# 8TH GRADE PHYSICAL SCIENCE

ECHOLS MIDDLE SCHOOL

MAY 2020 ISSUE 6

## WEEK 5 ANSWERS

**STEMscopedia:**

Magnet Labels: NS, NS, SN

**Reading Science:**

1. B, 2. C, 3. D, 4. C, 5. D, 6. A

**Math Connections:**

1. +, +, repulsive
2. +, -, attractive
3. -, +, attractive
4. -,-, repulsive
5. The force is repulsive so the arrows should be pointing away from each other.
6. The force is attractive so the arrows should be pointing toward each other.
7. The force is repulsive because the same poles are near each other.
8. The force is attractive because the opposite poles are close to each other.
9. As the charge increases, the electric force increases.
10. The electric force will double.
11. The electric force will be reduced by half.
12. Directly proportional as the line goes through the origin.
13. As electric force decreases, distance increases.
14. The electric force is quartered.
15. Non-linear as the the line does not go through the origin.

**Guided Practice:**

<u>Graphic Organizer</u>

Forces>electromagnetic> created with moving electrons in a coper wire>attractions>pull<more wire increases force field

Forces>magnetic>decrease distance, increase force field> repulsion> push, same poles > attaction> pull, opposite poles

<u>Paragraph</u>

electrons, copper, force, decrease, toward, repulsion

## IN THIS ISSUE




## CONTACT INFO

**MRS. HOLTER**

email: eholter@tcss.net

Remind codes: text code below to 81010

2nd: @k3ce2d
3rd: @bdfd77
4th: @chace4
5th: @ka4kba4
6th: @gd26d9
7th: @9ahag3k

**MRS. JUNEAU**

email: ejuneau@tcss.net

Remind codes: text code below to 81010

2nd: @junebug2
4th: @junebug4
5th: @junebug5
6th: @junebug6
7th: @junebug7

# Force Fields

## Reflect

Electric, magnetic, and gravitational forces all create a force field. **Forces** that act at a distance can be explained by **fields** that extend through space. Their size and shape can me mapped by their effect on a test object.

**force:** a push or a pull

**field:** a region of space near the source of a force that is creating it

A magnetic field is the place where an object that is magnetic exhibits its magnetic influence. Think back to a time where you were placing two opposite sides of a magnet near to each other. What did you notice? Could you feel the magnetic field in the moments where the magnets were not yet touching, but they were beginning to attract each other. The field where the two ends attract is called an attraction field. You may also have felt the magnetic field if you tried to push two identical sides (north and north, or south and south) of a magnet together. The field that you felt when the two ends of the magnet repelled each other is called a repulsion field.

Earth's north and south poles act like a magnet.

Earth also has a magnetic field just like a magnet. The only difference is that the Earth's magnetic field is huge. Earth's magnetic field protects Earth from solar wind and solar radiation. The aurora borealis is a demonstration of the light that is produced when the solar winds reach our magnetic field and the two charges react. Even though you do not feel the magnetic force of the Earth, it is still all around you acting on objects from a distance.

The aurora borealis results from Earth's magnetic field being bombarded by the solar wind.

Electric fields emanate around the movements of electrical charges. The strength of an electric field is related to the quantity of the charge and its distance from the source. So the larger the quantity of charges that you have collected in one place, the larger the electrical field. Or the closer you are to a smaller quantity of charges, the stronger the electrical force field will be.

If the electrical field source is positive, the field will radiate outward from the source. If the electrical field source is negative, the field will radiate inward. We use this information to manipulate electrical fields in experiments and in real world applications.

Gravitational fields are produced by all objects that have mass. Gravitational forces are very hard to measure in objects that are small, but they are still present. Often, gravitational fields are studied on the larger scale of planets and stars. Gravitational field models are used to explain the influence that a very massive body has on surrounding objects.

