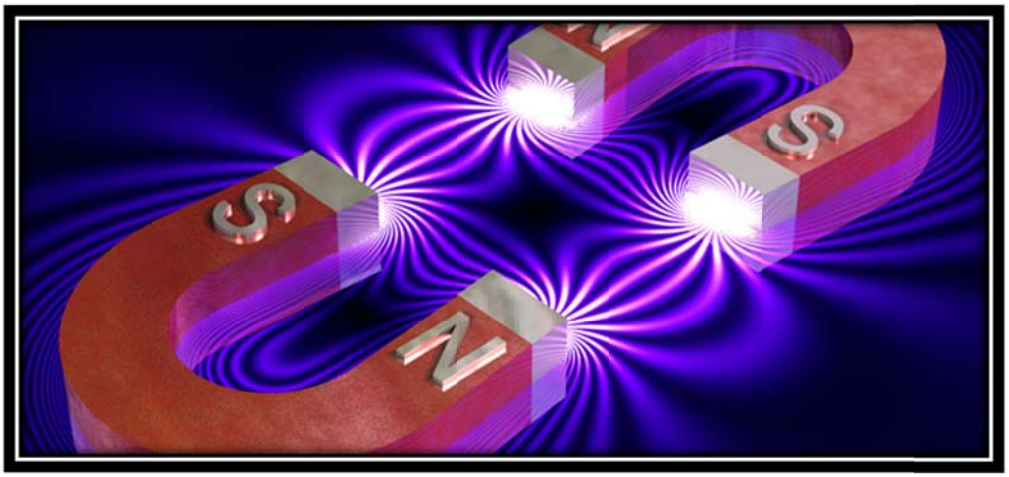
MAGNETISM

GRADE 4

ASSESSMENT PACKET

A comprehensive course that teaches the big ideas behind Maxwell's Principles. You'll discover how to detect magnetic poles and magnetic fields, learn about electromagnetism as they construct motors, generators, doorbells and earphones, and uncover the mysterious link between electricity and magnetism that marks one of the biggest discoveries of all science, ever.



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This curriculum is aligned with the National Standards and STEM for Science.

Educational Goals

The scientific principles we're going to cover were first discovered by a host of scientists in the 19th century, each working on the ideas from each other, most prominently James Maxwell. This is one of the most exciting areas of science, because it includes one of the most important scientific discoveries of all time: how electricity and magnetism are connected. Before this discovery, people thought of electricity and magnetism as two separate things. When scientists realized that not only were they linked together, but that one causes the other, the field of physics really took off.

Here are the scientific concepts:

Magnets

- Magnetic fields are created by electrons moving in the same direction. Electrons can have a "left" or "right" spin. If an atom has more electrons spinning in one direction than in the other, that atom has a magnetic field.
- If an object is filled with atoms that have an abundance of electrons spinning in the same direction, and if those atoms are lined up in the same direction, that object will have a magnetic force.
- A field is an area around an electrical, magnetic or gravitational source that will create a force on another electrical, magnetic or gravitational source that comes within the reach of the field.
- In fields, the closer something gets to the source of the field, the stronger the force of the field gets. This is called the inverse square law.
- A magnetic field must come from a north pole of a magnet and go to a south pole of a magnet (or atoms that have turned to the magnetic field.)
- All magnets have two poles. Magnets are called dipolar, which means they have two poles. The two poles of a magnet are called north and south poles. The magnetic field comes from a north pole and goes to a south pole. Opposite poles will attract one another. Like poles will repel one another.
- Iron and a few other types of atoms will turn to align themselves with the magnetic field. Over time, iron atoms will align themselves with the force of the magnetic field.
- The Earth has a huge magnetic field. The Earth has a weak magnetic force. The magnetic field comes from the moving electrons in the currents of the Earth's molten core. The Earth has a north and a south magnetic pole which is different from the geographic North and South Pole.
- Compasses turn with the force of the magnetic field.

Electromagnetism

- Magnetism is caused by moving electrons.
- Electricity is moving electrons.
- Electricity causes magnetism.
- Moving magnetic fields can cause electrons to move.
- Electricity can be caused by moving magnetic fields.
- Electricity is a flow of electrons.
- A flow of electrons creates a magnetic field.
- Magnetic fields can cause a flow of electrons.
- Magnetic fields can cause electricity.

