7th Grade Mathematics (Online)

-**Week 1 (3/16/20 – 3/20/20):** Complete IXL Math or Prodigy Math online for 30 minutes daily. (Parents please initial daily log)

-**Week 2 (3/30/20 – 4/6/20):** Complete IXL Math or Prodigy Math online for 30 minutes daily. (Parents please initial daily log)

7th Grade Mathematics (If no access to online)

-**Week 1 (3/16/20 – 3/20/20):** Complete daily assignments #1-5

-**Week 2 (3/30/20 – 4/6/20):** Complete daily assignments #6-10

7th Grade Science (If Online)

-**Week 1 (3/16/20 – 3/20/20):** Complete IXL Science online for 30 minutes daily. (Parents please initial daily log)

-**Week 2 (3/30/20 – 4/6/20):** Complete IXL Science online for 30 minutes daily. (Parents please initial daily log)

7th Grade Science (If no access to online)

-**Week 1 (3/16/20 – 3/20/20):** Complete daily assignments #1-5

-**Week 2 (3/30/20 – 4/6/20):** Complete daily assignments #6-10

NAME ______________________

Lesson 6.1 Ratio and Proportion

Day 1

A **ratio** is a comparison of two numbers. A **proportion** expresses the equality of two ratios.

A ratio can be expressed as 1 to 2, 1:2, or $\frac{1}{2}$, and it means that for every 1 of the first item, there are 2 of the other item.

Cross-multiply to determine if two ratios are equal.

$$\frac{2}{4}, \frac{3}{6} \qquad 2 \times 6 = 12 \qquad 3 \times 4 = 12 \qquad \frac{2}{4} = \frac{3}{6}$$

Circle the ratios that are equal. Show your work.

	a	b	c
1.	$\frac{1}{3}, \frac{2}{6}$	$\frac{3}{8}, \frac{1}{4}$	$\frac{3}{5}, \frac{9}{15}$
2.	$\frac{3}{4}, \frac{9}{12}$	$\frac{1}{2}, \frac{4}{8}$	$\frac{5}{6}, \frac{15}{18}$
3.	$\frac{5}{8}, \frac{4}{7}$	$\frac{1}{2}, \frac{1}{4}$	$\frac{4}{3}, \frac{16}{12}$
4.	$\frac{6}{18}, \frac{2}{6}$	$\frac{3}{25}, \frac{6}{50}$	$\frac{1}{8}, \frac{2}{10}$
5.	$\frac{1}{4}, \frac{2}{4}$	$\frac{5}{10}, \frac{3}{6}$	$\frac{4}{24}, \frac{7}{42}$
6.	$\frac{3}{5}, \frac{5}{3}$	$\frac{7}{8}, \frac{21}{24}$	$\frac{8}{23}, \frac{9}{46}$
7.	$\frac{7}{4}, \frac{28}{16}$	$\frac{3}{9}, \frac{1}{3}$	$\frac{16}{20}, \frac{9}{10}$
8.	$\frac{8}{100}, \frac{80}{50}$	$\frac{8}{12}, \frac{10}{14}$	$\frac{15}{20}, \frac{3}{4}$
9.	$\frac{9}{2}, \frac{12}{3}$	$\frac{6}{3}, \frac{8}{4}$	$\frac{1}{3}, \frac{11}{33}$
10.	$\frac{12}{7}, \frac{36}{21}$	$\frac{10}{12}, \frac{15}{20}$	$\frac{3}{4}, \frac{9}{16}$

NAME ____________________

Lesson 6.2 Solving Proportion Problems

Day 2

A proportion can be used in problem solving.

The ratio of apples to oranges is 4 to 5. There are 20 oranges in the basket. How many apples are there?

$\frac{4}{5} = \frac{n}{20}$	Set up a proportion, using *n* for the missing number.
$4 \times 20 = 5 \times n$	Cross-multiply.
$\frac{80}{5} = n$	Solve for *n*.
$16 = n$	There are 16 apples.

Solve each of the following.

	a	b	c
1.	$\frac{1}{3} = \frac{n}{24}$ ______	$\frac{4}{9} = \frac{n}{36}$ ______	$\frac{5}{45} = \frac{n}{9}$ ______
2.	$\frac{3}{5} = \frac{n}{15}$ ______	$\frac{10}{70} = \frac{n}{7}$ ______	$\frac{25}{40} = \frac{n}{16}$ ______
3.	$\frac{7}{12} = \frac{n}{36}$ ______	$\frac{13}{26} = \frac{n}{4}$ ______	$\frac{7}{1} = \frac{n}{3}$ ______
4.	$\frac{8}{5} = \frac{n}{40}$ ______	$\frac{2}{6} = \frac{n}{33}$ ______	$\frac{5}{13} = \frac{n}{39}$ ______
5.	$\frac{5}{6} = \frac{n}{18}$ ______	$\frac{9}{8} = \frac{n}{32}$ ______	$\frac{2}{3} = \frac{n}{15}$ ______

NAME ____________________

Lesson 6.3 Solving Proportion Problems

Day 3

The missing number can appear any place in a proportion.
Solve the same way.

$\frac{2}{3} = \frac{6}{n}$	$\frac{3}{5} = \frac{n}{10}$	$\frac{3}{n} = \frac{6}{8}$	$\frac{n}{4} = \frac{3}{6}$
$3 \times 6 = 2 \times n$	$3 \times 10 = 5 \times n$	$3 \times 8 = 6 \times n$	$4 \times 3 = 6 \times n$
$\frac{18}{2} = n$	$\frac{30}{5} = n$	$\frac{24}{6} = n$	$\frac{12}{6} = n$
$9 = n$	$6 = n$	$4 = n$	$2 = n$

Solve each of the following.

	a	b	c
1.	$\frac{n}{3} = \frac{3}{9}$ ______	$\frac{5}{3} = \frac{15}{n}$ ______	$\frac{2}{n} = \frac{1}{4}$ ______
2.	$\frac{15}{30} = \frac{2}{n}$ ______	$\frac{4}{6} = \frac{n}{24}$ ______	$\frac{n}{7} = \frac{15}{21}$ ______
3.	$\frac{6}{n} = \frac{15}{20}$ ______	$\frac{n}{12} = \frac{9}{18}$ ______	$\frac{9}{2} = \frac{27}{n}$ ______
4.	$\frac{7}{9} = \frac{n}{63}$ ______	$\frac{15}{n} = \frac{12}{4}$ ______	$\frac{40}{100} = \frac{n}{25}$ ______
5.	$\frac{35}{n} = \frac{4}{8}$ ______	$\frac{16}{4} = \frac{36}{n}$ ______	$\frac{n}{12} = \frac{25}{30}$ ______

NAME ____________ Day 3

Lesson 6.4 Problem Solving

SHOW YOUR WORK

Solve each problem.

1. The ratio of cars to minivans in the parking lot is 2 to 3. There are 96 minivans. How many cars are in the lot?

   There are __________ cars in the lot.

2. The ratio of skateboards to bicycles at the park is 5 to 2. If there are 12 bicycles, how many skateboards are there?

   There are __________ skateboards.

3. An ice cream shop sells 4 vanilla cones for every 3 chocolate cones. The store sold 48 vanilla cones today. How many chocolate cones did it sell?

   The store sold __________ chocolate cones.

4. A flower arrangement has 8 carnations for every 4 roses. There are 14 carnations. How many roses are in the arrangement?

   There are __________ roses in the arrangement.

5. There are 18 girls in the school choir. The ratio of girls to boys is 1 to 2. How many boys are in the choir?

   There are __________ boys in the choir.

6. A baseball player strikes out 3 times for every 2 hits he gets. If the player strikes out 15 times, how many hits does he get? If the player gets 46 hits, how many times does he strike out?

   The player gets __________ hits for every 15 times he strikes out.

   If the player gets 46 hits, he strikes out __________ times.

1.	
2.	
3.	
4.	
5.	
6.	

NAME ______________________

Mid-Test Chapters 1–6

Day 4

Add, subtract, multiply, or divide. Write each answer in simplest form.

	a	b	c	d
1.	$\begin{array}{r} 127 \\ 46 \\ +352 \\ \hline \end{array}$	$\begin{array}{r} 2079 \\ 114 \\ +\quad 17 \\ \hline \end{array}$	$\begin{array}{r} 5\frac{1}{2} \\ +7\frac{2}{3} \\ \hline \end{array}$	$\begin{array}{r} 3\frac{7}{8} \\ +2\frac{2}{5} \\ \hline \end{array}$
2.	$\begin{array}{r} 346 \\ -\quad 72 \\ \hline \end{array}$	$\begin{array}{r} 480 \\ -119 \\ \hline \end{array}$	$\begin{array}{r} 6\frac{2}{9} \\ -3\frac{1}{4} \\ \hline \end{array}$	$\begin{array}{r} 5\frac{1}{2} \\ -2\frac{3}{7} \\ \hline \end{array}$
3.	$\begin{array}{r} 275 \\ \times\quad 56 \\ \hline \end{array}$	$\begin{array}{r} 312 \\ \times\quad 9 \\ \hline \end{array}$	$\begin{array}{r} 1717 \\ \times\quad 34 \\ \hline \end{array}$	$\begin{array}{r} 5806 \\ \times\quad 42 \\ \hline \end{array}$
4.	$\frac{1}{4} \times \frac{5}{6}$	$\frac{3}{8} \times \frac{2}{3}$	$2\frac{5}{7} \times \frac{4}{9}$	$\frac{1}{2} \times \frac{3}{5} \times \frac{2}{3}$
5.	$8\overline{)72}$	$19\overline{)384}$	$52\overline{)6147}$	$8\overline{)1352}$
6.	$\frac{2}{3} \div \frac{4}{7}$	$3\frac{1}{2} \div \frac{5}{6}$	$\frac{4}{9} \div \frac{1}{12}$	$2\frac{2}{3} \div 1\frac{1}{8}$

NAME ____________________

Mid-Test Chapters 1–6

Day 4

CHAPTERS 1–4 MID-TEST

Add, subtract, multiply, or divide.

	a	b	c	d
7.	14 5138 + 203	72024 315642 + 1357	5.73 0.212 + 1.6	28.3052 1.071 + 5.58
8.	586423 − 7982	43248 − 19156	42.5 − 16.304	7.28 − 0.959
9.	586 × 3.7	2.1 × 0.8	3.507 × 2.6	38.2 × 7.58
10.	98 × 0.4	370 × 6.4	7.0215 × 9	42.36 × 13
11.	2.5) 10	0.03) 36	9) 7.2	8) 5.664
12.	4.8) 24.96	0.37) 2.2755	9.06) 66.138	1.205) 4.2175

NAME ____________________

Mid-Test Chapters 1–6

Day 5

Change to percents.

	a	b	c
13.	$\frac{3}{20}$ = ________%	$\frac{4}{5}$ = ________%	$\frac{14}{50}$ = ________%

Change to decimals.

14. 30% = ________ $72\frac{1}{4}$% = ________ 346% = ________

Change to fractions.

15. 75% = ________ 20% = ________ .140% = ________

Complete.

16. ________ is 9% of 30. ________ is 8% of 15. ________ is 22% of 90.

17. 36.9 is 45% of ________. 0.36 is 12% of ________. 120 is 150% of ________.

18. 13 is ________% of 52. 5 is ________% of 125. 38 is ________% of 40.

Complete the following.

	Principal	Rate	Time	Interest	Total Amount
19.	$720	$3\frac{1}{4}$%	4 years	________	________
20.	$500	$5\frac{1}{2}$%	$3\frac{1}{2}$ years	________	________
21.	$60	4%	$\frac{3}{4}$ year	________	________
22.	$480	$12\frac{1}{2}$%	$5\frac{1}{4}$ years	________	________

CHAPTERS 1–4 MID-TEST

NAME ___Day 5___

Mid-Test Chapters 1–6

SHOW YOUR WORK

Solve each problem.

23. A can of mixed nuts has 5 peanuts for every 2 cashews. There are 175 peanuts in the can. How many cashews are there?

There are __________ cashews in the can.

23.

24. A savings account pays $4\frac{1}{2}$% interest. How much interest will be earned on $450 in 3 years? How much money will be in the account in 3 years?

