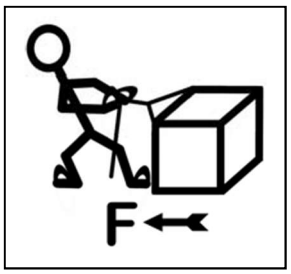
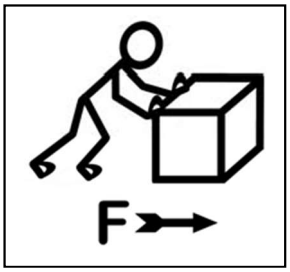
4th grade review- Forces and Motion

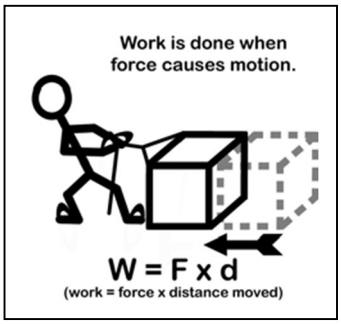
Directions: Please read the following passage below about force and motion, then answer the questions at the end.



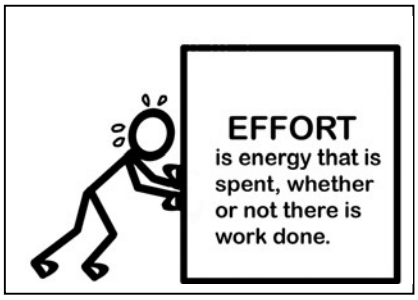
A Force (F) is energy that is created by a push or pull. You generate a force when you push against a box to move it across the floor, or when you pull a wagon. You generate a force when you push down on the pedals of your bike. You generate a force when you lift a book off a table, "pulling" the book up with the lever of your arm.



In order to create motion from an object, the energy you apply must be greater than any force(s) resisting motion. Motion is a change in position or location of a body. Another word for motion is movement. When a force causes motion, work is done. Work is by definition W=F x d, where F=force applied and d=the distance the object is moved, also called displacement.



Think about this: if you push against a refrigerator and cannot move it any distance, have you still done work? The answer is no. You have produced no motion in the refrigerator, and in the equation above, the displacement is zero. Therefore the work is zero. Have you generated a force? Yes. If you apply force to something and it does not move, you can still feel the effect of that force. You feel tired! The force you generated was not enough to overcome the mass of that refrigerator at rest.

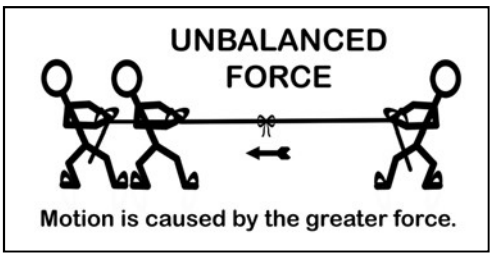


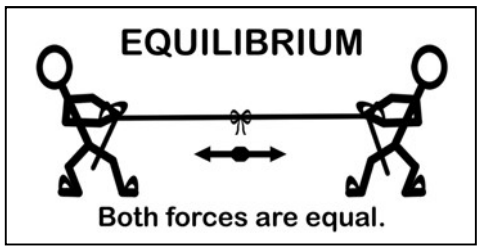
To create motion, you must supply enough work to overcome resistant forces. One resistant force is called inertia. Inertia is an object's resistance to changes in motion. If an object is not moving, it resists being moved. If an object is moving, it resists being stopped. But what causes the force of inertia? If an object is at rest, the force of inertia that must be overcome to move it is a combination of gravity pulling down on the object and friction resisting a push ahead. If an object is in motion, the force of the object's speed moving in a direction will oppose a force stopping the object.

Try the following experiment: mark off a distance of 25 feet with tape or chalk, either indoors or outdoors. Mark off midpoint distances at 10 feet and 20 feet. Begin running at the first marker, and stop at the 10-foot marker. Begin running again and stop at the 20-foot marker. Run again and stop at the 25-foot marker. What you will observe is that each time you stop, your feet will stop while your upper body continues to move forward. This

is especially true if you try to stop really fast. The phenomenon you observe is inertia. Your body resists being stopped.

If two forces are equal, such as two people of equal weight and strength pulling on opposite ends of a rope, then no motion takes place. The forces are balanced. If we add a second person to one side of the tug of war, then the force generated by the two people will be greater than that generated by the one person, and that force will cause motion. So, another thing to note is that motion will occur when one force is greater than another. Otherwise, if no motion takes place, we say that the forces are balanced, or in equilibrium.





Look now at another example of resistant forces. Say you are pushing a box across the floor from your teacher's desk to your desk. No matter whether you push across linoleum or carpet, you will encounter the resistant force of friction. Friction is a force that resists the relative motion of two bodies in direct contact, such as the box and the carpet.

How can you observe friction? Try the following experiment: rub your hands rapidly together. You will observe heat from the rubbing of your hands. The heat is caused by friction. Try another experiment: place two thin blocks of wood one on top of the other. Try to slide the top block over the bottom block. You will observe some resistance. Try placing 2 teaspoons of dishwashing liquid between the two blocks. Now try again to slide the top block over the bottom block. What did you observe? The blocks slide easily. The force of friction has been reduced by adding the dishwashing liquid between the blocks.

Imagine that now your teacher wants you to move a large table, triple the weight of the previous box, across the room. You will experience that it takes more energy to move this table. This is because greater force is needed to move larger objects. Similarly, if your teacher asks you to move the previous box much faster across the floor, you will find that greater force is needed. This is because larger objects require greater force to move. Also greater force is needed to move the same object at a faster rate.

Now that you know that force and motion are related, you can look for force whenever you see motion in your world. Now that you know that every force has a counteractive force against it, you may appreciate why it takes extra effort to move objects, especially large ones. You may even notice that inertia is what makes it hard to get up off the couch to do your homework! Force and motion are all around us. When you see motion, look for the force that is causing it.

Forces and Motion Exercises

Completion: Choose the word that completes the sentence given below.

Word Bank	
Friction	Inertia
Equilibrium	Force
Motion	Displacement
Work	Effort

1. When forces are balanced, pulling in opposite directions with equal size, we say they are in_____.
2. A force which resists the relative motion of two bodies in direct contact is called_____.
3. When work is done, we know because there is_____.
4. A_____is any push or pull in a direction.
5. There is a force which resists changes in motion, called_____.
6. We know we have exerted a force even when we have done no work. This is called_____.
7. Force x Displacement equals_____.
8. When a force causes_____, we know work has been done.

Questions: Answer each question in complete sentences.

1. Explain what inertia is. What causes inertia in an object that is at rest? In an object that is moving? Draw a picture which shows an example of inertia.

2. Why has no work been done if there is no displacement?
3.

4. What is one example of a resistant force? Explain why it is called resistant.

5. Why does no motion occur in an object at equilibrium?

6. Why is the force of friction between two blocks reduced by adding dishwashing liquid between them?

7. Why does your upper body want to keep moving when you stop running suddenly?

Crossword Puzzle

Across

1. When forces are of equal size and opposite direction.
6. The effect of work on an object.
8. The result of work done, felt by sweating.
9. The effect of motion on an object.

Down

2. The way forces are when in equilibrium.
3. Force multiplied by displacement.
4. The force of resistance by rubbing two bodies rubbing together.
5. A push or pull.
7. The principle by which objects resists changes in motion.