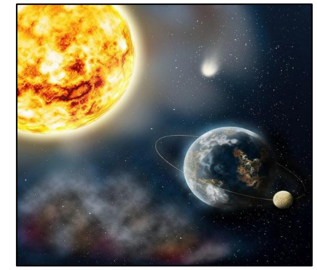






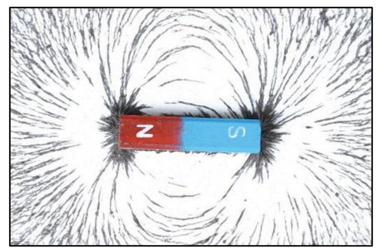
## Reflect

Gravitational force is an attractive force and thus has an impact on celestial bodies. In our search for other planets across the solar system we study gravitational field effects on stars. When planets surround stars, their gravitational field pulls at the star as they go around their orbit. This traveling around the orbit makes the star appear to wobble in the sky. The larger the wobble, the larger the planet that is orbiting the star.



Gravitational field strengths are determined by the mass of the object.

## What Do You Think?




Iron filings arrange themselves along magnetic lines of force.

You can see the magnetic field when you sprinkle iron filings around a bar magnet. The filings will line themselves up along the lines of the force field. As you travel away from the bar magnet the field gets weaker and more spread out. Why do you think there are such large quantities of filings directly next to the poles?

Could you change the shape of the magnetic force field? You can manipulate magnetic forces with other magnets. You can also create an electromagnet by wrapping copper wire around an iron object and attaching the wires to a battery.

The fields in a natural magnet and an electromagnet are very similar. The only difference is that the electromagnet and its field can be turned off by cutting off the flow of electricity. Can you see the differences in these two magnetic fields from the metal around them?

The crane prepares to pick up scrap metal with an electromagnet.

## Look Out!

Static electricity flows out of the ball, through the person and out into the hair.

Electrical fields can be dangerous. In charged particle movement like electricity, the electrons are moving at a high rate of speed towards the positive pole in the system. During its travels, the electrons are reacting to the electric field, which keeps getting stronger. That stronger field created by the moving electrons also propels the electrons forward. Moving electrical charges in the electrical field creates a magnetic field.

You can see an electric field when you shuffle your feet across a carpeted floor and then touch someone, you see a spark (the room must be dark to see the spark).

In the picture above, a Van de Graaff generator creates static electricity. If you touch it, your hair will stand on end as the positively charged hairs repel each other. The repulsion forces are a field and each like field will repel each other. Once charged fields finally are ionized to a maximum level, they will create a pathway for the electrons to move and flow, which will create electricity.







## Connecting With Your Child

**Magnetism and Gravity at Home**

This activity will help you explore the forces of magnetism with your child.
The only materials you will need are two balloons, string, and either a head of hair or carpeting.

1. Attach one end of the one string to one balloon. Do the same with the other string and balloon.
2. Rub one balloon either on a head of hair or on carpeting for several seconds.
3. Hold one string to one balloon in each hand, make sure one of the balloons is the one you just rubbed on the head of hair or carpeting.
4. Now try doing two non-rubbed balloons close to the one that was rubbed.
5. If time permits, and you have enough supplies, try increasing the number of balloons around the one that has been rubbed against a head of hair or carpeting.

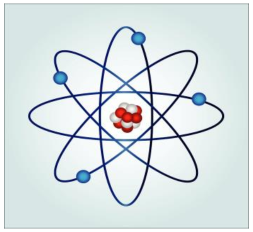
Here are some questions to discuss with your child:

- What did you notice in this experiment?
- Which forces act on the two balloons?
- What happened when you increased the number of non-rubbed balloons?
- Why did the rubbed balloon attract or repel the other balloons?

# Reading Science

Name: ______________________________ Date: __________

## Discovering the Strong Force



1 The strong force is the strongest of the four fundamental forces in nature. It holds atomic nuclei together. Protons are positively charged and close together inside the nucleus. The protons strongly repel each other. The strong force has to overcome these strong repulsive forces. The strong force depends on an exchange of subatomic particles, called gluons. Unlike gravity, the strong force remains constant over distance. Many diverse scientists worked for decades to produce a coherent theory of the strong force.