The account will earn __________ in interest in 3 years.

There will be __________ in the account in 3 years.

24.

25. A drawing of an office building has a scale of 2 inches = 30 feet. The building is 105 feet tall. How tall is the drawing?

The drawing is __________ inches tall.

25.

26. A company charges $2\frac{1}{4}$% for shipping and handling on all purchases. How much is shipping and handling on a purchase of $180? What is the total cost to the customer?

The shipping and handling charge is __________.

The total cost to the customer is __________.

26.

27. The Kendalls make monthly deposits into their savings plan. In 7 months, they have deposited $224. If they continue at this rate, how much will they have deposited in 12 months?

They will have deposited __________.

27.

28. During the first half of his shift, a server made $63 in tips on bills totaling $350. At this rate, what will be his total tips if the bills for the evening total $775? What percent was the server tipped?

His total tips will be __________.

The server was tipped __________%.

28.

CHAPTERS 1–4 MID-TEST

NAME ________________ Day 6

Lesson 7.1 Units of Length (inches, feet, yards, and mile)

1 foot (ft.) = 12 inches (in.)
1 yard (yd.) = 3 ft. = 36 in.
1 mile (mi.) = 1760 yd. = 5280 ft.

Use the table and multiply or divide to convert units of measure.

3.2 ft. = ________ in.
3.2 ft. = (3.2 × 12) = 38.4 in.

4224 yd. = ________ mi.
4224 yd. ÷ 1760 = 2.4 mi.

Convert the following.

	a	b	c
1.	17 yd. = ________ ft.	8 mi. = ________ ft.	5280 yd. = ________ mi.
2.	280.8 in. = ________ yd.	8.5 mi. = ________ yd.	708 in. = ________ ft.
3.	3 yd. 1 ft. = ________ in.	111 ft. = ________ yd.	12 mi. = ________ yd.
4.	4 mi. 182 yd. = ________ yd.	13 ft. 5 in. = ________ in.	2.4 mi. = ________ ft.
5.	328 in. = ____ yd. ____ in.	41.6 mi. = ________ yd.	22000 yd. = ________ mi.
6.	64.4 ft. = ________ in.	37.8 mi. = ________ ft.	2 mi. 311 ft. = ________ ft.

SHOW YOUR WORK

Solve each problem.

7. The race track at the high school is 0.25 miles long. How many yards is it?

   The track is ________ yards long.

8. Lisa swam in the 600-foot race at the swim meet. How many yards is this race?

   The race is ________ yards.

9. Rich measured 1.6 miles from his house to the library. How many yards is this? How many feet?

   The distance is ________ yards or ________ feet.

7.

8.

9.

NAME ________ Day 7

Lesson 7.2 Liquid Volume (cups, pints, quarts, gallons)

1 pint (pt.) = 2 cups (c.)

1 quart (qt.) = 2 pt. = 4 c.

1 gallon (gal.) = 4 qt. = 8 pt. = 16 c.

Use the table and multiply or divide to convert units of measure.

11 pt. = ________ c.

11 pt. = (11 × 2) c.

11 pt. = 22 c.

12 pt. = ________ gal.

12 pt. = (12 ÷ 8) gal.

12 pt. = 1.5 gal.

Convert the following.

	a	b	c
1.	13 c. = ________ pt.	2.5 gal. = ________ qt.	7 qt. = ________ pt.
2.	72 c. = ________ gal.	4 qt. 1 pt. = ________ pt.	5.4 gal. = ________ qt.
3.	3 gal. = ________ pt.	8.5 qt. = ________ c.	11 qt. = ____ gal. ____ qt.
4.	32 c. = ________ qt.	5.25 gal. = ________ c.	27 c. = ____ pt. ____ c.
5.	9.5 pt. = ________ qt.	9.5 qt. = ________ pt.	33 pt. = ____ gal. ____ pt.

SHOW YOUR WORK

Solve each problem.

6. A serving size is 1 cup of orange juice. How many servings are in a $\frac{1}{2}$ gallon bottle?

   There are ________ servings in the bottle.

7. If a teakettle holds 1.75 quarts of water, how many cups of tea can be made?

   ________ cups of tea can be made.

8. Rey's bathtub holds 42 gallons of water. How many quarts is this? How many pints?

   The bathtub holds ______ quarts. It holds ______ pints.

6.

7.

8.

NAME Day 8

Lesson 7.3 Problem Solving

SHOW YOUR WORK

Solve each problem.

1. The instructions on a package of garden fertilizer say to mix a spoonful of the powder with 9 pints of water. How many cups would this make? How many quarts? How many gallons?

   This would make ________ cups.

   This would make ________ quarts.

   This would make ________ gallons.

2. In an 880 relay race, 4 runners on a team each run 880 yards. How many total yards is this race? How many feet is this? How many miles is this?

   This is ________ yards.

   This is ________ feet.

   This is ________ miles.

3. Bill is 58 inches tall. Nikki is 4.75 feet tall. Elias is 1.5 yards tall. How tall are Bill, Nikki, and Elias in feet and inches? Who is the tallest?

   Bill is ________ feet ________ inches.

   Nikki is ________ feet ________ inches.

   Elias is ________ feet ________ inches.

   ________ is the tallest.

4. June needs to buy gas for her lawn mower. Her gas can holds 5.75 quarts. How many gallons is that?

   The gas can holds ________ gallons.

5. A water pitcher holds 0.75 gallons of water. How many pints is this? How many cups?

   The pitcher holds ________ pints.

   The pitcher holds ________ cups.

1.

2.

3.

4.

5.

NAME ____________ Day 9

Lesson 7.4 Weight (ounces, pounds, tons)

1 pound (lb.) = 16 ounces (oz.)

1 ton (T.) = 2000 lb. = 32000 oz.

Multiply or divide to convert units of measure.

3.6 lb. = ________ oz.

3.6 lb. = (3.6 × 16) oz.

3.6 lb. = 57.6 oz.

11000 lb. = ________ T.

11000 lb. = (11000 ÷ 2000) lb.

11000 lb. = 5.5 T.

Convert the following.

	a	b	c
1.	3.5 T. = ________ lb.	72 oz. = ________ lb.	$\frac{3}{4}$ lb. = ________ oz.
2.	9000 lb. = ________ T.	64000 oz. = ________ T.	430 oz. = ________ lb.
3.	10689 lb. = ____ T. ____ lb.	$3\frac{1}{4}$ lb. = ________ oz.	3800 lb. = ________ T.
4.	9 lb. 14 oz. = ________ oz.	24700 lb. = ________ T.	6.8 T. = ________ lb.
5.	519 oz. = ____ lb. ____ oz.	6.5 lb. = ________ oz.	13 T. = ________ lb.

SHOW YOUR WORK

Solve each problem.

6. A dump truck can carry 3,200 pounds of dirt. How many tons is that?

   The truck can carry ________ tons.

7. At his last veterinary visit, Jerry's cat weighed 12.8 pounds. How many ounces is that?

   Jerry's cat weighed ________ ounces.

8. For the class picnic, the class needs one 4-ounce beef patty for each student. There are 27 students in the class. How many total ounces are needed? How many pounds is that?

   A total of _____ ounces or _____ pounds are needed.

6.

7.

8.

NAME Day 10

Lesson 7.5 Time

1 minute (min.) = 60 seconds (sec.)
1 hour (hr.) = 60 min. = 3600 sec.
1 day = 24 hr. = 1440 min.

Multiply or divide to convert units of measure.

75 min. = ________ hr.
75 min. = (75 ÷ 60) hr.
75 min. = 1.25 hr.

16 min. = ________ sec.
16 min. = (16 × 60) sec.
16 min. = 960 sec.

Convert the following.

	a	b	c
1.	12 min. = ________ hr.	900 sec. = ________ min.	3.5 hr. = ________ min.
2.	8 days = ________ hr.	7 min. = ________ sec.	84 hr. = ________ days
3.	320 min. = ____ hr. ____ min.	$5\frac{1}{4}$ hr. = ________ min.	396 sec. = ________ min.
4.	150 hr. = ____ days ____ hr.	1800 sec. = ________ hr.	6.5 hr. = ________ min.
5.	42 days = ________ hr.	3 hr. 15 min. = ______ min.	3.75 min. = ________ sec.

SHOW YOUR WORK

Solve each problem.

6. Jenna swam two laps in 96 seconds. How many minutes did it take her?

It took Jenna ________ minutes to swim two laps.

7. According to the recipe, an apple spice cake has to bake for 90 minutes. How many hours is that?

The cake has to bake ________ hours.

8. Mickey is counting the hours until his trip to the ocean. It is now 228 hours away. How many days and hours are there until the trip?

The trip is in ______ days and ______ hours.

6.

7.

8.

NAME Day 10

Lesson 7.6 Problem Solving

SHOW YOUR WORK

Solve each problem.

1. Daniel, Trent, and Will competed in a race. Daniel's time was 0.09 hours, Trent's time was 5.8 minutes, and Will's time was 322 seconds. Express each runner's time in minutes and seconds. Who had the fastest time?

Daniel's time was ________ minutes ________ seconds.

Trent's time was ________ minutes ________ seconds.

Will's time was ________ minutes ________ seconds.

____________ had the fastest time.

2. Bobbie bought 5 bags of trail mix. Each bag weighs 36 ounces. How many pounds of trail mix did she buy?

Bobbie bought ____________ pounds of trail mix.

3. Helen has a washtub that holds 16.5 quarts of water. How many gallons does it hold? How many pints? How many cups?

The washtub holds ____________ gallons.

It holds ____________ pints.

It holds ____________ cups.

4. An engineer determined that it would take $14\frac{1}{2}$ tons of steel to build the structure she designed. How many pounds of steel is that?

That is ____________ pounds of steel.

5. Allen kept track of his time working on his science project. When he added it all up, he found that he spent 138 hours on his science project. How many days is that?

Allen spent ____________ days on his science project.

6. A stationery store sells paper by the pound. Patty bought 4.2 pounds of paper. How many ounces is that?

Patty bought ____________ ounces of paper.

1.

2.

3.

4.

5.

6.

Day 1

For each scientist listed below, explain how they contributed to the cell theory.

Scientist	Contribution to Cell Theory
1. Robert Hooke	
2. Matthias Schleiden	
3. Theodor Schwann	
4. Rudolf Virchow	

The observations of Hooke, Schleiden, Schwann, Virchow, and others led to the development of the cell theory. The cell theory is a widely accepted explanation of the relationship between cells and living things. The cell theory states:

- **All living things or organisms are made of cells and their products.**
- **New cells are created by old cells dividing into two.**
- **Cells are the basic building units of life.**

The cell theory holds true for all living things, no matter how big or small. Since cells are common to all living things, they can provide information about all life. And because all cells come from other cells, scientists can study cells to learn about growth, reproduction, and all other functions that living things perform.

Honorable Mention

Anton Van Leeuwenhoek was friends with Robert Hooke. He gets an honorable mention for the cell theory, because he expressed some interest in microscopes when they first became popular within the Renaissance men. He fashioned his own microscope and looked at many different things, including scrapings from his own teeth. That was when he saw moving particles that he called "animalcules". He shared this information with his English friend, Hooke.

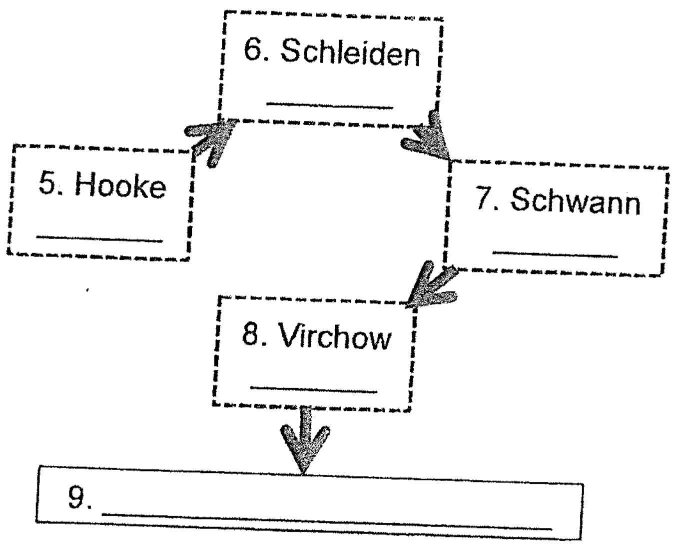
Complete the diagram below by writing the letter of the statement that appropriately explains what each scientist accomplished or discovered. **For number 9, list the theory that these scientists contributed to.**

a. Concluded that cells arise from other living cells.

b. Discovered that living plant cells are comprised of cells.

c. Discovered that animals are made of cells.

d. The first person to use the word "cells" to describe the nonliving plant (cork) he observed under the microscope.



