PHARMACHEMICAL IRELAND
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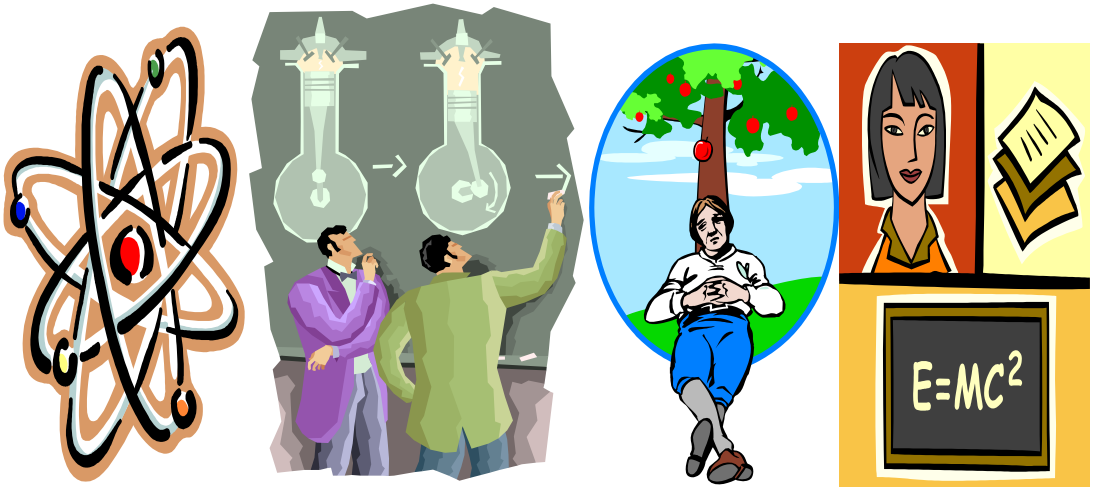
Presents

Fun Physics

PHARMACHEMICAL IRELAND
Confederation House 84/86 Lower Baggot Street Dublin 2
TELEPHONE + 353 1 605 1584 FAX + 353 1 638 1584
E-MAIL pharmachemicalireland@ibec.ie www.pharmachemicalireland.ie
A business association within IBEC / the Irish Business and Employers Confederation


E=MC²

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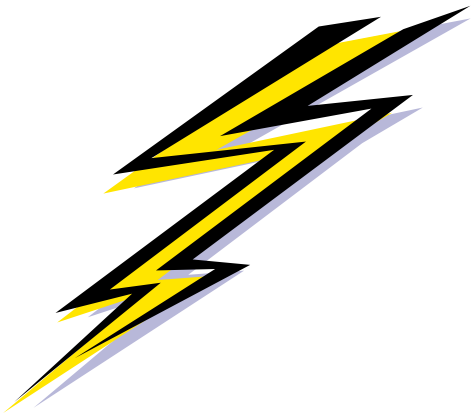
Activity 1: Bending Water

This activity is aimed at introducing the basic concepts of electricity, specifically static electricity, to the students. Static electricity is the accumulation of an electrical charge in an object. The electrical charge develops when two objects are rubbed against one another. When the objects are rubbed together, some electrons (charged components of atoms) jump from one object to the other. The object that loses the electrons becomes positively charged, while the object that they jump to becomes negatively charged. The nature of the objects has a large effect on how many electrons move. This determines how large an electrical charge accumulates in the objects. Hair and nylon are particularly good at acquiring charge when they are rubbed together.



A charged object attract small particles, such as dust. The charge in the object causes a complementary charge to develop in something close to it. The complementary charge is attracted to the charged object. If the complementary charge forms on something tiny, such as dust particles, these tiny particles move to the charged object. This is why your television screen becomes dusty faster than the television cabinet. When a television operates, electrons fly from the back to the screen. These electrons cause the screen to become charged. The charge on the screen attracts dust.

