MOTION COMMOTION
THIRD - FIFTH

Matter and Energy TEKS

Third Grade: 3.5B, 3.5C

Fourth Grade: 4.5C, 4.5D

Fifth Grade: 5.6B, 5.6D

Vocabulary

balanced forces, center of gravity, coil, electromagnet, force, friction, fulcrum, gravity, inertia, lever, load, magnetism, motion, Newton's First Law, Newton's Third Law, unbalanced forces

Pre-Show Activity

Pre-Show Lesson: Force and Motion

Post this question on the board: "How does force affect an object's movement?"

Materials:

Per class: quarter, playing card, cup, sandpaper,

Per partner: modeling clay, 2 rulers, a small toy car that can roll on the ruler, masking tape, a pencil and 2 books.

Procedure:

1. Hold out one of your hands in a fist and extend your index finger so it is pointing up. Balance a playing card on your finger. Place a quarter in the center of the card so that it also balances. Using a finger from the other hand, flick out the card. The coin will remain balanced on your fingertip. You will need to practice this ahead of time. If the coin does not stay balanced, put the card over a cup so that the coin falls into the cup when you flick the card.

2. Ask students to turn and talk to their partner about why they think the coin did not move with the card. Lead students to understand that, like all things, coins have inertia. When

you flicked your finger, the forward motion transferred to the card, not the coin. Since the coin was not stuck to the card, inertia kept it in place. Ask the students, "What do you think would happen if the card's surface was not slick? What if I used sandpaper?" How might this affect the motion of the coin? Make a guess and test it.

3. Ask a student to move from one end of the room to the other. Have the class describe the students' motion. Ask the students to show a change in motion when crossing the room. Tell students that in this lesson they are going to be describing motion and changes in motion. This could be describing the direction or the speed of an object.

4. *Student Exploration Activity 1*

   Materials:

   Per pair: modeling clay, 2 rulers, a small toy car that can roll on the ruler, masking tape, a pencil and 2 books.

   Procedure:

   1. Set up the ramp by raising one end of the ruler on one of the books and taping the other end down on the table. Tape the pencil perpendicular to the end of the ruler as a road block about 6 inches from the end. Make a clay person and put it in or on the car. Do not push the clay figure down any more than is necessary to get it to stay.
   2. Students will release the car at the top of the ramp and use the second ruler to measure the distance that the clay figure falls from the car. Students will repeat this three times and record the results in a data chart in their science notebooks.

	1 Book	2 Books
Trial 1		
Trial 2		
Trial 3		
Average		

   3. Next, raise the ramp by adding a book. Repeat step B for two books.
   4. Students will draw a picture of their procedure in their science notebook and label all parts of their experiment. They should draw the set up for one book and for two books.
   5. Students will draw conclusions based on the results of the experiment.
   6. Students will graph their results using a bar graph comparing one book and two books.

5. Debrief with students. Lead them to understand that as the car rolled down the ruler, its speed increased. The clay figure has the same speed as the car. When the car hits the pencil, the force of impact stops the car, but the clay figure is still moving forward at the same speed. This relates to Newton's First Law of Motion: an object at rest will stay at rest and an object in motion will stay in motion unless acted upon by an outside force. Discuss the forces at work here. Raising the height of the ruler causes the car to reach a higher speed before it hit the pencil. Therefore, the clay figure is moving at a higher speed. The faster the clay figure moves the farther it flies before gravity and the air molecules bring it to a stop. The car and clay both have inertia, a resistance to change motion (Newton's First Law). Once started, both continue to move until some outside force acts on them, causing them to stop. The pencil stopped the car's motion, but not the person inside.

6. Relate this experiment to seat belts. For an extension, you could have the students repeat the experiment using string as a seat belt. Students should understand the significance of wearing a seat belt. If you do not have time to let them complete the extension, you may want to show the difference a seat belt makes by modeling it one time with the materials.