With the historical discoveries of these scientists, we have been able further classify cells into prokaryotes and eukaryotes. Prokaryotic cells make up organisms called prokaryotes. All prokaryotes are tiny and consist of single cells. Bacteria are prokaryotic cells. Eukaryotic cells make up eukaryotes. You are a eukaryote, as are plants and some types of single-celled organisms. All multicellular organisms, or organisms that have many cells, are eukaryotes.

Eukaryotic cells contain a membrane-bound nucleus, while prokaryotic cells have no nucleus at all! In eukaryotic cells, the DNA, or genetic information, is found within the nucleus. In prokaryotic cells, the DNA is found in the cytoplasm, the jellylike substance that fills both types of cells.

Analysis Questions

10. What is the smallest, most basic unit of life? ______________________

11. What instrument was necessary to view cells and thus establish the cell theory?
______________________.

Analysis Questions

12. Why do you think that Robert Hooke used the term "cell" to describe what he saw? ____.

13. How were the discoveries of Schleiden and Schwann alike? How were they different? ____.

14. What is the cell theory? ____.

15. Why does Anton Van Leeuwenhoek get the honorable mention? ____.

16. Where is the DNA in a prokaryote? In a eukaryote? ____.

17. Prokaryotic cells are (circle one) bigger | smaller than eukaryotic cells.

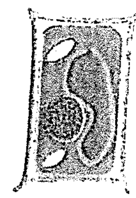
18. A friend tells you he read somewhere that rotting garbage can turn into maggots, which are fly larvae, and the maggots then can grow into adult flies. What part of the cell theory could you use to refute his claim? ____.

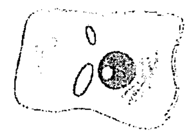
Name: ______________________________ Date: ____________

The Cell Theory

As you've grown, or watched a sibling or pet grow, you have seen remarkable changes over time. Plants, animals (yourself included) grow in height and weight with each passing year. These changes result from an increase in the number and size of cells in the organism's body.

All living things are made up of basic units called cells. Your body contains trillions of cells. Your cells have their own life cycles, which means that some are dying right now, while others are brand new. Your body is constantly making new cells. In order to do this, certain materials must be supplied, and wastes must be removed. Your body takes care of itself by carrying out these processes.

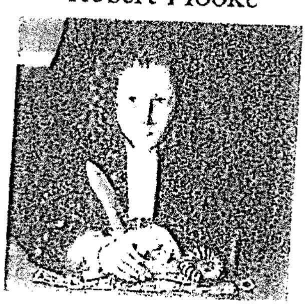




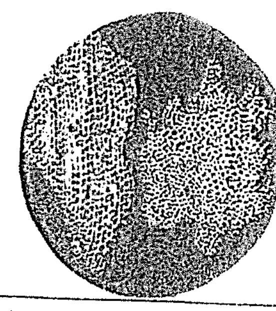
Discovery of Cells and the Cell Theory

Today we know that all organisms are made up of cells. The cell is the basic unit of structure and function in all living things. It is the smallest unit that performs all life processes, such as growth, reproduction, and metabolism. However, we did not always know that cells existed, or what they were.

Robert Hooke



In 1665, a scientist by the name of Robert Hooke used a microscope to view some slices of cork. Cork is simply a processed wood product from the bark of an oak tree. Hooke noticed that the cork was divided into thousands of tiny walled sections. He described these individual sections as "cells".



Cork cells under the microscope as Robert Hooke observed.

In 1839, nearly 200 years after Hooke's discovery, a German botanist by the name of Matthias Schleiden looked at living plant parts through a microscope. He discovered that living plants are also made up of cells. At around the same time, a German physiologist named Theodor Schwann used the microscope to view the parts of animals. He discovered that animals are also made up of cells. Shleiden and Schwann suggested that cells are found in all living things and are the basic unit of life.

Rudolf Virchow, who practiced medicine in Germany, added to the findings of Schleiden and Schwann. When studying organisms under a microscope, Virchow showed that all cells come from other living cells by viewing the stages of cell division.

Day 2

A Volcano Wakes Up

By:Kate Ramsayer

After resting for nearly 2 decades, Mount St. Helens woke up this fall. Shaking ground and a skyward blast proved to the world that it's still an active volcano.

Tiny earthquakes had been shaking the mountain for a week before it erupted on Oct. 1, 2004. The volcano spewed a gray plume of steam and ash 10,000 feet into the air. Hot magma began oozing out of the crater a few weeks later. As it kept coming, the magma literally built a small mountain in front of scientists' eyes.

Mount St. Helens on a quiet day this fall, just before it spewed steam and ash into the air on Oct. 1, 2004.
Forest Service, U.S. Department of Agriculture

These events weren't as explosive as the massive eruption that blew the top off the mountain in 1980. But the recent activity at Mount St. Helens has kept scientists busy making observations and trying to guess what comes next.

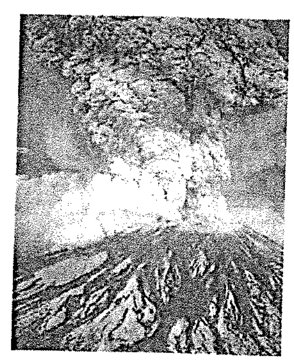
"All of us geologists are curious to see what's going to happen," says Tom Pierson. He's a research geologist with the U.S. Geological Survey.

Making a volcano

Mount St. Helens is in Washington State. It's part of the Cascade Mountain Range, which stretches from British Columbia in Canada to northern California.

Mountains in the Cascades formed where two big chunks of Earth's crust, called plates, ran into each other. When the plate under the Pacific Ocean pushed beneath the plate under North America, the incredibly high pressure and temperature caused rocks to melt into a gooey, superheated magma. The magma then seeped up through the crust. Occasionally, it reached the surface, creating volcanoes.

On the morning of May 18, 1980, Mount St. Helens demonstrated this ongoing process. The mountain erupted, sending ash more than 15 miles into the sky. The blast also went outwards, blowing out the north face of the mountain. This outburst caused massive landslides and leveled trees for miles. Lasting for 9 hours, the eruption killed fifty-seven people.



Over the next 6 years, there were some small eruptions. At times, magma seeped out of the crater, creating a lava dome. Then, except for a few minor outbursts, all was pretty quiet on Mount St. Helens for about 18 years.

Puzzling earthquakes

When a swarm of small earthquakes started up in late September, it puzzled geologists. On Mount St. Helens, earthquakes usually mean that fresh magma filled with expanding gases is pushing toward the surface, shoving rocks aside.

Scientists can detect these gases, including sulfur dioxide and carbon dioxide, using a special airplane that collects air samples. But when they made flights early this fall, the air didn't have unusual amounts of the gases.

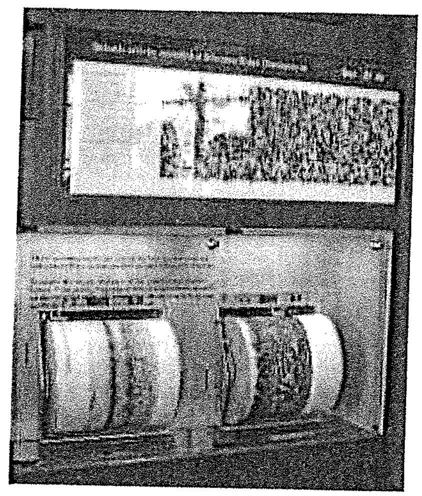
This would normally suggest that old magma was triggering the earthquakes. Like a flat soda, this magma would have already lost its gas, and the volcano probably wouldn't erupt explosively.

But the earthquakes became more frequent and stronger as time went on. Altogether, they released more energy than had been released since the 1980 eruption. This didn't fit with the old-magma hypothesis, Pierson says.

So geologists came up with a new hypothesis. Maybe fresh magma *was* causing the ruckus on Mount St. Helens. But airplanes couldn't detect any released gas because it was being absorbed by the crater's glacier.

Then seismographs, which record ground movements, detected something called a harmonic tremor. A harmonic tremor is a slow vibration of the ground. It's a bit like the rattling sound you sometimes hear when water flows through pipes, Pierson says.

This ground motion told scientists that fresh magma was definitely on the move.



"Each one of these tremor events means the magma moved a little further," says Jim Vallance. He's a research geologist with the Cascades Volcano Observatory and the U.S. Geological Survey.

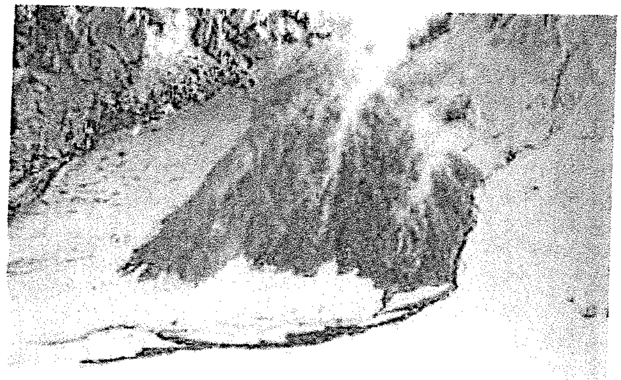
The increasing tremors and moving magma indicated that an eruption could occur within 24 hours of the first blast. On Oct. 2, scientists and park rangers with the U.S. Forest Service decided to move hundreds of volcano watchers back for safety.

"When you see a really strong tremor, it's a good time to give the volcano a little room," Bill Steele says. He's the seismic laboratory coordinator at the Pacific Northwest Seismograph Network at the University of Washington.

However, nothing happened that weekend, showing that nobody can predict exactly what a volcano might do. Since then, the mountain has released several, small plumes of steam and ash.

A new dome

Many scientists are now excited about the creation of a new lava dome in the crater of Mount St. Helens. Since mid-October, magma has been breaking through the surface at a rate of about 7 or 8 cubic yards per second.



A new lava dome is forming in the crater of Mount St. Helens.
U.S. Geological Survey

"That's like having a dump truck or cement mixer full of magma ejected every second onto the dome," Steele says. "It's pretty phenomenal." Scientists can practically watch a mountain being built right before their eyes.

Will the dome continue to grow, or will the volcano take another rest? That's the big question, says Willie Scott of the U.S. Geological Survey. There's no reliable way for geologists to predict what a volcano will do.

"All we can do is monitor it closely and see if indeed it's dying down or if it's changing its behavior," Scott says. "There's no cookbook that tells us that, if we see this, this will happen."

Scientists have several ways to keep an eye on the volcano. They can measure the gases that the volcano releases. These measurements give them clues about the magma beneath the surface.

They can use seismographs to track earthquakes, which have quieted down since the magma forged a path to the surface. Although the first eruption this fall destroyed some instruments, others have been slung into place on the crater by helicopter to measure the shaking.

Geologists can also look for changes in the shape and size of the mountain. They can look for hotspots on the crater by detecting the heat given off by the surface. They can collect rocks to study the magma itself.

Quick trips

Most of the monitoring equipment is placed in the crater by helicopter. A few times, however, scientists have made very quick trips to the crater floor to take samples or set up instruments. They don't linger, though, because they don't want to be there if the volcano erupts!

Still, scientists want to be able to detect any changes in the mountain that could signal danger. The new dome is unstable. If it collapses and clogs the magma flow, the pressure could build up and lead to an eruption. Ash in the air could cause problems for nearby airplanes. Mudslides or floodwaters from a melted glacier could harm people near the mountain.

"Any volcano surprises the people who are studying it," Pierson says. It pays to pay attention.

