take the form of complete (closed) loops before electrical energy can pass.
- Use diagrams to illustrate ways that two light bulbs can be attached in simple series and in parallel to a battery to make a complete circuit. Explain any differences that will result in the brightness of the bulbs, depending upon the way they are connected to the battery.
- Demonstrate, through writing and drawing, a variety of ways to construct open, closed, simple parallel and series circuits. List the advantages and/or disadvantages of series and parallel circuits.
- Use knowledge of electric circuits to explain how a wall switch can be used to "turn on" and "turn off" a ceiling lamp.
- Observe diagrams or pictures of a variety of circuits and demonstrate how the switch can be used to open or close the circuit.

7. Some materials allow electricity to flow freely (conductors), while other materials inhibit the flow of electricity (insulators).

Students should be able to:

- Test objects for their conductivity and classify the materials based on whether they conduct electricity (conductors) or do not conduct electricity (insulators). Choose which materials would be used to construct a circuit and justify your choices.

8. Some materials are magnetic and can be pushed or pulled by other magnets.

Energy Interacting With Materials; the Transformation and Conservation of Energy

Students should know that:

3. Electrical energy in circuits can be changed (transformed) into light, heat, sound, and the energy of motion.

Students should be able to:

- Observe that electricity can be transformed into heat, light, and sound as well as the energy of motion. Explain that electrical circuits provide a means of transferring electrical energy from sources such as batteries to devices where it is transformed into heat, light, sound, and the energy of motion.

The Production, Consumption, and Application of Energy
Students should know that:

1. The production of most of the energy that we use in our daily lives comes from energy stored in natural resources. The quantity of these resources is limited, so it is important to conserve our natural resources by using them wisely.

Students should be able to:

- Explain where the electrical energy available at an electric outlet in your home or school comes from.
- Using books, computers, and other resources, search for ways that people use natural resources to supply energy needs for lighting, heating, and electricity. Report your results by making a poster, written report or oral presentation.

Big Ideas

1. Observation and Evidence: Observe the changes in the force of attraction.

2. Properties of materials: Conductors vs. Insulators; Magnetic vs. Non-Magnetic.

3. Processes to create a circuit system.

4. Application of electricity and magnetism in the interaction of science and technology
(application is covered in readings but not through investigative activities within kit)

5. Investigate the force of magnetism and the conditions that may affect magnetism

6. Reasoning and Explanation: Comparing/contrasting different types of circuits.

7. Interactions between electricity and materials.

8. Accurate data collection is to provide evidence to compare with the prediction.

9. Accurately collect data using observations, simple tools and equipment. Display and organize data in tables, charts, diagrams, and bar graphs. Compare and question results with and from others.

10. Contributions by individuals have been essential in advancing the body of scientific knowledge.

11. Electrical energy in circuits can be changed (transformed) into light, heat, sound, and the energy of motion.

Unit Enduring Understandings

Students will understand that…

1. A series circuit has only one pathway for electricity to flow through.
2. A parallel circuit has two or more pathways for electricity to flow through.
3. The strength of an electrical current can be varied dependent on the number of electrical sources and the distance electricity travels.
4. Metal materials conduct electricity and non-metal materials are insulators and do not conduct electricity.
5. Magnets will attract iron and steel,
6. Magnetic forces can attract or repel each other,
7. We use trouble-shooting strategies or reasonable evidence to complete an incomplete circuit,
8. Electrical energy in circuits can be changed (transformed) into light, heat, sound (telegraph) and the energy of motion.
9. The purpose of accurate data collection is to provide evidence in the form of a data chart, line and bar graph to compare with their prediction.
10. Fair test design supports the validity of the investigation. Sometimes it is not possible to know everything that will have an effect on the investigation or control all conditions through the comparison of investigation results with others.

Unit Essential Question(s)

1. Explain what is needed to complete a simple circuit and why?
2. Describe and explain the path of electricity through a given circuit.