By the end of the labs in this unit, students will be able to:

- Build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.
- Understand how electric currents produce magnetic fields.
- Know how to build and use an electromagnet.
- Construct electric motors, electric generators, and simple devices, such as doorbells and earphones.
- Understand that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.
- Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- Measure and estimate the weight, length, or volume of objects.
- Formulate and justify predictions based on cause-and-effect relationships.
- Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
- Construct and interpret graphs from measurements.
- Follow a set of written instructions for a scientific investigation.

NOTE: This assessment packet contains two sets of evaluations: one for general magnetism and one for electromagnetism.

Magnets Grade 4 Evaluation

Teacher Section

Overview Kids will demonstrate how well they understand important key concepts from this section.

Suggested Time 45-60 minutes

Objectives Students will be tested on the key concepts of magnetism:

1. All magnets have two poles. Magnets are called dipolar, which means they have two poles. The two poles of a magnet are called north and south poles. The magnetic field comes from a north pole and goes to a south pole. Opposite poles will attract one another. Like poles will repel one another.

2. A magnetic field is an area around a magnet that will create a force on another magnet that comes within reach of the magnetic field. In fields, the closer something gets to the source of the field, the stronger the force of the field gets. This is called the inverse square law.

3. The Earth has a huge magnetic field. The Earth has a weak magnetic force. The magnetic field comes from the moving electrons in the currents of the Earth's molten core. The Earth has a north and a south magnetic pole which is different from the geographic north and south pole.

4. Compasses turn with the force of the magnetic field.

5. Iron and a few other types of atoms will turn to align themselves with the magnetic field.

Students will also demonstrate these principles:

6. Design and build a simple compass and use it to detect magnetic effects, including Earth's magnetic field.
7. Design and build experiments that demonstrate the principles above.
8. Know how to demonstrate that magnets attract or repel each other.

Materials (one set for entire class)

- Needle
- Foam
- 2 different kinds of magnets (round or square, N-S pole locations different, etc.)
- Cup of water
- Paperclip
- Penny
- Quarter

Lab Preparation

1. Print out copies of the student worksheets, lab practical, and quiz.
2. Have a tub of the materials in front of you at your desk. Kids will come up when called and demonstrate their knowledge using these materials.

Lesson

The students are taking two tests today: the quiz and the lab practical. The quiz takes about 20 minutes, and you'll find the answer key to make it easy to grade.

Lab Practical

Students will demonstrate individually that they know magnetic objects attract or repel each other. While other kids are waiting for their turn, they have a choice of three different homework assignments to get started on. You choose whether they get to work together or individually.

Magnets Grade 4 Evaluation

Student Worksheet

Overview: Today you're going to take two different tests: the quiz and the lab practical. You're going to take the written quiz first, and the lab practical at the end of this test. The lab practical isn't a paper test – it's where you get to show your teacher that you know how to do something.

Lab Test & Homework

1. Your teacher will call you up so you can share how much you understand about magnets and how they interact with each other. Since science is so much more than just reading a book or circling the right answer, this is an important part of the test to find out what you really understand.
2. While you are waiting for your turn to show your teacher how much of this stuff you already know, you get to choose which homework assignment you want to complete. The assignment is due tomorrow, and half the credit is for creativity and the other half is for content, so really let your imagination fly as you work through it. Choose one:
    a. Write a short story or skit about magnetism from the perspective of the electron or the magnet itself. You'll read this aloud to your class.
    b. Make a poster that teaches the main concepts to magnetism. When you're finished, you'll use it to teach a class in the younger grades and demonstrate each of the principles that you've learned.
    c. Write and perform a poem or song about magnetism. This will be performed to your class.

Magnets Grade 4 Quiz

Teacher's Answer Key

1. How many poles do magnets have, and what are they? *Two. North and south poles.*
2. What happens when you bring two like poles together? *They repel each other.*
3. How do I know which pole is which on a magnet? *Put two magnets together and find the spot where they are repelling the strongest. The poles facing each other are the same. Or bring it close to a compass. If the magnet attracts the needle to north, then the magnet's pole is the south pole.*
4. Is the magnetic force stronger or weaker the closer a magnet gets to another magnet? *Stronger.*
5. What kinds of materials are magnets made from? *Iron, nickel and cobalt.*
6. Name three objects that stick to a magnet. *Paperclips, pipe cleaners, and staples.*
7. Name three that don't stick to a magnet. *US quarter, glass, plastic.*
8. What does a compass detect? How do you know when it's detected it? *The direction of a magnetic field. When the needle is deflected, the compass is in a magnetic field.*
9. Circle the correct answer in the parenthesis:

    a. The Earth has a (tiny | **huge**) magnetic field.

    b. The Earth has a (strong | **weak**) magnetic force.

    c. The magnetic field comes from the moving electrons in the currents of the Earth's (**molten core** | rocky core).

    d. The Earth has a north and a south magnetic pole which is (the same | **different**) from the geographic north and south pole.

