HOME SCIENCE TOOLS
THE GATEWAY TO DISCOVERY

Young Science Explorers
Science fun for 4 to 9-year-olds!

April 2011 – Force & Motion

Do you know what causes motion? What are forces and what do they do? Discover some fascinating things about the way things work in this issue!

Physical Science Projects

Balancing Coins

Build a balancing tower and watch it topple down when you put one small penny on top of it. What makes the tower fall? Find out in this science project exploring balance and motion.

What You Will Need:

- wood or plastic ruler
- marker or highlighter
- pennies or small weights

What To Do:

1. Set the marker or pencil on a sturdy surface (like a table or desk) so that it is standing up tall.
2. Find the middle of the ruler. See how long the ruler is, then divide that number by 2 to find the center. If you are using a 12 inch ruler, the center would be at 6 inches.
3. Carefully set the ruler laying flat on top of the marker. Put the center of the ruler right on top of the marker's end.
4. Put a penny down on top of the tower in the center of the ruler.
5. Continue adding coins to the tower - hold a penny in each hand and slowly set a penny down at the same time on each end of the ruler.
6. Try putting a penny down on just one end of the ruler. What happens to the tower?

What's Happening?

What makes the tower topple down? Gravity is a force that is always pulling. When you put a cup of water down on the table, it stays there because gravity pulls it down. When you jump on a trampoline, you come back down because of gravity. When you put equal weights on each side of the tower, it was balanced and even on each side. It's sort of like a see-saw when the ends are balanced and only your feet touch the ground. With equal weights on each side of the tower, gravity pulled down with equal force on each side, so it stayed balanced. When you

placed a coin on just one side and not the other, gravity pulled on that coin (because gravity is a force that is always pulling) and the tower was not even any more. It was no longer balancing in the air and so it toppled over. The pull of that one coin caused the ruler to be pulled down, making the tower collapse. Even a small coin can create a big motion because of the powerful force of gravity pulling on it.

Do you think you can build a better balancing tower? Try building it higher using markers stacked on top of each other. Do you think you could build the same tower using a new pencil (with an unsharpened end) and a ruler? What if you used a weight that was lighter than a penny (for example, a flower petal, paperclip, or scrap of paper), do you think the tower would still fall down? Try it out.

Swing Science

For this project you will need a friend to help you. Have you ever thought about the forces that are causing motion when you're on a playground? The slide, fireman's pole, tire swing, and merry-go-round are all examples of forces. Using a swing set, either in a park or your backyard, you can learn more about how forces work and what inertia means.

What You Will Need:

- Stopwatch or timer
- Pencil and paper
- Calculator
- Swing
- Someone to help you

What To Do:

1. Tell your helper that she or he will use the stopwatch to time one minute - exactly 60 seconds - of swinging.
2. Have your helper pull back the swing that you are sitting on, and let go. Then, the helper will start the timer as soon as s/he lets go of the swing.
3. Be careful not to pump your legs, but just sit in the swing. Count how many times you go forward and then back. Each swing (back and forth) gets one count.
4. After a minute has gone by, stop the swing, and get out the pencil and paper. Write down how many swings you counted. Then, divide this number by the number of seconds (60) using the calculator. Write the new number down. You found the **frequency**, or amount of swings there are each second, with a certain amount of force.
5. Let your helper have a turn in the swing. Pull the swing back and let go. Have the helper count swings while you keep time. Then find the frequency. Write down the number you found, telling what you did to get that frequency.
6. What would happen if you added force? Pull back the swing (or have your helper pull) as far back as you can, and push it forward. Find the frequency, and write it down.
7. Now, try adding force after the swing has been pushed once by pumping your legs back and forth. What is the frequency? Have your helper try, and be sure to record the results.

What's Happening?

The direct force of someone pushing you made the swing move back and forth. A famous scientist named Isaac Newton studied physics by using a swing, or pendulum. A pendulum swings back and forth again and again until something stops it or slows it down. Newton came up with three laws of motion. The first one has to do with swings! It is called inertia (ih-ner-sha). Inertia means that when something is in motion, it will stay in motion, but when something is stopped, it won't move until something else (a force pushing or pulling) moves it. Inertia happens on the swing set when your partner pushes you. Once you are in motion, you keep going, just like a pendulum. Think about which person had the highest frequency of swings - you or your helper. Which person is bigger? Objects that are heavy have more inertia than small objects. That means it may take more force to get a large object moving, but once it is moving it will want to keep going and will be harder to slow down than a smaller object.

What happened when you added force by pumping your legs? This movement helped you go higher and faster. You pushed forward with your body when the swing was going forward, and you pulled back when the swing was going back. The pushing and pulling you did worked together with the pushing and pulling of the swing in motion to make you swing high up in the air.

Fun Facts

- Because of gravity (the force that pulls objects in space towards each other) we weigh slightly less when the moon is directly overhead.
- On the moon, because there is less gravitational pull than on earth, you could jump six times higher than on earth. If you can jump 15 inches, you could jump almost 10 feet high if you were on the moon!

Silly Science

- What goes up and down but never moves?
  - Stairs!
- What has wheels and flies?
  - A garbage truck.
- What is the center of gravity?
  - The letter 'v'!

Way Cool Websites

- Sort pictures into the two kinds of forces - push or pull.
- Design your own roller coaster and test the track out with a rolling marble.
- Watch this amazing video clip about kids who perform circus balancing tricks.
- Visit the different rooms in the EdHeads house to learn about simple machines!

Teacher Tidbits

What Is Force?

Force can be a push or a pull. There are many different kinds of forces that we see everyday. For example, when you open the refrigerator door, you are using a **force** by pulling on the handle. When the wind blows, it is a strong force that can pull back on our clothing, or push our hair into our face. Some forces are small, and others are very big. Scientists that study forces are called Physicists. Physics is all about what things are made of, and how they move.

Forces can be indirect or direct. When a force is direct, one object touches another, or makes contact. You opening the refrigerator door is a direct force. Indirect force is like a magnet - it pulls on an object (like another magnet, or a paperclip or nail), even though it isn't touching that object. When you are riding a bike downhill, you might notice that you don't have to pedal as much. That is because an indirect force is pulling down on you and the bike. This force is called **gravity**. Gravity is a force that is always pulling. When you put a cup of water down on the table, it stays there because of gravity. When you jump on a trampoline, you come back down because of gravity. Gravity is such a big force that it controls the way our planet Earth moves around in an orbit, being tugged at by the sun.

Motion Is Movement

When something has **motion**, it means that it is moving. Motion is caused by force. Not all forces cause motion! For example, if you tried pushing on the back of your family's car, you would be using force (push), but the car wouldn't move. An example of force that causes motion is riding a bicycle. When you ride a bike, you are pushing on the pedals, and they are connected to gears, which cause the wheels to turn. The bike doesn't move by itself. To be in motion, the bike needs to have you put force on it by pedaling. Because of the gears, a small force on the pedals works to make the bicycle move. Riding a bike is much easier than pushing it along the sidewalk. This is because of **inertia** (ih-ner-sha). Inertia is not a force, but it changes the way things can be pushed or pulled. The word inert means not moving. Inertia means that a heavy object requires more force to move, but once it is in motion, it will move farther. Next time you're at the grocery store with your parent, try this. See how easy it is to push an empty shopping cart compared to one that is full of groceries. But, once the heavier cart starts moving, you can let go of the handles and it will still move forward. The heavier object has more inertia.