Post-Show Enrichment Activities

Activity One: Electromagnet

Materials:

Per Group: One iron nail fifteen centimeters (6 in) long, three meters (10 ft) of 22 gauge insulated, stranded copper wire, one or more D-cell batteries, and a pair of wire strippers

Procedure:

1. Use a pair of wire strippers to remove a few centimeters of insulation from each end of the wire.
2. Neatly wrap the wire around the nail. Start at about one foot from the end of the wire and wrap toward the opposite end. Make certain that you leave enough of the wire unwound at both ends so that you can attach the battery. The more wire you wrap around the nail, the stronger your electromagnet will be. Be sure to wrap the wire around the nail all in one direction.
3. Attach one end of the wire to the positive terminal of the battery and the other end of the wire to the negative terminal of the battery. If all has gone well, your electromagnet is now working.
4. Students should be able to pick up paperclips using the electromagnet.
5. Depending on the ability of your students, you can have the whole class test one assigned variable or allow students to set up a test to explore how their own chosen variable affects their electromagnet. Possible variables to test: type of wire, amount of wire, amount of coils, type of nail, size of nail, type of battery, amount of batteries, etc.

Activity Two: Magnets

Materials: magnets, baggie of objects (coins, buttons, paperclips, etc), paper, cardboard, plastic

1. Hide a magnet underneath the fingers of your right hand by curling your fingertip over it.
2. Reach over and pick up the two paper clips, one in each hand. Show them to the audience, showing the back of your hand so that the magnet is not exposed. The paper clip in the right hand should be touching the magnet.

3. Hold the right hand with the fingers pointed down and the paper clip pointing out under it. Take your other paper clip and place it at the end, so that the tips of the paper clips are touching. Dramatically remove your left hand so that they remain stuck together.
4. Ask students to infer what happened. Explain that magnetism (an invisible force) can push and pull through some materials such as paper and plastic.
5. Paper clips are made of steel. If you hold a paper clip close to a magnet, you can feel the magnet pulling on the paper clip with magnetism.
6. All magnets have two ends or poles (north & south). If you put the poles of two magnets together, they will either pull together or push apart. They will pull (attract) each other if the poles are different. They will push (repel) each other if the poles are the same.
7. Give each group a baggie of objects (coins, buttons, paperclips, etc.) and a couple of magnets. Give students time to experiment with magnets. Tell them to especially notice when the magnet pushes and when it pulls. Have students test the distance between a magnet and an object when pushing and pulling. Have students put something in between, like a piece of paper, cardboard or plastic, and see if the magnet works.
8. Challenge students to design their own “magic trick” using magnetic forces. They should be able to explain if the magnet is pushing or pulling.

<u>Activity Three: Gravity</u>

Materials:

Per class: tennis ball, marble, 2 pieces of paper

Per student: butterfly cut out (Appendix A-1), paper clip, ball of clay, pencil

Procedure:

1. Show students two objects - a tennis ball and a marble. Ask students to predict which one will hit the ground first if you drop them from the same height. Have a couple students get down on the floor eye level so they can tell us what happens. Drop both objects. Repeat this several times. Students should see that they hit the ground at about the same time. That is because gravity is pulling them both the same.
2. Show students two pieces of paper that are exactly the same. Crumble one up into a ball. Ask students to predict which one will hit the ground first if you drop them from the same height. Have a couple students get down on the floor eye level so they can tell us what happens. Drop both papers. Repeat this several times. Students should see that the ball

of paper hit the ground first. They should also note that the sheet of paper floated back and forth through the air. The air pressure around the objects affected them. The air is exerting an upward force on the paper. Since one has a larger area, there was more force pushing it up.

3. Give each student a tag board butterfly cut out. Students will put a pencil into a piece of clay on their desk to hold it upright. Students will place the butterfly on top of the pencil to try to balance it by finding its center of gravity. Students can attach paperclips to the wings to try to balance it. Students will move the paper clips around and experiment with center of gravity.

4. Debrief with students. The place on the butterfly where it can be balanced is called the center of gravity. This is the point where all parts of the butterfly can be balanced. Adding paper clips increases the weight of the wings. Weight is a measure of the downward pull of gravity. The weight of the metal clips shifts the position of the center of gravity. Tightrope walkers need to have a good center of gravity!

Activity Four: Balanced and Unbalanced Forces

Materials:

Per partner: ping pong ball, bar of soap, ruler, bag of pennies

Per student: straw

Procedure:

1. Put a ping pong ball in between a pair of students. Using the straw, students will blow the ball toward their partner. They can play with this for a little while.