Name____Date________________Period___

Question Sheet: A Volcano Wakes Up

Before reading

1. How do you think earthquakes and volcanoes are related?

2. Why can volcanoes be found in some areas of the world but not in others?

During reading

3. What happened at Mount St. Helens on May 18, 1980?

4. What gases are scientists looking for when they fly over Mount St. Helens?

5. Describe a harmonic tremor.

6. In what ways are scientists observing and studying the volcano?

7. What might happen if the new lava dome in the crater of Mount St. Helens collapses?

<u>After reading</u>

8. Besides volcanoes, what other natural occurrences might cause mountains to form or disappear?

9. In what ways might a volcanic eruption affect the environment?

Day 3

Name ______________________________ Date ____________ Period ________

Identifying the Controls and Variables

Scientists use an experiment to search for cause and effect relationships in nature. In other words, they design an experiment so that changes to one item cause something else to vary in a predictable way.

These changing quantities are called **variables**. A variable is any factor, trait, or condition that can exist in differing amounts or types. An experiment usually has three kinds of variables: independent, dependent, and controlled.

The **independent variable** is the one that is changed by the scientist. To insure a fair test, a good experiment has only one independent variable. As the scientist changes the independent variable, he or she observes what happens.

The scientist focuses his or her observations on the **dependent variable** to see how it responds to the change made to the independent variable. The new value of the dependent variable is caused by and depends on the value of the independent variable.

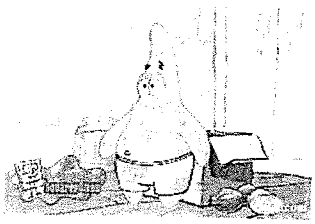
For example, if you open a faucet (the independent variable), the quantity of water flowing (dependent variable) changes in response--you observe that the water flow increases. The number of dependent variables in an experiment varies, but there is often more than one.

From Science Buddies: http://www.sciencebuddies.org/science-fair-projects/project_variables.shtml

Directions:

Read each of the following investigation scenarios and determine the independent variable and dependent variable, and state a conclusion based on the results of the experiment.

Name ______________________________ Date ____________ Period ________



1. Patrick notices that his rock is covered in a strange green slime. His friend Sponge Bob tells him that clam juice will get rid of the green slime. Patrick decides to check this out by spraying half of the rock with clam juice. He sprays the other half with water. After 3 days of "treatment" there is no change in the appearance of the green slime on either side.

A. Identify the independent variable: ______________________________

B. Identify the dependent variable: ______________________________

C. What should Patrick's conclusion be? ______________________________

____

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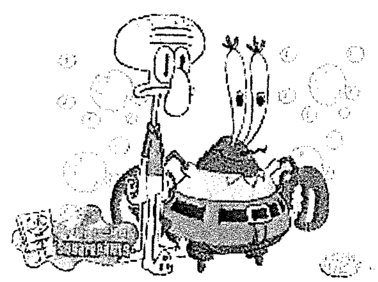
2. Mr. Krabs thinks that adding a special sauce to his Krabby Patties will make the customers want to buy more Krabby Patties. He tells Sponge Bob to make 2 groups of patties: 50 with special sauce and 50 original. Mr. Krabs instructs Squidward to serve the special sauce patties to half of the restaurant and the original patties to the other half. He also tells Squidward to keep track of which customers ordered a second Krabby Pattie. After all the patties had been served 37 customers that ate the special sauce ordered a second Krabby Pattie. Only 15 customers that ate the original ordered a second Krabby Pattie.



A. Identify the independent variable: ______________________________

B. Identify the dependent variable: ______________________________

C. What should Mr. Krabs' conclusion be? ______________________________

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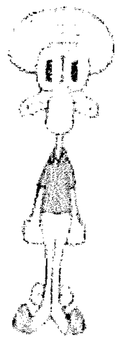

3. Squidward has been playing his clarinet a lot lately and notices that he gets a headache after all this playing. He heard an advertisement for a new headache medicine that will relieve his headache 50% faster than his old medicine. He decides to give it a try. After playing his clarinet and getting a headache Squidward took his usual headache medicine. He timed how long it took until he felt relief – 30 minutes. The next headache Squidward got after playing the clarinet he took the new medicine. He noticed relief in only 15 minutes.

A. Identify the independent variable: ________________________________

B. Identify the dependent variable: ________________________________

C. What should Squidward's conclusion be? ____________________________

____

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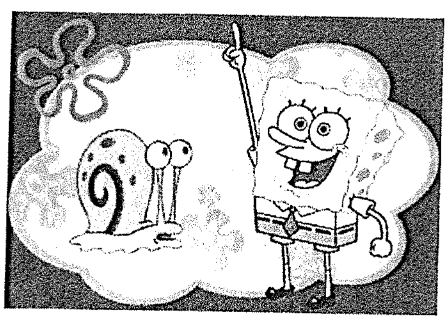


4. Sponge Bob thinks that Gary snores too much and it keeps him awake at night. He wonders if Gary's sleeping position has anything to do with how much Gary snores. He tells Gary about his idea and Gary agrees to try sleeping in a different position. On the first night Gary sleeps in his usual horizontal position. Sponge Bob times how many minutes Gary snores. On the second night Gary sleeps vertically – stuck to the side of Sponge Bob's bed. Sponge Bob times how long he snores. On both nights Gary snored for 3 hours and 12 minutes.

A. Identify the independent variable: ________________________________

B. Identify the dependent variable: ________________________________

C. What should Sponge Bob's conclusion be? ____________________________

____

____

Adapted from *T. Trimpe 2003 http://sciencespot.net/*

Day 4

Day 3: **Investigating Nature Near You Lab**

Pre-Lab:

Directions: Find and outdoor area to observe. Look around and find as many organisms as you can. Spend about 5 minutes looking around. Make a list below of what you found.

Lab:

Select one of the organisms from above to observe for 15 minutes. Write down an observation of the organism or the organism's environment every minute until the 15 minutes have passed. Remember an observation is something that you use your 5 senses to determine (taste, touch, see, hear, smell).

Minute	Observation
1	
2	
3	
4	
5	
6	
7	

8	
9	
10	
11	
12	
13	
14	
15	

Diagram the environment the organism is in. Label the diagram.

Diagram the organism. Label colors, textures and parts of the organism.

Post-Lab: Make inferences about the organism you studied:

Make a food chain with the organism you selected:

[ ] → [Your Organism] → [ ]

Where wouldn't this organism live and why?

Record a list of abiotic and biotic factors present in the environment.

Abiotic: Part of an ecosystem that was <u>never</u> living. (example: rocks)

Biotic: Part of an ecosystem that is living or was living at one time.

Abiotic	**Biotic**

Day 5

Hubble Lives On

By Susan Gaidos / January 22, 2009

NASA has scheduled the last servicing mission for the orbiting Hubble Space Telescope. keep the space craft up and running until at least 2014.

NASA

It's been a rocky past year for the Hubble Space Telescope.

The 24,500-pound spacecraft has been racing around Earth for 18 years. Over that time, it has collected a wealth of groundbreaking data. And it has revolutionized our understanding of space.

In recent months, however, technical difficulties have plagued the historic telescope. There have been electrical malfunctions, instrument failures, downed lines of communication and more.

These problems are not all that surprising, says Frank Summers, an astronomer at the Space Telescope Science Institute in Baltimore. The Hubble has already lived longer than it was originally expected to, he says. And space is a particularly harsh environment for electronic equipment.

"Big, fancy things break," Summers says. "Those are the hazards of doing business in space."

All is not lost, however. Many of Hubble's instruments continue to send images and other data to scientists on Earth. Engineers on the ground have revived some of the telescope's compromised parts. And during a servicing mission, now planned for spring of this year, astronauts will attempt to repair what can't be fixed from here.

In the meantime, Hubble's problems highlight how important the telescope has been to astronomy in the last two decades. Scientists have used the telescope to peer into some of the most distant galaxies in the universe. It has detected moons around planets and planets around stars. It has taught scientists about black holes and dark matter. And it has taken stunning images of colliding galaxies, exploding stars, dust storms on Mars and more.

Just in the last few months, Hubble has observed two of the most massive stars in the Milky Way, watched spots move on Jupiter and given scientists insight into how stars form.

"It is arguably the best telescope in history," Summers says. "There are things we can do with Hubble that we can't do with anything else. It provides us with a birds-eye view of the universe."

Deep view

On Earth, the best place to see stars is from the top of a really tall mountain far from city lights. That's because particles in the air, like dust, debris and smog produced by cities, absorb surrounding light. Also, our atmosphere causes light from space to bend and dim as it travels to our eyes. The effect is like looking up from the bottom of a swimming pool, says Sandra Faber, an astronomer at the University of California Observatories in Santa Cruz.

Moving closer to space removes some of this distortion. That's why many of the world's biggest telescopes are built on mountaintops from Chile to Hawaii to Australia.

But moving *into* space provides the best view of all. Scientists first started sending satellites and telescopes into space in the 1950s. The Hubble launched in 1990.

The images Hubble produced were 10 times sharper than pictures astronomers could get from the ground, Faber says. No one had seen anything like it before.

"In the early days, people would crowd around computer screens and wait with bated breath for the next image to come down," Faber says.

Scientists have to apply to use the Hubble. When their time finally arrives, the wait is almost always worth it. Based on the mounds of data collected by Hubble over the years, researchers from around the world have published thousands of groundbreaking papers.

One of Hubble's greatest scientific accomplishments, Faber says, is a picture called the Hubble Ultra Deep Field. To get the image, produced in 2004, the telescope collected light for a million seconds from just one region of space. The result is a picture of what the universe looked like not long after the Big Bang. (The Big Bang was a huge explosion that sparked the start of the universe about 13.7 billion years ago.)

The Hubble has also transformed the way ordinary people view astronomy. It has taken more than a hundred thousand spectacular and colorful images of galaxies, nebulae, planets and more. The gallery includes space objects that often seem too fantastic to be real.

And the Hubble is about a lot more than just pretty pictures. A variety of instruments on the telescope collect forms of light that we can't see with our own eyes. These wavelengths reveal what stars are made of and how quickly the universe is expanding, among other types of information.

A long life

When scientists first designed the Hubble Space Telescope, they expected it to last for 15 years. In April, it will have its 19th anniversary. The spacecraft recently completed its 100,000th orbit around Earth.

One reason the Hubble has lasted so long is that astronauts have been able to go up and fix it when parts break. Repairs are common on ground telescopes. But the Hubble is the only space telescope that receives these kinds of visits, called servicing missions.

The first servicing mission was in 1993. During that trip, astronauts fixed a flaw in the telescope's main mirror. They also installed and replaced a handful of instruments.

Similar missions happened in 1997, 1999 and 2002. During these visits, scientists have been able to enhance Hubble with the latest and greatest technologies.

"Each time we add new instruments, it's like building a whole new telescope," Summers says. "We make a brand new telescope every time."

The latest servicing mission was originally planned for October 2008. Just two weeks before the scheduled shuttle launch, however, Hubble suddenly stopped sending data to Earth. The problem was traced to a device that formats and labels data sent to Earth. The device is supposed to collect information from the telescope's five main instruments and send the data to scientists on Earth.

NASA engineers are prepared for problems like these. They keep a copy of the Hubble on the ground that they practice with before doing anything to the telescope in space. And they place backups of each instrument on board.

A few days after the data formatting unit shut down, scientists were able to turn on its backup. That worked, but only for a day. Then, new troubles arose, and Hubble shut down its instruments and went into a hibernating "safe mode."

Over the next few weeks, scientists were able to turn most of the instruments back on. Hubble is now completing most if its normal operations.

One last visit

With all of the recent hiccups, the next servicing mission has been postponed until May 12, Summers says. When astronauts finally get to Hubble, they will have a small amount of time to do a lot of work. For five days, they'll have six hours a day devoted to space walks.

During that time, astronauts plan to install two new instruments: the Wide Field Camera 3 (WFC3) and the Cosmic Origins Spectrograph (COS). They'll try to repair two major instruments: the Advanced Camera for Surveys (ACS) and the Space Telescope Imaging Spectrograph (STIS).