The comb attracts the stream of water in the same way. The charge on the comb attracts the molecules of water in the stream. Because the molecules in the stream can be moved easily, the stream bends toward the comb.

When you comb your hair with a nylon comb, both the comb and your hair become charged. The comb and your hair acquire opposite charges. Because the individual hairs acquire the same charge, they repel each other.[1]

[1] **On average, a person loses 40-100 strands of hair per day**

Perhaps you noticed that after running the nylon comb through your hair, the hairs on your head stood on end. This is a result of your hairs repelling each other because they are charged.

Static electricity is more of a problem when humidity is low. When humidity is high, most surfaces are coated with a thin film of water. When objects coated by a film of water are rubbed together, the water prevents electrons from jumping between the objects.

Materials

Nylon comb, running tap.

Procedure

1. Allow water to run at a medium pace from the tap.
2. Rub comb vigorously on your hair for a minute.
3. Put comb close to the water stream without touching it
4. You will notice the water bending towards the comb.[2]

[2] **The longest living cells in the body are brain cells which can live an entire lifetime.**

Activity 2: Floating Bowling Balls

This activity is designed to explain the concept of density to the students by showing how different weight bowling balls can float on water. Have you ever really thought about just how dense water really is? If you've ever carried a gallon of water you know that water is not very light. In fact, a gallon of water weighs about 8 pounds! But what does this have to do with bowling balls?

If you've ever been bowling you know that bowling balls range from about 8 to 16 pounds. However they are all the same size! This means that the average density of an 8 pound ball must be HALF the average density of a 16 pound ball. The inside of a bowling ball can get complicated but basically manufacturers vary the size, shape and material of the core of the ball to adjust the weight.

So if one gallon of water weighs 8 pounds and an 8 pound bowling ball takes up more space than a gallon of water, the ball will float!

What does this mean

When an object is placed in water it will displace its weight in water (Archimede's principle). So the 8 pound ball is displacing 8 pounds of water but since it doesn't take up less volume than 8 pounds of water if floats. On the other hand, the 16 pound ball (is trying to displace 16 pounds of water but it has less volume than 16 pounds of water and sinks. OR we can just say the 8 pound ball is less dense than water and the 16 pound ball is more dense than water where density is the mass of the ball divided by its volume.[3]

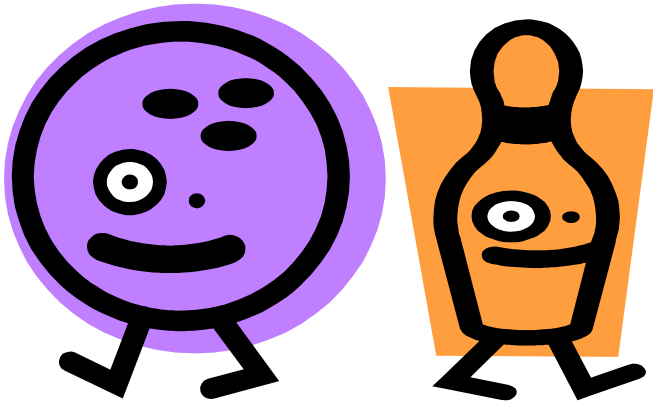
[3] **Sound travels about 4 times faster in water than in air.**

Materials

8 pound bowling ball, 16 pound bowling ball, large basin, water

Procedure

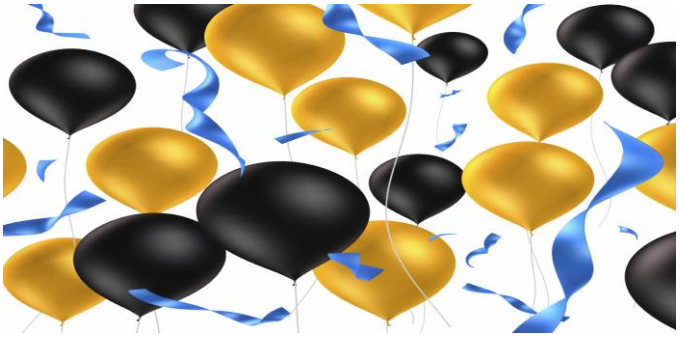
1. Fill basin nearly to the top with water
2. Place 16 pound ball in first. It will sink
3. Place 8 pound ball in and it will float.
4. Demonstrate to the kids why this is and ask them to guess possible reasons[4]