2. Discuss with students how this is an unbalanced force. Any time there is movement toward one side, the force is unbalanced.

3. Challenge students to create a balanced force with the ping pong balls and straws.

4. Discuss the difficulty of creating a balanced force. What were the tricks?

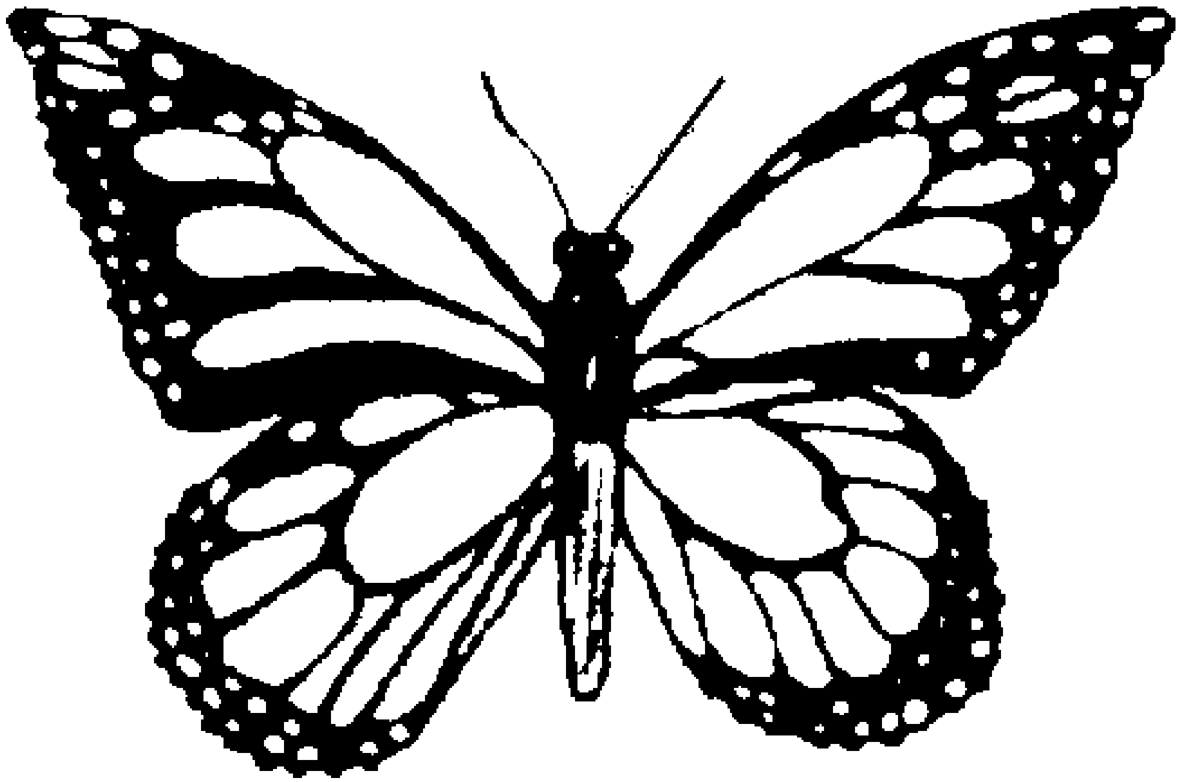
5. Introduce students to a lever using a bar of soap still in its packaging as a fulcrum, a ruler and pennies for the load. Place the soap standing up on its side and balance the ruler on top. This is a balanced force. Ask: “If I place 6 pennies at the 12 inch mark, how many pennies would I need to put at the 1 inch mark to get a balanced force?” They should respond with six pennies. Model this for your students. If the pennies do not stay in place, you may want to use large clips to hold them at each end. You will need to make sure that

the clips are the same size and type to make it a fair test. Ask: "What if I move the 6 pennies up to the 11 inch mark. Do you think that it will take more or less pennies at the 1 inch mark to balance the load? Why?"

6. Students will experiment with the levers, placing the pennies in different places on each side and comparing the amount of pennies needed on each side to create a balanced force. They will record their data on the student worksheet Appendix A-2.
7. Debrief with students. They should see that when you increase the distance that the pennies are away from the fulcrum on one side, the side with the pennies closer to the fulcrum (shorter distance) will need more pennies (force) to balance the extra distance on the other side.