And they'll complete routine maintenance. Among other such tasks, they need to replace six 125-pound batteries and add new insulation to certain areas of the telescope.

"There is more planned for this servicing mission than for any other," Summers says. "If all goes as planned, Hubble will be at the peak of its powers after this mission."

No matter what happens, the next servicing mission will be Hubble's last. Scientists hope this final round of fixes will keep the telescope ticking until at least 2014.

Around that time, NASA plans to launch the James Webb Space Telescope. Similar but different from Hubble, the JWST will pick up where Hubble left off: hot on the trail of the universe's most tantalizing mysteries.

Pre-Reading

1) What do you think the purpose of the Hubble Space Telescope is?

2) Describe another type of technology used to study space.

During Reading

3) Describe three achievements of the Hubble Telescope as described in the article.

-
-
-

4) Why is the best place to look at stars on Earth on top of a mountain?

5) When was the Hubble Telescope launched?

a) 1950

b) 1960

c) 1980

d) 1990

6) How long has the Hubble Telescope been in operation? Why has it lasted longer than first expected?

7) Describe the process of how the telescope is fixed. How much time do astronauts have to repair it? What types of repairs are made?

8) How do astronauts prepare and practice to fix the telescope?

After Reading

9) What new information about space has the Hubble Telescope revealed to us?

10) Why do you think the telescope gets damaged when it is out in space? What factors can wear it down or cause it to break?

Day 6

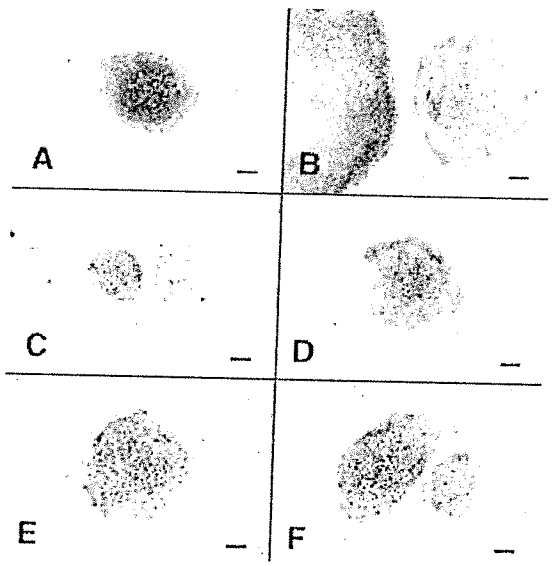
From Stem Cell to Any Cell

Emily Sohn **Oct. 19, 2005**

For maybe a day, about 9 months before you were born, you were just one cell. Then you were two identical cells. Then you were four. Then eight.

Since then, you've grown into a complicated organism with many trillions of cells grouped into specialized tissues and organs. The cells in your brain do the thinking. The cells in your heart pump blood. The cells in your tongue let you taste food. And so on.

In recent years, scientists have made an amazing discovery. Even though most cells have specific jobs, some primitive cells—called stem cells—exist in everyone's body. Stem cells are unspecialized cells that can develop into nearly any type of body cell.



These images show human embryonic stem cell colonies, as grown in 1998 by researchers at the University of Wisconsin–Madison, in different stages of development.
© *Science*

Embryos—babies in the earliest stages of growth before they are born—have stem cells. Certain tissues in adults also contain stem cells, although the range of cells into which they can develop is limited.

In 1998, scientists at the University of Wisconsin–Madison figured out how to collect human embryonic stem cells and make them grow. Since then, researchers have learned to mix stem cells with combinations of proteins called growth factors to make the cells grow into different types of cells. Now, the search is on for ways to use stem cells to treat injuries and cure diseases.

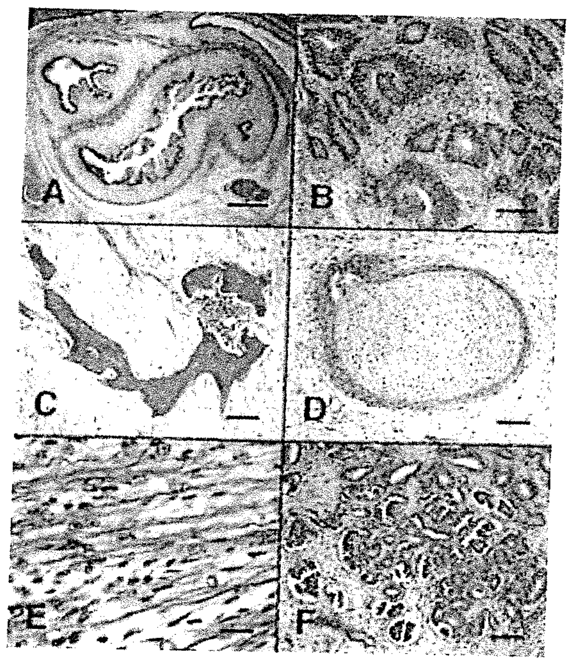
For example, stem cells could be extracted, turned into new bone cells, and then injected into weak or broken bones. Or, they could become nerve cells that could heal spinal cord injuries, skin cells that could replace badly burnt skin, or brain cells that could help people who have suffered brain damage. The possibilities are endless.

"At this point, the ability to create all the different cells in the body has been pretty much proven to be real," says Gary Friedman. He's director of the Center for Regenerative Medicine in Morristown, N.J. "All the focus now is on getting new cells to behave the way we want them to and to go where we want them to go."

Living better

Treating heart disease is one promising area of research. In dishes in the laboratory, scientists have already turned stem cells into heart cells, which gather into a group and throb in synch with one another, just like cells do in your heart.

At the University of Texas Health Science Center in Houston, researchers are now taking stem cells from a patient's own body and injecting them into the heart to rebuild heart tissue and combat heart disease.



Human embryonic stem cells can turn into a variety of different cell types, including (A) gut, (B) neural cells, (C) bone marrow cells, (D) cartilage, (E) muscle, and (F) kidney cells.
© *Science*

Elsewhere, scientists are working to battle spinal cord injuries, diabetes, cancer, and more. But stem cells can't cure all our ills. Some health problems are proving harder to treat this way than others.

Hearts, nerves, and livers are simple, Friedman says. Kidneys and lungs, on the other hand, are organs are tougher to repair. In kidneys, for example, stem cells have to not only specialize but also move into appropriate positions.

The goal of stem cell research is to help people live better, Friedman says.

"If kids are looking at their grandparents, maybe they see somebody who can't walk well or somebody who is partly paralyzed because of a stroke," he says.

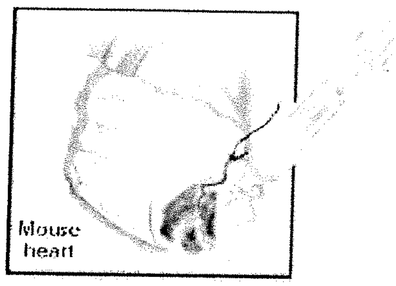
"If you could take an older person and give that person cells to regenerate heart muscle or part of the brain that died during a stroke, or inject cells into joints to take away arthritis, all of a sudden you're going to have a pretty vibrant person there," Friedman says.

"This will help society," he says. "People will be more functional instead of being in a weakened state and having to be cared for."

More than science

As promising as the research may seem, discussions about stem cells often involve more than just science. Ethics is also involved, along with politics and religion, especially when it comes to stem cells taken from embryos.

So far, embryonic stem cells appear to be more useful than stem cells that come from adults. Because an embryo's cells are still dividing and specializing anyway, its stem cells can still become almost anything. By the time we grow up, however, our stem cells have a more limited ability to diversify.



To repair heart muscle in a mouse, researchers inject adult stem cells into the muscle of the damaged wall of a mouse heart.
National Institutes of Health

The problem with embryonic stem cells, for some people, is that they originally come from destroyed embryos. Many scientists argue that stem cells are our best hope for curing a huge number of diseases. They also argue that fertility clinics end up with a surplus of embryos that are never born anyway.

Nevertheless, critics think its wrong to use cells from dead embryos. It's a very complicated issue that involves basic beliefs about when life begins, and these are the types of beliefs about which people tend to feel passionate.

Some recent research may help put an end to the debate, Friedman says.

A new technique called "somatic cell nuclear transfer" has given scientists the ability to create embryonic-like stem cells out of a person's own cells. This strategy is especially appealing to doctors, because it's always better to use a person's own cells for transplants and injections. Our bodies often reject cells that come from someone else, even if that someone else is an unborn embryo.

Scientists have also found embryonic-like stem cells in umbilical cord blood. About 100 million babies are born each year, and every one of them has an umbilical cord that connects it to its mother. If umbilical cords prove to be a reliable source, the supply of stem cells could be enormous and controversy-free.

All this may sound a bit confusing, but it's worth learning more. Stem cells are big news in medicine right now. "I don't think a day goes by when there aren't articles or something on the Web about it," Friedman says.

As you get older, you're bound to hear more and more about stem cells.

From Stem Cell to Any Cell

Question Sheet: From Stem Cell to Any Cell

Before reading:

1) In biology, what are cells? Why are they important?

During reading:

1) What are stem cells?

2) Where are they found?

3) What are three important uses for stem cells?

   X

   X

   X

4) Name two organs that are easy to repair using stem cells.

5) What are two organs that are difficult to repair using stem cells?

6) Why are embryonic stem cells more useful than other stem cells?

7) What makes the new technique called "somatic cell nuclear transfer" appealing to doctors?

8) How are scientists trying to get around ethical concerns about the use of embryonic stem cells in research and medicine?

Day 7

TeensHealth.org
A safe, private place to get doctor-approved information on health, emotions, and life.

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Vitamins and Minerals

Breakfast cereals advertise that they're packed with vitamins and minerals. Sports drinks claim they can rev up your flagging energy with a jolt of vitamins or minerals (sorry, but even powerful vitamins and minerals can't act that fast!). You know vitamins and minerals are good for you. But which ones does your body really need? And is it possible to get too much of a good thing?

What Are Vitamins and Minerals?

Vitamins and minerals make people's bodies work properly. Although you get vitamins and minerals from the foods you eat every day, some foods have more vitamins and minerals than others.

Vitamins fall into two categories: fat soluble and water soluble. The **fat-soluble** vitamins — A, D, E, and K — dissolve in fat and can be stored in your body. The **water-soluble** vitamins — C and the B-complex vitamins (such as vitamins B6, B12, niacin, riboflavin, and folate) — need to dissolve in water before your body can absorb them. Because of this, your body can't store these vitamins. Any vitamin C or B that your body doesn't use as it passes through your system is lost (mostly when you pee). So you need a fresh supply of these vitamins every day.

Whereas vitamins are organic substances (made by plants or animals), minerals are inorganic elements that come from the soil and water and are absorbed by plants or eaten by animals. Your body needs larger amounts of some minerals, such as calcium, to grow and stay healthy. Other minerals like chromium, copper, iodine, iron, selenium, and zinc are called **trace minerals** because you only need very small amounts of them each day.

What Do Vitamins and Minerals Do?

Vitamins and minerals boost the immune system, support normal growth and development, and help cells and organs do their jobs. For example, you've probably heard that carrots are good for your eyes. It's true! Carrots are full of substances called **carotenoids** that your body converts into vitamin A, which helps prevent eye problems.

Another vitamin, vitamin K, helps blood to clot (so cuts and scrapes stop bleeding quickly). You'll find vitamin K in green leafy vegetables, broccoli, and soybeans. And to have strong bones, you need to eat foods such as milk, yogurt, and green leafy vegetables, which are rich in the mineral calcium.

Fuel for Growth

People go through a lot of physical changes — including growth and puberty — during their teenage years. Eating right during this time is especially important because the body needs a variety of vitamins and minerals to grow, develop, and stay healthy.

Eating a variety of foods is the best way to get all the vitamins and minerals you need each day, as well as the right balance of carbohydrates, proteins, fats, and calories. Whole or unprocessed foods — like fresh fruits and vegetables, whole grains, low-fat dairy products, lean meats, fish, and poultry — are the best choices for providing the nutrients your body needs to stay healthy and grow properly.