Magnets Grade 4 Quiz

Name_____

1. How many poles do magnets have, and what are they?

2. What happens when you bring two like poles together?

3. How do I know which pole is which on a magnet?

4. Is the magnetic force stronger or weaker the closer a magnet gets to another magnet?

5. What kinds of materials are magnets made from?

6. Name three objects that stick to a magnet.

7. Name three that don't stick to a magnet.

8. What does a compass detect? How do you know when it's detected it?

9. Circle the correct answer in the parenthesis:

    a. The Earth has a (tiny | huge) magnetic field.

    b. The Earth has a (strong | weak) magnetic force.

    c. The magnetic field comes from the moving electrons in the currents of the Earth's (molten core | rocky core).

    d. The Earth has a north and a south magnetic pole which is (the same | different) from the geographic north and south pole.

Magnets Grade 4 Lab Practical

Teacher's Answer Key

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- Needle
- Foam
- 2 different kinds of magnets (round or square, N-S pole locations different, etc.)
- Cup of water
- Paperclip
- Penny
- Quarter

Lab Practical: Ask the student *Note: Answers given in italics!*

- Design and build an experiment that shows how to detect a magnetic field. *Magnetize the needle by wiping it in one direction with a magnet, stick it through a piece of foam, and float it in a cup of water. Compare the reading with your own hidden compass. Student can also bring a magnet close and the needle deflects.*
- Using all the materials, even the cup and the foam (remove the needle), separate the objects into two piles: one pile for things that are not magnetically attracted and another that are magnetically attracted. *When the student finishes, run a magnet over the two piles and see if the objects are in the correct piles.*

Magnets Grade 4 Lab Practical

Student Worksheet

This is your chance to show how much you have picked up on important key concepts, and if there are any holes. You also will be working on a homework assignment as you do this test individually with a teacher.

Materials:

- Needle
- Foam
- 2 different kinds of magnets (round or square, N-S pole locations different, etc.)
- Cup of water
- Paperclip
- Penny
- Quarter

Lab Practical:

- Design and build an experiment that shows how to detect a magnetic field.

- Using all the materials, even the cup and the foam (remove the needle), separate the objects into two piles: one pile for things that are not magnetically attracted and another that are magnetically attracted.

Electromagnetism Grade 4 Evaluation

Teacher Section

Overview Kids will demonstrate how well they understand important key concepts from this section.

Suggested Time 45-60 minutes

Objectives Students will be tested on the key concepts of electromagnetism:

1. Electric currents produce magnetic fields.
2. Magnetic fields create electrical currents.
3. The role of electromagnets in the construction of electric motors, electric generators, and simple devices such as doorbells and earphones.

Students will also demonstrate these principles:

4. How to build a simple electromagnet.
5. How two magnetic fields interact to cause motion.

Materials (one set for entire class)

- AA battery case
- 2 AA batteries
- Alligator clip leads
- Plain nail (not wrapped in wire)
- Electromagnet (nail already wrapped in wire), ends *not* sanded
- Electromagnet (nail already wrapped in wire), ends sanded down
- Paper clips
- 9-18 VDC motor
- LED

Lab Preparation

1. Print out copies of the student worksheets, lab practical, and quiz.
2. Have a tub of the materials in front of you at your desk. Kids will come up when called and demonstrate their knowledge using these materials.

Lesson The students are taking two tests today: the quiz and the lab practical. The quiz takes about 20 minutes, and you'll find the answer key to make it easy to grade.

Lab Practical Students will demonstrate individually that they know how to wire up a circuit and explain how electrical energy can be converted to heat, light, and/or motion. While other kids are waiting for their turn, they have a choice of three different homework assignments to get started on.

Electromagnetism Grade 4 Evaluation

Student Worksheet

Overview: Today, you're going to take two different tests: the quiz and the lab practical. You're going to take the written quiz first, and the lab practical at the end of this lab. The lab practical isn't a paper test – it's where you get to show your teacher that you know how to do something.