[4] **If you stretch a standard Slinky out flat it measures 87 feet long.**

Activity 3: Magic Needles and Balloons

This is a fun activity to carry out during a class. It gets the students thinking about how this possibly works but it will also mean that as the teacher you will need pain killers for your head by the end of the day with all the banging of the balloons.



Materials

Sewing needle of approximately 12 inches, Vaseline, Balloon that has some thickness around the nipple and the mouth.

- Balloons sold as "Helium Balloons" are supposedly thicker and more durable than standard balloons because the molecules of helium gas are smaller than those of air and hence the balloons must be thicker so as to not go flat through diffusion so quickly.

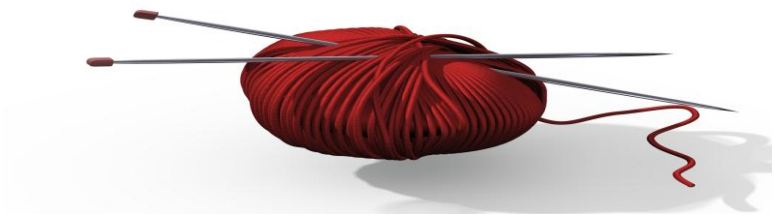
Procedure

1. Get a sewing needle of about 12" in length. You can find these at fabric stores. Make sure the tip end is very sharp and pointy and that the tail end is unadorned and straight. It will probably have an eye (the place where you would put the thread) on the end and that is fine.
2. Coat the needle in Vaseline (or any petroleum jelly will do). [5]

[5] **The temperature can be determined by counting the number of cricket chirps in fourteen seconds and adding 40. (F)**

3. Blow up a regular-sized balloon about 4/5 full. The balloon should be taut but still have some thickness on the top where the "nipple" is and on the bottom where the open end is. Tie it normally.
4. Make a big production out of it and then simply poke the tip of the needle into the top or bottom of the balloon and then through to the opposite side, pulling it out all the way.
5. Toss the balloon into the air and then poke it, on its way down, with the sharp tip of the needle but this time in the side of the balloon. The balloon will pop with a bang.
6. While their mouths are still hanging open, discreetly stow the needle or wipe off the Vaseline and provide the needle for examination.

The type of balloon is important. Magic stores sell the good kinds but you can get them at a fraction of the cost by hunting around party supply stores. You want balloons that have some extra thickness near the nipple and mouth of the balloon. It is this extra thickness, combined with the Vaseline, that provides the gimmick. Through trial and error, you will find the best kind to match your needle.



Try not to use too much Vaseline. The coat should be applied in advance and a person should not be able to see the Vaseline even from two to three feet away (remember also that they are not looking for it and you should be moving it around in the air anyway).

When you get good at this, try tying a thin ribbon to the eye of the needle. It is possible to pull a colored thread through the balloon without the balloon noticeably losing air. [6]

[6] **The wristwatch was invented in 1904 by Louis Cartier**

Activity 4: Cartesian Divers

This is a very simple experiment again aimed at explaining the principles of pressure in an experiment the student can carry out at home. Scuba divers have to control their depth in the water. Since the human body is less dense than water, people float. A diver wears two pieces of equipment: a weigh belt and a buoyancy compensator. The heavy metal weights on the belt enable the diver to sink. The buoyancy compensator can be inflated with air to increase buoyancy or deflated to reduce it.