2 Protons and neutrons were discovered long before gluons. British chemist, Ernest Rutherford, discovered protons in 1919. Rutherford hypothesized that neutral particles were also part of the nucleus of atoms. In 1932, James Chadwick discovered neutrons and described their properties. Shortly thereafter, Eugene Wigner proposed that protons and neutrons are the same particle, affected by a property called spin. However, none of these scientists could explain how an atomic nucleus is held together.

3 Hideki Yukawa was a Japanese scientist. He published a set of hypotheses about proton and neutron interaction in 1935. He stated that the strong force was involved in the interaction. Yukawa also proposed that exchange of a new subatomic particle was necessary for the strong force. While the gluon had not yet been discovered, he used his hypothesis to make predictions about its properties, including its mass. Yukawa was the first Japanese scientist to win a Nobel Prize.

4 In 1964, American physicists, Murray Gell-Mann and George Zweig, hypothesized the existence of quarks. They proposed that quarks come in six “flavors”. While no free quarks were observed, different combinations of quarks create protons and neutrons. The strong force holding protons and neutrons together within a nucleus is now considered to be an extension of the force holding the quarks together within a proton or neutron. The first evidence for the existence of quarks came from experiments at the Stanford Linear Accelerator Center in 1968. Scientists shot high energy electrons at protons and analyzed the scatter angles. The scatter angles were inconsistent with the assumption that protons have a uniform interior. Instead, they demonstrated the existence of subatomic particles inside the protons. Over the years, all six “flavors” of quarks were discovered. Fermilab discovered the last quark in 1995. Gluons, the particle exchanged to transmit the strong force, were finally discovered in 1979. There are eight independent types of gluons.






# Reading Science

5 As with all scientific theories, the theory of the strong force began as a set of hypotheses. Over many years, many different scientists tested and refined those hypotheses. Scientists from the United States, Britain, and Japan collaborated and competed. The Nobel Prize is one of the highest honors given to a scientist. Nobel Prizes were awarded over the years to Rutherford (1908), Chadwick (1935), Wigner (1963), Yukawa (1949), and Gell-Mann (1969). As years and years of supporting evidence accumulated, the hypotheses were accepted as a scientific theory. Scientists are confident that the principles of the strong force theory can be used to explain natural phenomena and make predictions.

6 Research into nuclear processes is still occurring. Recent experiments describe the contribution of different quarks and gluons to the proton. Until 2002, scientists thought that only pairs or triplets of quarks can form particles. Since then, many experiments have demonstrated the existence of a five-quark structure. Why is the nuclear strong force still an active area of research? Nuclear power uses the decay of heavy elements to produce electricity. It produces highly radioactive waste. Better understanding of nuclear interactions may point the way to using different elements and producing less waste.

8.12 Force fields
Reading Science

1. Over What Range Does The Strong Force Apply?
    A. Within the Nucleus
    B. Within the Electron
    C. Within the Ion
    D. Within a thin Slice of Metal

2. What are Gluons?
    A. Subatomic particles that are created as part of Strong Force interactions
    B. Subatomic particles that are involved only in weak interactions
    C. Subatomic particles that are exchanged as part of Strong Force interactions
    D. Subatomic particles that are manipulated directly in nuclear reactor

3. Which best describes the experimental evidence for subatomic particles such as quarks?
    A. Protons colliding with each other scatter elastically
    B. Electrons colliding with nuclei scatter at angles
    C. Protons colliding with nuclei are absorbed
    D. Free quarks were observed

4. How did Hideki Yukawa's work contribute to the identification and characterization of the gluon?
    A. His experiments discovered gluons in collisions.
    B. He identified how the gluon interacted with quarks.
    C. He recognized that gluons were the strong force transfer particle.
    D. He predicted the gluon and its properties, inspiring others to search for it.

5. Scientists from which nations were involved in discovering and describing the strong nuclear force?
    A. United States, Britain, and Japan
    B. Britain, Japan, and China
    C. United States, Japan, and Korea
    D. Japan, China, and Korea

6. Which of the following statements regarding current research in nuclear processes is correct?
    A. Research on nuclear processes stopped with the discovery of the last quark in 1995.
    B. Current research may help improve electricity production from nuclear power plants.
    C. It is unlikely that any scientist currently working on nuclear processes will receive a Nobel Prize.
    D. Current research is most concerned with discovering the number of protons and neutrons in the nuclei of heavy atoms.