Lab Test & Homework

1. Your teacher will call you up so you can share how much you understand about electromagnetism and how it works. Since science is so much more than just reading a book or circling the right answer, this is an important part of the test to find out what you really understand.
2. While you are waiting for your turn to show your teacher how much of this stuff you already know, you get to get started on your homework assignment. The assignment is due next week, and half the credit is for creativity and the other half is for content, so really let your imagination fly as you work through it.

   Here it is: Your classroom is going to be converted into an interactive science museum next week. You will be in charge of one of the stations. Your audience knows nothing about magnetism. Your job is to design and build an experiment that teaches the students in lower levels an important concept in one of the following areas: magnetism or electromagnetism. You will get to explain to your students what's going on as you demonstrate your experiment. You can have them watch or actively do something at your station. You will be graded based on content and creativity, so really let your mind go wild. (Hint: If you were the audience, what would *you* want to learn about most?)

Electromagnetism Grade 4 Quiz

Teacher's Answer Key

1. Why didn't the coil of wire on an electromagnet work when it wasn't hooked up to a battery? What does the battery do to the coil of wire? *(The wire is just wire until you have electricity passing through it. The electricity causes a small magnetic field around the wire. When you bundle and coil the wire up, you multiply this effect to create an electromagnet.)*
2. Why is it called an 'electromagnet' and not just a 'magnet'? *(An electromagnet is a magnet that can be turned off and off using electricity.)*
3. What's inside a DC motor? *(An electromagnet and a magnet.)*
4. How can we use electromagnets to make things move? Give an example. (*When you energize a coil of wire, you turn it into an electromagnet. If you bring two magnets together, their magnetic fields interact and they repel each other, causing motion. The DC Motor is one example. When the rotor is energized, it aligns itself with the magnet. As it tries to align itself, it overshoots and so that the un-sanded portion breaks the connection and the electromagnet turns back into just a coil of wire. The coil continues to float around in a circle until it hits the sanded parts again, which re-energizes the coil, turning it back into an electromagnet, which is now attracted to the magnet on the battery, which pulls it around again…and round it goes!)*
5. Give an example of how electricity causes magnetism. *(When you run an electrical current through a coil of wire, you can detect the magnetic field using a compass.)*
6. Give an example of how magnetism causes electricity. *(The Motors and Generators experiment is a great example of this. When you spin the motor shaft, you move an electromagnet quickly past a permanent magnet, which produces a jolt of electricity at the motor's tabs. You can detect this current when the LED lights up or by a digital multimeter.)*

Electromagnetism Grade 4 Quiz

Name_____

1. Why didn't the coil of wire on an electromagnet work when it wasn't hooked up to a battery? What does the battery do to the coil of wire?

2. Why is it called an 'electromagnet' and not just a 'magnet'?

3. What's inside a DC motor?

4. How can we use electromagnets to make things move? Give an example.

5. Give an example of how electricity causes magnetism.

6. Give an example of how magnetism causes electricity.

Electromagnetism Grade 4 Lab Practical

Teacher's Answer Key

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- AA battery case
- 2 AA batteries
- Alligator clip leads
- Plain nail (not wrapped in wire)
- Electromagnet (nail already wrapped in wire), ends *not* sanded
- Electromagnet (nail already wrapped in wire), ends sanded down
- Paper clips
- 9-18 VDC motor
- LED

Lab Practical: Ask the student *Note: Answers given in italics!*

- Design and build an electromagnet that picks up paperclips. *Battery connects to the electromagnet that has both ends sanded down. When the coil is brought next to the paperclips, they jump up onto the electromagnet.*
- Design and build an experiment that shows how magnetism creates electricity. *Connect the LED to the back of the motor at the terminals, and when you spin the motor, the LED lights up. Explain to the teacher that there's an electromagnet inside moves past a permanent magnet.*

Electromagnetism Grade 4 Lab Practical

Student Worksheet

This is your chance to show how much you have picked up on important key concepts, and if there are any holes. You also will be working on a homework assignment as you do this test individually with a teacher.

Materials:

- AA battery case
- 2 AA batteries
- Alligator clip leads
- Plain nail (not wrapped in wire)
- Electromagnet (nail already wrapped in wire), ends *not* sanded
- Electromagnet (nail already wrapped in wire), ends sanded down
- Paper clips
- 9-18 VDC motor
- LED

Lab Practical:

- Design and build an electromagnet that picks up paperclips.

- Design and build an experiment that shows how magnetism creates electricity.