It's OK to eat foods like potato chips and cookies once in a while, but you don't want to overdo high-calorie foods like these that offer little nutritionally.

To choose healthy foods, check food labels and pick items that are high in vitamins and minerals. For example, if you're choosing beverages, you'll find that a glass of milk is a good source of vitamin D and the minerals calcium, phosphorous, and potassium. A glass of soda, on the other hand, doesn't have any vitamins or minerals.

You can also satisfy your taste buds without sacrificing nutrition while eating out: Vegetable pizzas or fajitas, sandwiches with lean cuts of meat, fresh salads, and baked potatoes are just a few delicious, nutritious choices.

If you're a vegetarian, you'll need to plan carefully for a diet that offers the vitamins and minerals found primarily in meats. The best sources for the minerals zinc and iron are meats, fish, and poultry. However, you can get zinc and iron in dried beans, seeds, nuts, and leafy green vegetables like kale.

Vitamin B12, which is important for manufacturing red blood cells, is not found in plant foods. If you don't eat meat, you can find vitamin B12 in eggs, milk and other dairy foods, and fortified breakfast cereals. Vegans (vegetarians who eat no animal products at all, including dairy products) may need to take vitamin supplements.

If you're thinking about becoming a vegetarian, talk to your doctor or a dietitian about how to plan a healthy, balanced diet.

Common Concerns

Lots of teens wonder if they should take vitamin or mineral supplements. If your diet includes a wide variety of foods, including whole-grain products, fresh fruits and vegetables, dairy products, nuts, seeds, eggs, and meats, then you are probably getting the vitamins and minerals your body needs.

But if you're skipping meals, dieting, or if you're concerned that you're not eating enough items from a particular category, such as vegetables or dairy products, then talk to your doctor or to a dietitian. These professionals can help you create an eating plan that includes the nutrients your body needs.

Check with your doctor before taking vitamin or mineral supplements. Some people think that if something is good for you, then the more you take in, the healthier you'll be. But that's not necessarily true when it comes to vitamins and minerals. For example, fat-soluble vitamins or minerals, which the body stores and excretes more slowly, can build up in your system to levels where they could cause problems.

There are hundreds of supplements on the market and of course their manufacturers want you to purchase them. Beware of unproven claims about the benefits of taking more than recommended amounts of any vitamin or mineral. A healthy teen usually doesn't need supplements if he or she is eating a well-rounded diet.

Your best bet for getting the vitamins and minerals you need is to eat a wide variety of healthy foods and skip the vitamin pills, drinks, and other supplements. You'll feel better overall and won't run the risk of overdoing your vitamin and mineral intake.

Reviewed by: Mary L. Gavin, MD
Date reviewed: July 2014

Note: All information on TeensHealth® is for educational purposes only. For specific medical advice, diagnoses, and treatment, consult your doctor.

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Name ____________________________

Vitamins and Minerals Questions Sheet

1. What are the fat-soluble vitamins?

2. Why is vitamin B12 important for the body?

3. When, or should you take vitamin supplements?

4. Which vitamin aids in blood clotting and why?

5. What are the water-soluble vitamins and how do they help the body?

6. What foods help you receive the type and amount of vitamins you need each day?

Day 8

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Vitamin D

Vitamin D has been called the new "wonder vitamin." Doctors are learning more and more about its role in good health and the prevention of diseases. Unfortunately, though, most teens don't get enough.

Why Do I Need It?

Vitamin D plays a part in the bone-building process by helping the body to absorb calcium. If someone doesn't get enough, it could affect the body's ability to build and maintain strong bones and teeth.

It's not just about bones, though. Vitamin D is needed for a healthy immune system — helping the body to fight off infections and prevent the development of autoimmune diseases like rheumatoid arthritis. Research done in adults suggests that getting enough vitamin D may help lower the chances of developing heart disease, certain cancers, and other serious diseases like diabetes.

Why Don't People Get Enough?

There are several reasons why people don't get enough vitamin D:

- **Less exposure to UV rays.** Vitamin D is sometimes called the "sunshine" vitamin. When the sun's ultraviolet rays penetrate bare skin, it sets off a process in the body that produces vitamin D. As many of us spend more and more time on computers and game consoles, we're not outdoors as much as we once were. And, when we do spend time in the sun, more of us are making the wise decision to use sunscreen to block the UV rays that cause sun damage and cancer. Where we live makes a difference, too: If you live in northern U.S. and Canada, it's possible you're not getting the UV exposure required for your body to make enough vitamin D.
- **Dark skin.** The melanin (the pigment that gives skin its color) in darker skin protects against sun damage, but it can also block the sun needed to produce vitamin D.
- **Certain health conditions.** Some health conditions, like cystic fibrosis or inflammatory bowel disease, affect how well the body absorbs nutrients, including vitamin D. And because vitamin D is a fat-soluble vitamin that gets stored in the body's fat cells, obesity increases a person's risk for vitamin D deficiency.
- **Lower consumption of D-rich foods.** Experts recommend eating vitamin D-rich foods as the best way to get enough vitamin D. But many of the best foods — like fatty fish and oil — are not the most popular. These days, most milk is "fortified" with added vitamin D. But many teens aren't drinking enough milk to get the recommended daily amount.

Why Not Just Get More Sun?

Sun exposure can lead to serious problems, like skin cancer. There's just not enough evidence yet that getting vitamin D from exposing bare skin to the sun is worth the risk. You may see advice that it's OK to get unprotected sun exposure at certain times, but there's no way to say for sure whether that advice is safe for you. It depends on a combination of things, including body size, skin color, geographic location, season, whether it's cloudy or sunny out, and how much sun protection you use.

How Much Vitamin D Do I Need?

The Institute of Medicine (IOM) recommends that teens get 600 IU (international units) of vitamin D per day. Ask your doctor if you should take a daily multivitamin or vitamin D-only preparation that contains the 600 IU of vitamin D you need.

You may need even more than 600 IU if you have darker skin, live in areas with limited sunshine, have a condition that affects how well your body absorbs nutrients, or if tests show you have low vitamin D levels. Check with your doctor before taking higher doses, though. Vitamin D is a fat-soluble vitamin, meaning it gets stored in the body. In rare cases extremely large doses could build up to dangerous levels.

The IOM recommends an upper limit — the highest daily intake that is likely to pose no risk — of 4,000 IU of vitamin D per day for teens. Most people who eat foods rich in vitamin D, who get normal sun exposure, and who take a 600 IU supplement will not get toxic buildup of vitamin D in their bodies. Problems with vitamin D toxicity happen when people take supplements with megadoses of the vitamin or lots of different supplements containing the vitamin.

As always, your doctor is the best advisor of what works for you!

Getting More Vitamin D Into Your Diet

As with all vitamins, it's best to get our D through the foods we eat. The best sources of vitamin D are:

- fatty fishes and fish oils, such as salmon, mackerel, and cod liver oil
- egg yolks
- vitamin D-fortified milk and other dairy products

Lots of other foods are fortified with vitamin D, including orange juice, soy milk, cereals, and bread. Read the nutrition facts label to see how much vitamin D is in each serving.

Reviewed by: Mary L. Gavin, MD
Date reviewed: February 2014

Note: All information on TeensHealth® is for educational purposes only. For specific medical advice, diagnoses, and treatment, consult your doctor.

Name ______________________________

Vitamin D Question Sheet

1. How much vitamin D should a teen get a day?

2. How does vitamin D help the body?

3. What are the reasons people don't get enough Vitamin D?

4. If we get the proper amount of Vitamin D, what type of disease will it help lower our chances of contracting?

5. How can you get more Vitamin D into your diet?

6. What type of foods are fortified with Vitamin D?

Name ______________________ Class ______________ Date ____________

CHAPTER 18 Electromagnetism

SECTION 1

Magnets and Magnetism

Day 9

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What are the properties of magnets?
- Why are only some materials magnetic?
- What are four kinds of magnets?
- What are two examples of the effect of the Earth's magnetic field?

National Science Education Standards

PS 3a

What Are the Properties of Magnets?

Have you ever experimented with magnets? If so, you know that they can stick to each other and to some kinds of metal. You also know that magnets can stick to things without touching them directly. For example, a magnet sticks to a refrigerator door even with a piece of paper in between. They are not really sticky, so what makes things cling to them?

More than 2,000 years ago, the Greeks discovered a mineral that attracted things made of iron. They found it in a part of Turkey called Magnesia, so the Greeks called it *magnetite*. Today, we call any material that attracts iron or things made of iron a **magnet**. All magnets have certain properties. For example, all magnets have two poles. Magnets exert forces on each other. Last, all magnets are surrounded by magnetic fields. ☑

STUDY TIP

Predict Before reading this section, predict whether each of the following statements is true or false:

- Every magnet has a north pole and a south pole.
- The magnetic pole near the Earth's South Pole is a north pole.

READING CHECK

1. List What are three properties of a magnet?

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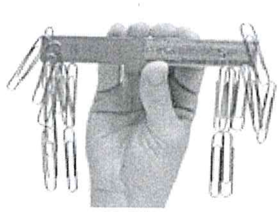
MAGNETIC POLES



More paper clips stick to the ends, or magnetic poles, of the magnet because the magnetic forces are strongest there.

Magnetic effects are not the same throughout the magnet. What happens when you put a bar magnet into a box of paper clips? Most of the clips stick to the ends of the magnet. The strongest magnetic forces occur near the ends of the bar magnet. Each end of the magnet is a magnetic pole. **Magnetic poles** are points on a magnet that have opposite magnetic qualities. ☑

READING CHECK

2. Describe What are magnetic poles?

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NORTH AND SOUTH

Suppose you hang a magnet by a string so that the magnet can rotate. You will see that one end of the magnet always points toward north. A compass is a suspended magnet. The pole of the magnet that points toward north is called the magnet's *north pole.* The opposite end of the magnet points toward south. It is called the magnet's *south pole.* Magnetic poles are always in pairs. You will never find a magnet that has only one pole. ☑

READING CHECK

3. Identify What is the name of a magnet's pole that points north?

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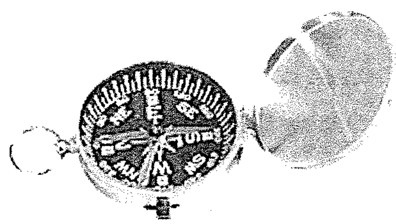

The needle in a compass is a magnet that is free to rotate.

TAKE A LOOK

4. Describe What is a compass?

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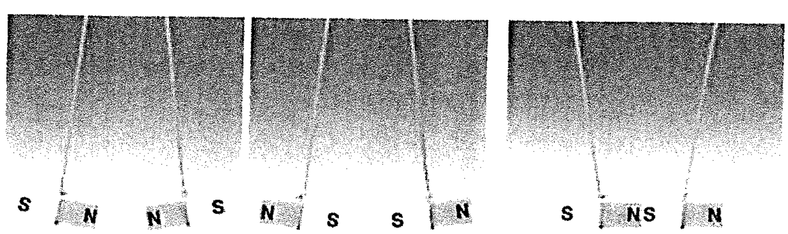
MAGNETIC FORCES

When you bring two magnets close together, the magnets exert a magnetic force on each other. **Magnetic force** can either push the magnets apart or pull them together. This force comes from spinning electric charges in the magnets. The force is a *universal* force. That means it is always present when magnetic poles come near each other. ☑



▲ If you hold the north poles of two magnets close together, the magnetic force will push the magnets apart. The same is true if you hold two south poles close together.

▲ When the north pole of one magnet is close to the south pole of another, magnetic force pulls the magnets together.

TAKE A LOOK

5. Describe What are two ways two magnets can be placed to show them repelling each other?

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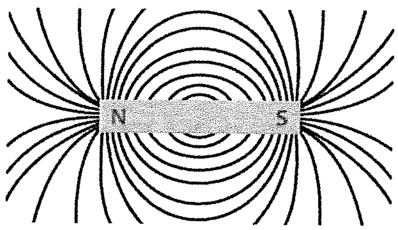
The magnetic force between magnets depends on how the poles of the magnets line up. Poles that are the same repel. So if you put two south poles together, they push apart. Opposite poles attract, as you can see in the pictures above.