Appendix

A-1



Source: Arthur's Clipart

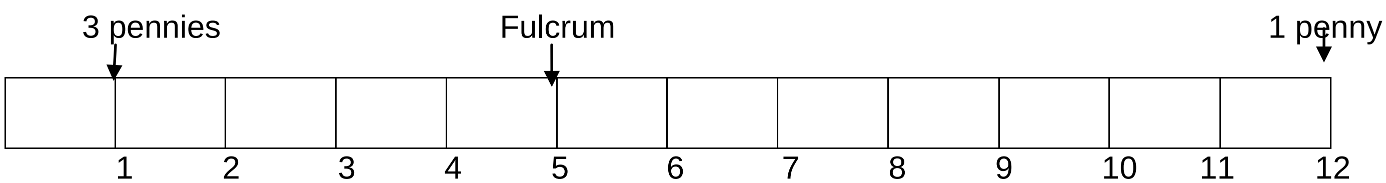
A-2

Name ____________________________ Date _______________

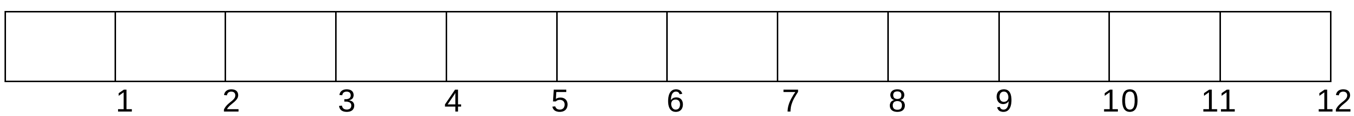
Balanced Forces on a Lever

Directions: Place some pennies on one side of the ruler. Mark where you placed them on the ruler below and mark where your fulcrum is. Place pennies on the other side of the ruler to balance the force and record the number of pennies you used and where they were placed.

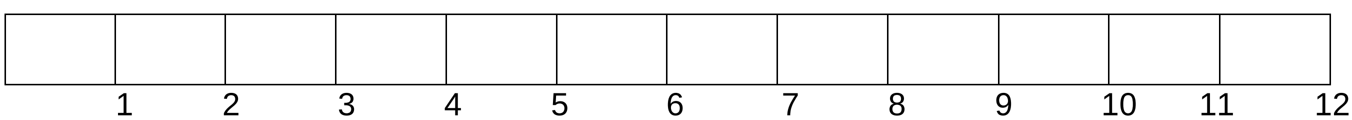
Example:



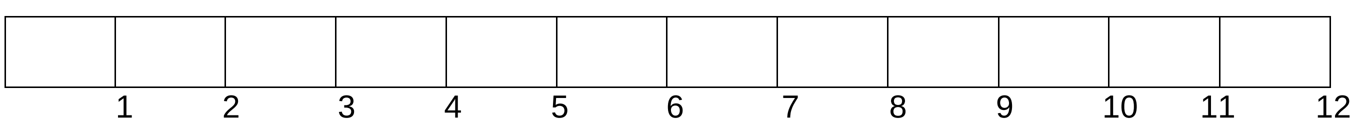
1.



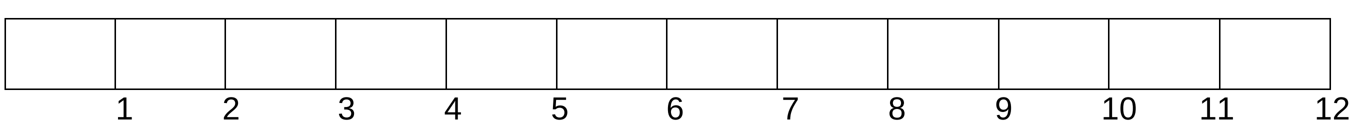
2.



3.



4.



5.

1	2	3	4	5	6	7	8	9	10	11	12

6.

1	2	3	4	5	6	7	8	9	10	11	12

7.

1	2	3	4	5	6	7	8	9	10	11	12

8.

1	2	3	4	5	6	7	8	9	10	11	12

9. How does the distance from the fulcrum affect the load needed to balance the force?