3. What happens to a light bulb when connected to a complete circuit and explain why?

4. Given metallic and non-metallic objects, explain which you would use to complete a circuit and why?

5. How is the flow of electricity the same and different in a series versus parallel circuit? How would you tell?

6. Given certain materials, how would you classify them as magnetic/non-magnetic?

Knowledge & Skills

Students will know….

- What are a series and parallel circuit,
- More sources of electricity will increase the amount of current,
- What materials are conductors and which are insulators,
- That electricity can produce light, heat, sound, and motion,
- That energy flows a complete circuit,
- That magnets will be attracted to iron,
- That magnetic forces can cause a push or pull,
- That certain variables may affect the result of an investigation

Students will be able to (Grade Level Expectations)…

Compare/contrast a series and parallel circuit,

Observe that electricity can be transformed into heat, light, and sound as well as the energy of motion. Explain that electrical circuits provide a means of transferring electrical energy from sources such as batteries to devices where it is transformed into heat, light, sound, and the energy of motion.

Identify the basic components (i.e., battery, wires, bulbs, switch) of an electric circuit and understand their function. Draw an example circuit and label the important parts. Relate that circuits must take the form of complete (closed) loops before electrical energy can pass,

Use diagrams to illustrate ways that two light bulbs can be attached in simple series and in parallel to a battery to make a complete circuit. Explain any differences that will result in the brightness of the bulbs, depending upon the way they are connected to the battery,

Test objects for their conductivity and classify the materials based on whether they conduct electricity (conductors) or do not conduct electricity (insulators). Choose which materials would be used to construct a circuit and justify your choices.

Demonstrate, through writing and drawing, a variety of ways to construct open, closed, simple parallel and series circuits. List the advantages and/or disadvantages of series and parallel circuits.

Use knowledge of electric circuits to explain how a wall switch can be used to "turn on" and "turn off" a ceiling lamp.

Observe diagrams or pictures of a variety of circuits and demonstrate how the switch can be used to open or close the circuit.

Recognize magnetism as a force that attracts or repels only other magnets.

Explain that electrical energy is a form of energy that is transferred through circuits to devices that are designed to make use of this form of energy (e.g., lamps, fans, computers, etc.).

Test objects for their magnetism and classify objects based on whether they are attracted to a magnet or not attracted to a magnet. Identify the physical property of materials that makes them attracted to magnets.

Generate focused questions and informed predictions about the natural world.

Design and conduct simple to multi-step investigations in order to test predictions. Keep constant all but the condition being tested.

Accurately collect data using observations, simple tools and equipment. Display and organize data in tables, charts, diagrams, and bar graphs or plots over time. Compare and question results with and from others.

Construct a reasonable explanation by analyzing evidence from the data. Revise the explanation after comparing results with other sources or after further investigation.

Communicate procedures, data, and explanations to a variety of audiences. Justify the results by using evidence to form an argument.

Use mathematics, reading, writing, and technology when conducting scientific inquiries.

Stage 2: Assessment Evidence
(Design Assessments To Guide Instruction)

Suggested Performance Task(s)

The Magnetism and Electricity unit is assessed through the use of an end-of-unit summative assessment. This assessment is intended to uncover student misconceptions, which will then inform instruction. Both the student guide and teacher rubrics are included. To access the end-of-unit summative assessment, go to the web site listed below. Click on the Delaware Science Comprehensive Assessment Program.

http://www.doe.k12.de.us/programs/ci/content_areas/science.shtml

Key Transfer Ideas
1. Electric circuits have key components.
2. A circuit must be complete for electricity to light a bulb.
3. A switch functions to cause a break in the circuit.
4. Conductors conduct electric current whereas insulators do not.

Student expectations:

- Construct a simple circuit.
- Draw a complete circuit.
- Recognize key components of an electric circuit.
- Trace the path of electricity through a complete circuit.
- Manipulate selected materials such as wires, clips, a battery, and a bulb.
- Understand the function of a switch.
- Distinguish conductors from insulators.
- Troubleshoot a problem in an electric circuit.