MAGNETIC FIELDS

A magnetic field exists in the region around a magnet in which magnetic forces can act. We can show the shape of a magnetic field with lines drawn from the north pole of a magnet to the south pole. ☑



Magnetic field lines show the shape of the magnetic field around a magnet.

READING CHECK

6. Describe Magnetic field lines point in what direction?

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These lines map out the magnetic field and are called *magnetic field lines*. The closer together the field lines are, the stronger the magnetic field is. The lines around a magnet are closest together at the poles. That's where the magnetic force on an object is strongest. ☑

READING CHECK

7. Describe When looking at magnetic field lines, how can you tell where the field is strongest?

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What Causes Magnetism?

Some materials are magnetic. Some are not. For example, a magnet can pick up paper clips and iron nails. But it cannot pick up paper, plastic, pennies, or aluminum foil. Whether a material is magnetic depends on the material's atoms.

ATOMS AND DOMAINS

All matter is made of atoms. Electrons are negatively charged particles of atoms. As an electron moves around, it creates a magnetic field. The atom has a north and south pole. In materials that are not magnetic, magnetic fields of the atoms cancel each other out.

But in materials such as iron, nickel, and cobalt, groups of atoms are in tiny areas called *domains*. The north and south poles of the atoms in a domain line up and make a strong magnetic field. Domains are like tiny magnets of different sizes within an object. Most of the domains must line up for the object to be magnetic. ☑

READING CHECK

8. Explain Why is iron magnetic, but copper and aluminum are not?

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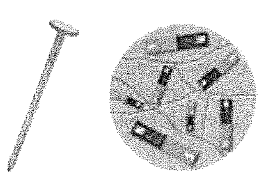
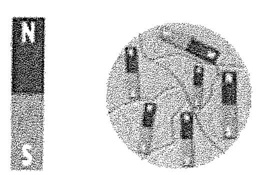


If the domains in an object are not aligned, the magnetic fields cancel. The object is not magnetic.



If the domains in an object are aligned, the magnetic fields combine. The object is magnetic.

LOSING ALIGNMENT

The figure on the previous page shows how domains work. If the domains line up, the object has a magnetic field. But the domains of a magnet may not always stay lined up. When domains move, the magnet is *demagnetized.* It loses its magnetic properties.

A magnet can lose its magnetic properties if you:

- drop or hit the magnet
- put the magnet in a strong magnetic field that is opposite to its own
- heat up the magnet (which makes the atoms vibrate faster).

Any one of the above actions can change the domains so they are no longer in line. ☑

READING CHECK

9. Describe What are two ways a magnet can lose its magnetic properties?

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MAKING MAGNETS

You can make a magnet out of, or *magnetize,* iron, cobalt, or nickel. You just need to line up the domains in it. For example, you can magnetize an iron nail if you rub it in one direction with one pole of a magnet. The domains in the nail line up with the magnetic field of the magnet. So the domains in the nail get in line. As more domains line up, the magnetic field of the nail grows stronger.

The process of making a magnet also explains how a magnet can pick up an object that is not magnetic. Bring a magnet close to a paper clip. Some domains in the paper clip line up with the field of the magnet. So the paper clip becomes a temporary magnet.

The north pole of the paper clip points toward the south pole of the magnet. The paper clip is attracted to the magnet. When the magnet is removed, the domains of the paper clip will become scrambled again.

Critical Thinking

10. Explain How is magnetizing an object the opposite of demagnetizing a magnet?

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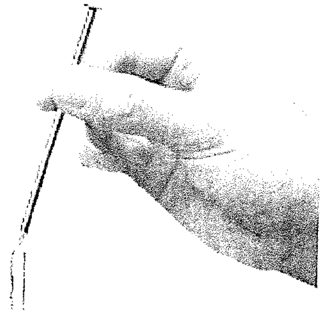

This nail was magnetized by dragging a magnet down it many times.

TAKE A LOOK

11. Identify If the tip of the nail is a north pole, what is the pole on the end of the attached paper clip?

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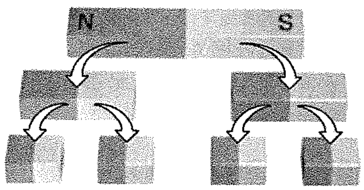
CUTTING A MAGNET

What do you think would happen if you cut a magnet in half? You might think that you would end up with one north-pole piece and one south-pole piece. But that's not what happens. Instead, when you cut a magnet in half, you get two magnets. Each piece has its own north and south pole. The picture below shows what happens when a magnet is cut.



If you cut a magnet in pieces, each piece will still be a magnet with two opposite poles.

A magnet has poles because its domains are lined up. Each domain within a magnet is like a tiny magnet with a north pole and a south pole. So even the smallest pieces of a magnet have two poles. ☑

READING CHECK

12. Explain Why do even the smallest magnets have two poles?

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What Kinds of Magnets Are There?

There are different ways to describe magnets. Some magnets are made of iron, nickel, cobalt, or mixtures of those metals. Magnets made with these metals have strong magnetic properties and are called *ferromagnets*. The mineral magnetite (which has iron in it) is an example of a natural ferromagnet. ☑

Another kind of magnet is the *electromagnet*. This is a magnet made by an electric current through a coil of wire. An electromagnet usually has an iron core.

READING CHECK

13. Define What is a ferromagnet?

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TEMPORARY AND PERMANENT MAGNETS

We also describe magnets as temporary or permanent. *Temporary magnets* are made from materials that are easy to magnetize. Something that is *temporary* does not last as long time. Temporary magnets lose their magnetization easily. Soft iron makes a good temporary magnet.

Permanent magnets are difficult to magnetize. However they keep their magnetic properties longer than temporary magnets. *Permanent* means something lasts or stays the same. Some permanent magnets are made with alnico, an alloy of aluminum, nickel, cobalt, and iron.

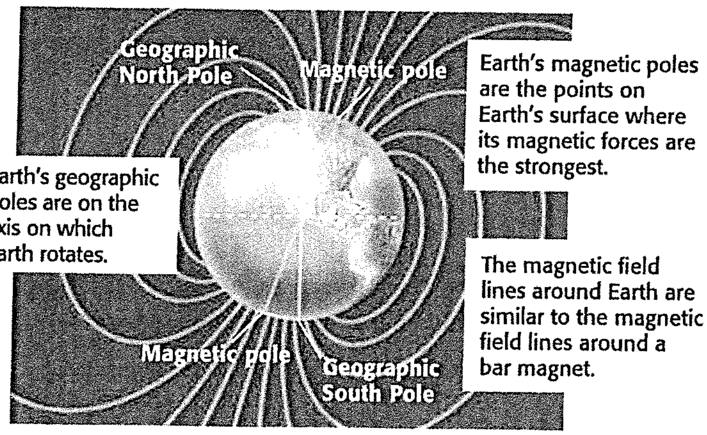
How Does the Earth Work as a Magnet?

Tie a string around a magnet so when the end of the string is held, the magnet is free to rotate. One end of the magnet will point north. For more than 2,000 years, travelers have used this property to find their way. You use it when you use a compass because a compass has magnet that is free to rotate.

ONE GIANT MAGNET

In 1600, an English doctor named William Gilbert suggested that magnets point to the north because Earth is one giant magnet. Earth really does act as if it has a bar magnet running through its center. The poles of this imaginary magnet are located near Earth's *geographic* poles. Geographic poles are the poles you see on maps.

Earth's Geographic and Magnetic Poles



TAKE A LOOK

14. Identify What are the magnetic field lines around Earth similar to?

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POLES OF A COMPASS NEEDLE

If you put a compass near a bar magnet, the marked end of the needle points to the south pole of the magnet. Does that surprise you? Remember that opposite poles of magnets attract each other. A compass needle is really a small magnet. The tip that points to the north is the needle's north pole. Therefore, the point of a compass needle moves toward the south pole of the magnet.

SOUTH MAGNETIC POLE NEAR NORTH GEOGRAPHIC POLE

A compass needle points north. This is because the magnetic pole of Earth that is closest to geographic north is a magnetic south pole. A compass needle points north because its north pole is attracted to the Earth's very large magnetic south pole. ☑

READING CHECK

15. Identify Is Earth's north pole a magnetic north pole or a magnetic south pole?

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THE CORE OF THE MATTER

Earth may act as if it has a giant bar magnet through its center, but there isn't really a magnet there. The temperature of Earth's core (or center) is very high. That makes the atoms in it move too violently to stay lined up in domains.

Scientists think that the movement of electric charges in the Earth's core creates Earth's magnetic field. The Earth's core is made mostly of iron and nickel. Great pressure makes Earth's inner core solid. The outer core is liquid because the pressure is not as high. As Earth rotates, the liquid in the core flows. That makes electric charges move, which makes a magnetic field. ☑

READING CHECK

16. Explain What do scientists think causes Earth's magnetic field?

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A MAGNETIC LIGHT SHOW

The beautiful curtain of light in the picture below is called an *aurora*. Earth's magnetic field plays a part in making auroras. An aurora forms when charged particles from the sun hit oxygen and nitrogen atoms in the air. The atoms become excited and then give off light of many colors.

Earth's magnetic field blocks most of the charged particles from the sun. However, the field bends inward at the magnetic poles. This causes the charged particles from the sun to enter the atmosphere at and near the poles. We see auroras near Earth's North Pole. They are called the northern lights, or *aurora borealis*. Auroras near the South Pole are called the southern lights, or *aurora australis*. ☑

READING CHECK

17. Identify What causes charged particles from the sun to bend inwards after entering the atmosphere?

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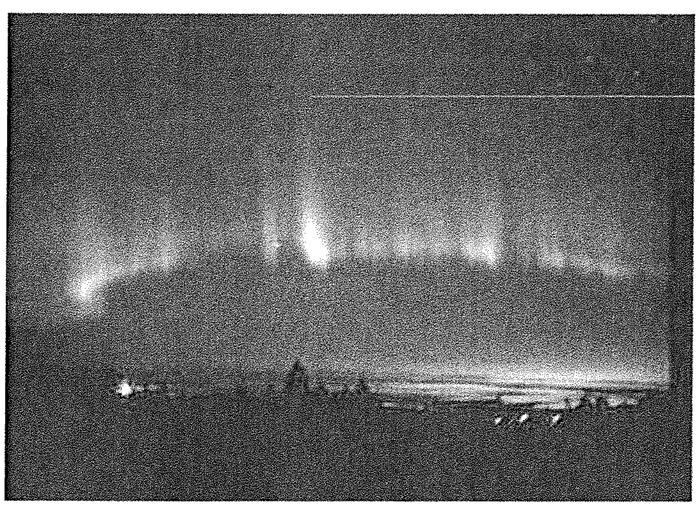


An aurora is an amazing light show in the sky.

Name ______________________ Class ______________ Date ______________

CHAPTER 18 Electromagnetism

SECTION 2

Magnetism from Electricity

Day 10

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How are an electric current and a magnetic field related?
- What are solenoids and electromagnets?
- How does electromagnetism run doorbells, electric motors, and galvanometers?

National Science Education Standards

PS 3a

How Was Electromagnetism Discovered?

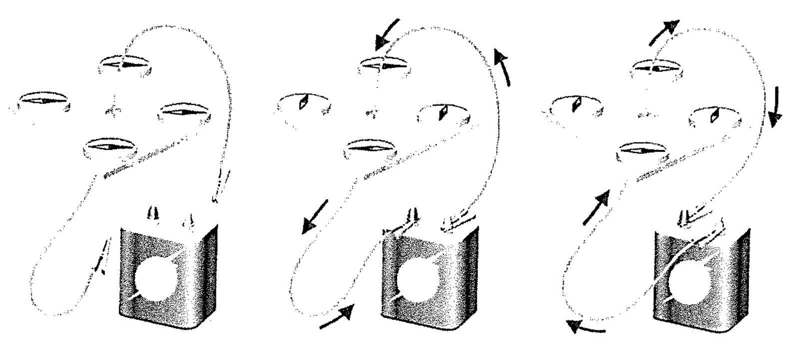
Many things around you—doorbells and motors, for example—use electricity to make magnetism. In this section, you will learn how electricity and magnetism are related and how we make electromagnets.