# Math Connections

Name: ______________________________ Date: __________

The strength of magnetic fields can be measured similar to other physical properties. The International System Unit of measurement for magnetic field strength is the Tesla. One Tesla is equal to 10,000 magnetic field lines per square centimeter.

*1 Tesla = 10,000 magnetic field lines/cm$^2$*

The table below displays the strength of the magnetic field for different objects.

**Use the table and the unit conversion for Tesla to answer the questions in this lesson.**

**Strength of Magnetic Fields**

| Object | Strength in Tesla |
|---|---|
| Earth's Magnetic Field | 0.00005 |
| Bar Magnet | 0.01 |
| Sunspot | 0.5 |
| Neodymium Magnet | 1.2 |
| Strong Laboratory Magnet | 10 |
| Large Electromagnet | 1.5 |
| Electron Microscope | 1 |
| Fluorescent Lamp | 0.00001 |
| National High Magnetic Field Laboratory Magnet | 45 |
| Large Hadron Collider Accelerator | 6.5 |
| Computer Monitor | 0.0000000025 |
| Hair Dryer | 0.000004 |
| MRI Electromagnet | 3 |
| Lodestone | 0.001 |
| Jupiter | 0.1 |
| Pulsar | 100,000 |
| White Dwarf | 300 |






# Math Connections

1. List the objects from least to greatest magnetic field strength in the table below. Write each strength using scientific notation.

**Least to Greatest Magnetic Fields**

| Object | Strength in Tesla | Strength Written in Scientific Notation |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# Math Connections

2. The Large Hadron Collider Accelerator is the world's largest particle accelerator. A particle accelerator is a research tool used to accelerate particles close to the speed of light before they collide, providing information about subatomic particles. An electromagnet is a type of magnet powered by an electric current. Compare the magnetic field strength of the Large Hadron Collider and a large electromagnet.

   a. Write an equation that reflects how many Tesla units larger the Large Hadron Collider's magnetic field strength is compared to a large electromagnet.

   b. Explain the equation in words.

3. Magnetic resonance imaging, or MRI, is a test that uses a strong magnetic field produced by an electromagnet to capture pictures of structures inside the body. The National High Magnetic Field Laboratory (NHMFL) is the world's highest powered magnet laboratory. Compare the magnetic field strength of an MRI electromagnet and a magnet at the NHMFL.

   a. Write an equation that reflects how many MRI electromagnets are equal to the magnetic field strength of 1 NHMFL magnet.

   b. Explain the equation in words.

4. In science class, you have likely used a small bar magnet with a low magnetic field strength. In professional science laboratories, scientists have access to much more powerful magnets. Compare the strength of a bar magnet and a laboratory magnet.

   a. Write an equation that reflects how many bar magnets are equal to 1 laboratory magnet.

   b. Explain the equation in words.

5. Scientists have discovered that Jupiter's magnetic field strength is many times larger than Earth's. Compare the strength of Earth's magnetic field and Jupiter's magnetic field.

   a. Write an equation that reflects how many times larger Jupiter's magnetic field is compared to Earth's magnetic field.

   b. Explain the equations in words.

# Guided Practice

## Check Understanding

**Directions:** Fill in the blanks using the word bank below.

### Word Bank

| | | | |
|---|---|---|---|
| poles | gravitational | attraction | metal |
| every | field | same | magnetic |

Force fields can be found everywhere. One type is a magnetic force ______. This is created from the repulsion or __________of a magnet and iron, which is a type of metal. When observing a __________field, you will be able to witness the iron pulling towards the magnet if ________are opposite, or away in the poles are the ________.
A gravitational force field occurs between ________mass, or a group of masses. The Earth has its own ________________force field, as does the solar system.

**Directions:** Answer the questions below using complete sentences.

1. Describe what you would you witness if you placed a magnet near a pile of iron filings.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

2. A student says, "The only place in the universe where gravitational force fields exist is on Earth." How could you correct their misunderstanding? Provide at least 2 examples.

______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________