Other Evidence

Possible Formative Assessments from Investigations

Investigation 1: The Force
Part 1: Student sheet #3 – Magnetic Observations
Part 3: Student sheet #5 – The Force

Investigation 2: Making Connections
Part 1: Student sheet #7 – The Flow of Electricity
Part 2: Student sheet #9 – Response Sheet (Bulbs)

Part 4: Student sheets #11 and 12 – Mystery Circuits and Making Connections

Investigation 3: Advanced Connections
Part 2: Student sheet #16 – Response Sheet (Circuit Design)
Part 3: Student sheet #17 – Recommendation to the Board

Stage 3: Learning Plan
(Design Learning Activities To Align with Goals and Assessments)

Key learning events needed to achieve unit goals

Resource: The Regents of the University of California. *Foss Kit: Magnetism and Electricity*. 2000. Delta Education.

Investigation 1: Investigate the Force
Part 1 – Investigating Magnets and Materials: Students will find objects that have certain magnetic force (Iron) and that magnets will attract and repel.

Part 2 – Investigating More Magnetic Properties: Students find out that the magnetic force acts through materials.

Part 3 – Breaking the Force: The students will collect accurate data to provide evidence in the form of a data chart, table, and bar graph to compare with their prediction and results.

Investigation 2: Making Connections
Part 1 – Lighting a Bulb: Students will use trial and error to create a simple circuit and begin to provide evidence of a complete circuit. Students will also begin to develop concepts and understand the pathway of electricity through a circuit.

Part 2 – Making a Motor Run: Students create a circuit with a D-Cell and motor. Students will begin to understand that electrical energy in circuits can be changed (transformed) into light, heat, sound and the energy of motion.

Part 3 – Finding Conductors and Insulators: Students will build a circuit to determine whether certain objects are conductors or insulators.

Investigation 3: Advance Connections
Part 1 – Building a Series Circuit: Students find ways to invent a series circuit to operate more than one component. Students will discover that a series circuit has only one pathway for electricity to flow through.

Part 2 – Building a Parallel Circuit: Students find other ways to operate multiple components using a parallel circuit. Students will discover that a parallel circuit has more than one pathway for electricity to flow through.

Part 3 – Solving the String of Lights Problem: Students will determine which type of circuit is best in using a string of lights by use trouble-shooting strategies or reasonable evidence.

Resources & Teaching Tips

- **What text/print/media/kit/web resources best support this unit?**

Foss Science Stories:

Investigation 1:
Part 1 - Magnus Gets Stuck (pages 1-4)
Part 2 - Magnificent Magnetic Models (page 5)

Investigation 2:
Part 3 – Making Static (page 7)
Part 3 – A fictional interview with Benjamin Franklin (pages 8 -9)
Two Resources about Edison (pages 10-11)

Investigation 3:
Part 1 - Illuminating Teamwork (pages 12-15)
Part 2 – A True Pioneer (Page 16)

Website: www.fossweb.com

- **What tips to teachers of the unit can you offer about likely rough spots/student misunderstandings and performance weaknesses, and how to troubleshoot those issues?**

  - Check batteries, light bulbs and motors before investigations
  - Ask essential questions after each investigation
  - Not all metal is magnetic
  - Variables will affect outcomes of investigations
  - Wires must be firmly attached (connected) within the circuit

- Iron filings are messy
- Wires need to be stripped at ends before using
- Teachers may want to set up the balances
- Go over conclusions from graph (Investigation 1: Part 3)
- Background information is for teacher only!
- Stress to students to stay away from electrical outlets
- Discuss class safety rules before each investigation
- Review previous concepts before next investigation
- Check materials after each investigation
- Think aloud in the classroom for certain concepts

Accommodation/Differentiation ideas and tips