The Cartesian diver is named after the French philosopher, Rene Descartes (1596-1650), and is a very old experiment. The volume of a gas decreases as the pressure on the gas increases. As you squeeze the bottle, the pressure is transferred from your hand to the water and from the water to the air trapped inside the diver. As the volume of air in the diver gets smaller, more water enters the diver, making it heavier and less buoyant, and the diver sinks to the bottom. As the pressure is released, the air inside the diver expands and increases the buoyancy so that the diver rises.

Here's an experiment to help you see how this works.

Materials

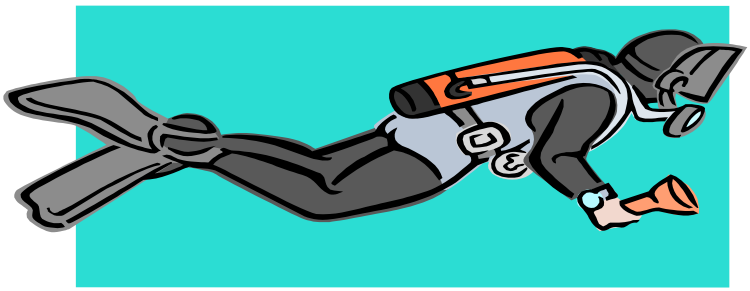
Clear, soft plastic, 2-litre bottle with tight fitting cap, filled with water almost to top, bowl, Biro cap, blue tack, waterproof tray in which to work.[7]

[7] **Due to gravitational effects, you weigh slightly less when the moon is directly overhead.**

Procedure

1. Half fill the bowl with water.
2. Roll some blue tack into a ball the size of a marble.
3. Stick the blue tack to the pointed end of the pen lid.
4. Gently lower the ‘diver’ into the bowl of water so that the lid remains full of air.
5. If the diver sinks, remove some blue tack. If it floats, add some more blue tack. Adjust the amount of blue tack until the top of the pen lid only just sticks out of the water. The experiment will not work unless the amount of blue tack is just right.
6. Fill the plastic bottle to the brim.
7. Gently lower the diver into the bottle.
8. Screw on the lid.
9. Check that the only air inside the bottle is in the diver.

If you squeeze the sides of the bottle, the diver should sink. If you stop squeezing, the diver should float back to the top of the bottle. If the diver does not sink when you squeeze really hard, you need to add more blue tack.[8]



[8] **There is a high and low tide because of our moon and the Sun.**

Activity 5: Are Diet Drinks Actually Lighter

This activity is used to explain density as well as how dissolved substances add to the weight of a liquid without increasing the volume. It is also handy to explain how bad fizzy drinks are to the body.

Believe it or not, diet drinks really are lighter! When you read the labels you will see that each can contains the same number of ounces. Fluid ounces are a measure of volume, not weight. A 12-ounce can of regular soda contains about ten (count them) teaspoons of sugar! That sugar dissolves in the liquid without increasing the volume because the sugar molecules spread evenly between the water molecules where there is a lot of space. The regular soda contains more molecules in the same amount of space than the diet soda, which makes the regular soda's liquid denser. The can that contains the lower-density liquid floats higher. Diet sodas are usually sweetened with a tiny amount of aspartame. Less aspartame is needed because it is 160 times sweeter than sugar. Clearly, ten teaspoons of sugar weigh more than a pinch of aspartame!

Materials

Basin of Water, one can of regular soda, one can of diet soda.