Danish physicist Hans Christian Oersted discovered how electricity and magnetism are related in 1820. While teaching a class, he held a compass near a wire carrying an electric current. When the compass was brought close to the wire, the compass needle moved. It no longer pointed to the north. He had accidentally discovered that electricity and magnetism are related.

A compass needle is a magnet. It moves from its north-south position only when it is in a magnetic field different from Earth's. Oersted tried a few experiments with the compass and the wire. He learned that electric current produces a magnetic field. That made the needle of the compass line up with the direction of the magnetic field. The picture below shows how his experiments worked.

STUDY TIP

Compare As you read this section, make a table to compare solenoids and electromagnets.



a If no electric current is in the wire, the compass needles point in the same direction.

b Electric current in one direction causes two compass needles to deflect in a clockwise direction.

c Electric current in the opposite direction causes the two compass needles to deflect in a counter-clockwise direction.

TAKE A LOOK

1. Describe Why does a compass needle move when it is near a wire with an electric current running though it?

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READING CHECK

2. Define What is electromagnetism?

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READING CHECK

3. Identify What are two things you can do to make the magnetic field of a solenoid stronger?

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MORE RESEARCH

Oersted also found that the direction of the magnetic field depends on the direction of the current. The French scientist André-Marie Ampère heard about Oersted's findings. Ampère did more research with electricity and magnetism. Their work was the first research into electromagnetism. **Electromagnetism** is the interaction between electricity and magnetism. ☑

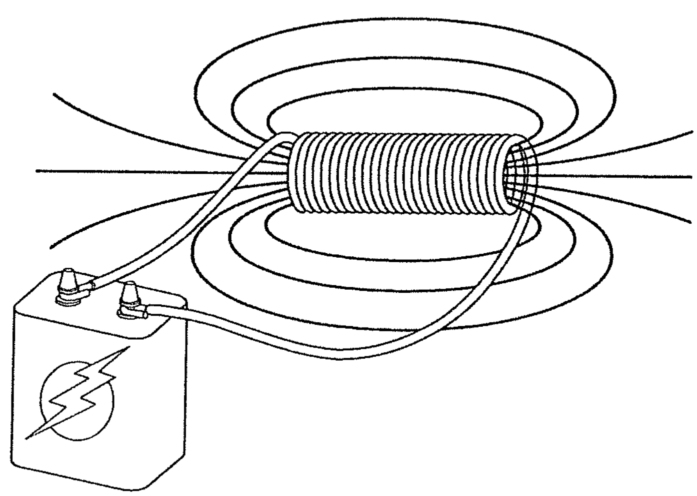
How Do We Use Electromagetism?

The magnetic field produced by an electric current in a wire can move a compass needle. But the magnetic field is not strong enough to be very useful. However, two devices, the solenoid and the electromagnet, make the magnetic field stronger. They make electromagnetism more useful.

SOLENOIDS

A single loop of wire that carries a current does not have a very strong magnetic field. But if you form many loops into a coil, it makes the magnetic field stronger. The magnetic fields of the loops work together.

The picture below shows a solenoid. A **solenoid** is a coil of wire that produces a magnetic field when an electric current runs through it. The magnetic field around a solenoid is very similar to the magnetic field of a bar magnet. The magnetic field of a solenoid gets stronger if it has more loops. The magnetic field also becomes stronger as the current in the wire increases. ☑



The ends of the solenoid are like the poles of a bar magnetic.

ELECTROMAGNETS

We can make magnets with an even stronger magnetic field than one made by a solenoid. Electromagnets can make a train float! An **electromagnet** is made up of a solenoid wrapped around an iron core. It acts as a magnet when an electric current runs through the coil. The magnetic field of the solenoid makes the domains inside the iron core line up.

The magnetic field of the electromagnet is the field of the solenoid plus the field of the magnetized core. As a result, the magnetic field of an electromagnet may be hundreds of times stronger than the magnetic field of just the solenoid. You can make an electromagnet stronger by increasing the number of loops per meter in the solenoid. You can also increase the electric current in the wire. ☑

Engineers have developed trains called *maglev* trains that use electromagnetism. Maglev is a short name for *magnetic levitation.* Instead of rolling on wheels over the tracks, these trains *levitate,* or float, above the track. How? Remember what happens when you bring two magnets close together—the magnets exert a magnetic force on each other. In maglev trains, powerful electromagnets in the rails repel strong magnets on the train cars.

READING CHECK

4. Explain Why is the magnetic field of an electromagnet stronger than a solenoid?

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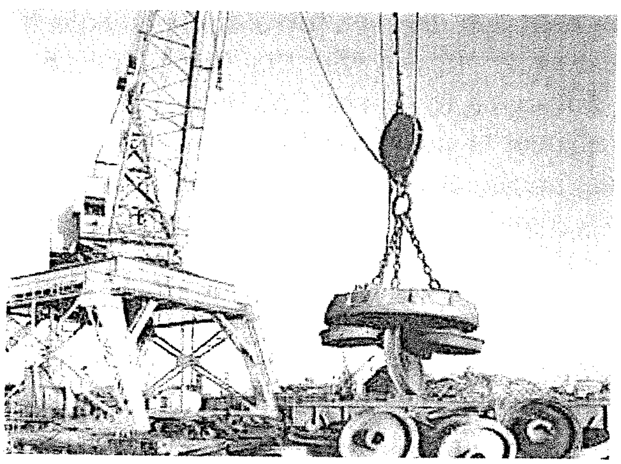

Electromagnets used in salvage yards are turned on to pick up iron objects and turned off to put them down.

TURNING ELECTROMAGNETS ON AND OFF

Electromagnets are very useful because we can turn them on and off. The solenoid has a field only when electric current runs through it. So electromagnets attract things only when a current exists in the wire. When no current runs through the wire, the electromagnet turns off.

Critical Thinking

5. Infer Why could an electromagnet be more useful than a permanent magnet?

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Applications of Electromagnetism

You may not ride on a maglev train, but you use electromagnetism in simple ways every day. For example, you use a solenoid when you ring a doorbell. Electromagnetism makes vending machines give you the right change. It's what makes metal detectors and motors work. An electromagnet makes the fuel gauge in a car work. ☑

READING CHECK

6. Name What are two things that operate using electromagnetism?

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DOORBELLS

Have you ever noticed a doorbell button that has a light inside? When you pushed the button, did the light go out? Two solenoids in the doorbell allow the doorbell to work.

When you push the button, it opens the circuit of the first solenoid. The current stops. That makes the magnetic field drop and the light go out. The change in the field causes a current in the second solenoid. This current induces a magnetic field that pushes an iron rod and that makes the bell ring.

MAGNETIC FORCE AND ELECTRIC CURRENT

An electric current in a wire can cause a compass needle to move. The needle is a small magnet. The needle moves because the electric current in a wire creates a magnetic field that exerts a force on the needle. ☑

READING CHECK

7. Explain Why does a wire having an electric current running through it cause a compass needle to move?

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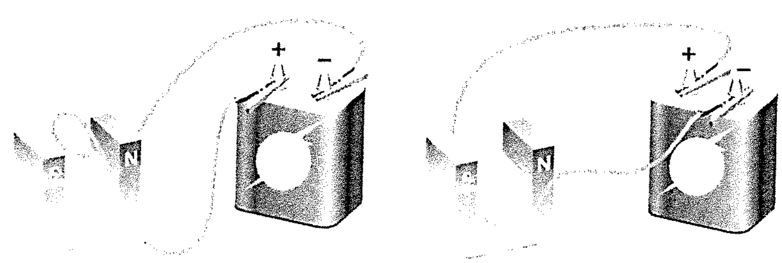
Can a magnet cause a wire that has an electric current running through it to move? The picture below shows that the answer is yes. The wire is pushed up or down depending on the direction of the current in the wire. This force makes electric motors work.



a A wire is connected to a battery as shown above. When the wire is placed between two poles of a strong magnet, the wire will move up.

b Switching the wires at the battery reverses the direction of the electric current. Now the wire will be pushed down.

ELECTRIC MOTORS

An **electric motor** is a device that changes electrical energy into mechanical energy. All electric motors have an *armature*—a loop or coil of wire that can rotate. The armature is mounted between the poles of a permanent magnet or electromagnet.

An electric motor that uses direct current, like the one below, contains a device called a commutator. It is attached to the armature to reverse the direction of the electric current in the wire.

A *commutator* is a ring that is split in half and connected to the ends of the armature. Electric current enters the armature through brushes that touch the commutator. Every time the armature and the commutator make a half turn, the direction of the current in the armature reverses.

STANDARDS CHECK

PS 3a Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.

8. Identify An electric motor changes electrical energy into what kind of energy?

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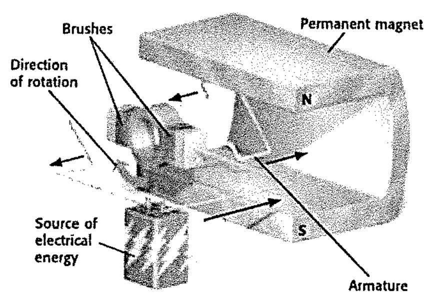
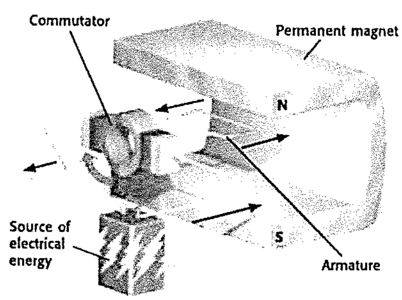
Getting Started The electric current in the armature causes the magnet to push on the armature. The current is moving in a different direction in either side of the armature. So one side is pushed up and the other side down. This causes the armature to rotate.





Running the Motor The commutator causes the electric current in the rotating armature to change directions. This causes the side that was pushed down to be pushed up and the other side to be pulled down. So the armature keeps rotating in the same direction.

GALVANOMETERS

A *galvanometer* measures current or voltage. Electricians use galvanometers when they use ammeters and voltmeters. ☑

A galvanometer has an electromagnet placed between the poles of a permanent magnet. The electromagnet is free to rotate and is attached to a pointer. A current in the galvanometer causes the permanent magnet to push the electromagnet, rotating the pointer. The pointer moves along a scale that shows the size and direction of the current, or the voltage.

READING CHECK

9. Identify What does a galvanometer measure?

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Name ______________________ Class ______________ Date ____________

Section 2 Review

NSES PS 3a

SECTION VOCABULARY

electric motor a device that converts electrical energy into mechanical energy **electromagnet** a coil that has a soft iron core and that acts as a magnet when an electric current is in the coil	**electromagnetism** the interaction between electricity and magnetism **solenoid** a coil of wire with an electric current in it

1. Describe What does an electric current through a wire produce? What affects the strength of what is produced?

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2. Interpret Graphics Which of the magnets below is a solenoid? Which one is an electromagnet? Label each one. If the current and the number of coils are the same, which of the magnets has a stronger magnetic field?

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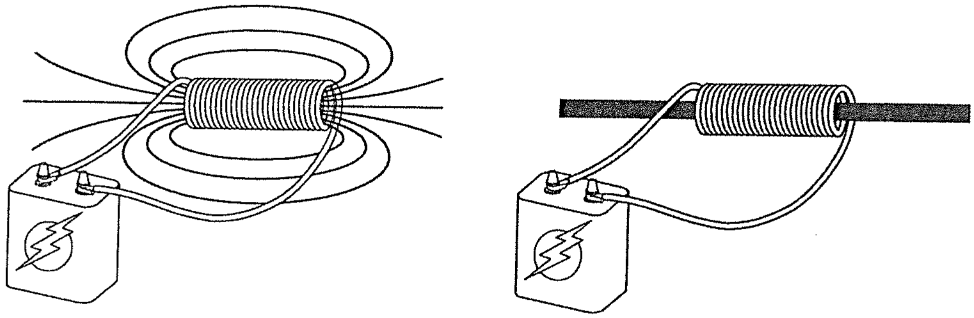

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3. Explain Why does a current in a galvanometer move a pointer?

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4. Name What are four devices that use electromagnetism?

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5. Explain What makes the armature in an electric motor rotate?

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