Procedure

1. Fill the clear container with water so that it is at least 8 inches deep.
2. Blindfold the volunteer and put a can of soda in each of his/her hands; one hand should hold the can of regular soda, the other should hold the same brand's diet or "lite" soda . [9]

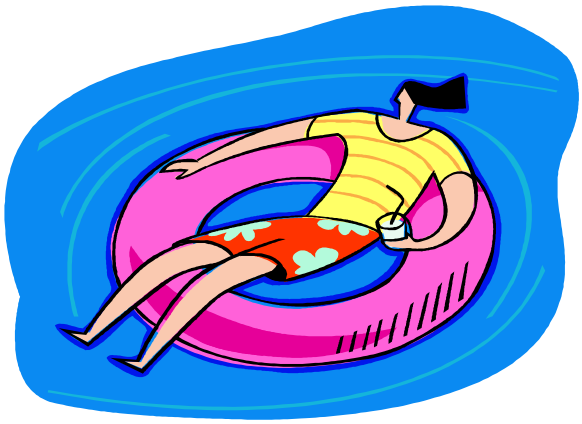
[9] **Porcupines float in water.**

3. Have the volunteer hold the two cans underwater; the cans should be held in a *vertical* position with their bottoms resting on the bottom of the container.
4. Then ask your volunteer to let go of the cans as the rest of the students watch how the cans move.

The can of diet soda will float higher than the regular soda will. The other students will be able to see, and your volunteer will be able to feel, the difference.

Specific gravity" is a measure of how dense a substance is compared to water. Water's specific gravity is the number "1." Objects with an overall specific gravity less than 1 will float. If the specific gravity is greater than 1, an object will float.

Note: Many cans of soda will float a little bit because they also contain a gas that lowers their overall specific gravity. [10]



[10] **Our eyes are always the same size from birth, but our nose and ears never stop growing.**

Activity 6: Rockets

The purpose of this activity is to introduce the basic concepts of force by looking at how explosive reactions can drive rockets. The force will be delivered by a effervescent tablet dissolving in water.

When the fizzy tablet is placed in water, many little bubbles of gas escape. The bubbles go up, instead of down, because they weigh less than water. When the bubbles get to the surface of the water, they break open. All that gas that has escaped from the bubbles pushes on the sides of the canister.

Now when you blow up a balloon, the air makes the balloon stretch bigger and bigger. But the little film canister doesn't stretch and all this gas has to go somewhere!

Eventually, something has to give! So the canister pops its top (which is really its bottom, since it's upside down). All the water and gas rush down and out, pushing the canister up and up, along with the rocket attached to it.

Real rockets work kind of the same way. But, instead of using tablets that fizz in water, they use rocket fuel. The rocket that launched Deep Space 1 on October 24, 1998, had four different kinds of engines. Some pushed the rocket off the ground. Then some helped it continue its climb into space. Others gave the Deep Space 1 spacecraft its final push away from Earth. But all of them forced a gas to shoot out of the rocket, thus pushing the rocket the other way. We call this wonderful and useful fact the law of action and reaction. The action is the gas rushing out of the rocket. The reaction is the rocket taking off in the other [11]

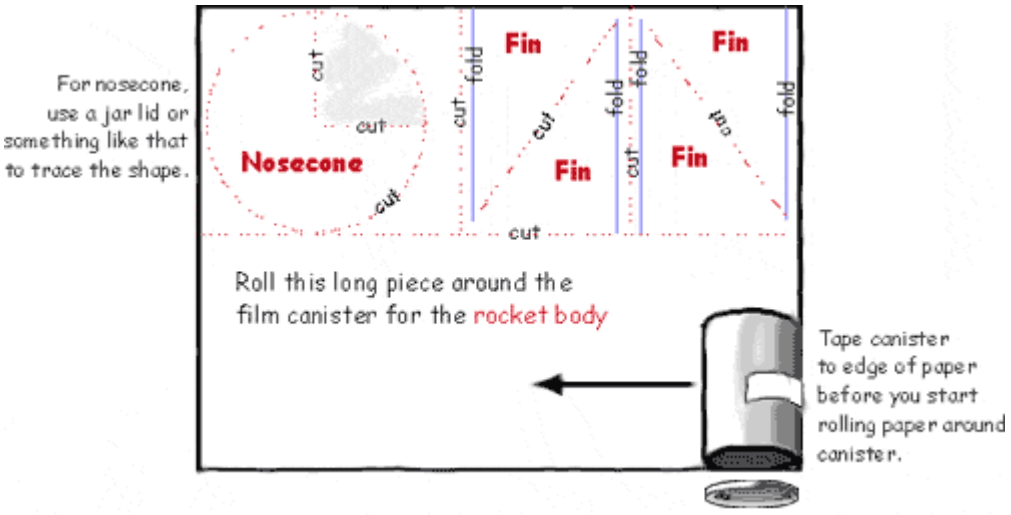
The leg muscles of a locust are about 1000 times more powerful than an equal weight of human muscle.

direction. In other words, for every action there is an equal and opposite reaction. The rocket goes in the opposite direction from the gas, and the faster the gas leaves the rocket, the faster the rocket gets pushed the other way.

Materials

Paper, regular 8-1/2- by 11-inch paper, such as computer printer paper or even notebook paper. Plastic 35-mm film canister, Cellophane tape Scissors, Effervescing (fizzing) antacid tablet (the kind used to settle an upset stomach), Paper towels, Water ,Eye protection (like eye glasses, sun glasses, or safety glasses)

Procedure



1. Cut out all the pieces for your rocket.
2. Wrap and tape a tube of paper around the film canister. **Hint:** Tape the canister to the end of the paper before you start wrapping. (lid facing down)
3. Tape fins to your rocket body, if you want.
4. Roll the circle (with a wedge cut out) into a cone and tape it to the rocket's top.

Blasting Off

1. Put on your eye protection.
2. Turn the rocket upside down and remove the canister's lid.
3. Fill the canister one-third full of water.
4. Drop one-half of an effervescing antacid tablet into the canister.
5. Snap the lid on tight.
6. Stand your rocket on a launch platform, such as your sidewalk or driveway.
7. Stand back and wait. Your rocket will blast off![12]

[12] **According to an old English system of time units, a moment is one and a half minutes.**

Activity 7: Two Ball Bounces

This activity aims to try and explain the principals of energy transfer. It is very simply to carry out yet a very effective method in explaining energy and indeed force. By placing one ball on top of the other, dramatic results will be observed when dropped. An easy way to explain this energy transfer is by looking at a snooker match. When the player strikes the white ball with his cue, he transfers energy to the white ball making it move. When the white ball hits a red ball, the white stops and the red begins to move until it falls into the pocket.

When you drop the two balls together, they will separate just a little bit. The bottom one will hit the ground first, and will rebound. As it is on the way up, it hits the top ball, which is still on its way down. So you have a head-on collision, between balls of very different masses. When this happens, a lot of the energy of the first ball gets transferred to the second ball, and - watch out! The top ball, the small one, will end up bouncing very high indeed!

Materials

A football, a tennis ball.

Procedure

1. Take two balls, one large and one small, and place the small one on top of the large one
2. Now, drop them together[13]

[13] **The Earth's equatorial circumference (40,075 km) is greater than its polar circumference (40,008 km).**

Activity 8: Straw Flutes

This is a very funny activity aimed at explaining to the students how frequency and sound work. This activity will guarantee some laughs in trying to make the sounds but will also frustrate the life out of you as it is hard to get the sound right.

When you blow on the end of the straw, the two pieces of the tip vibrate together. This makes a vibration, which is necessary to make sound. But the tips don't just vibrate at any old frequency. The vibration travels down the straw, and reflects from the end. This sets up a wave in the air in the straw; the vibration will bounce back and forth between the two ends. It is this vibration that you are hearing! Changing the length of the straw (by clipping it off, or by making a straw trombone) changes the time necessary for the vibration to travel up and down the straw, and so changes the pitch. And making a hole in the straw, so it is like a real flute, lets the vibration bounce off from where the hole is, which will also change the pitch!

Materials

Straw, scissors, someone to blow hard

Procedure

1. Take the straw and the scissors, and cut off the tip of the straw to a point, like so. (Try to get both sides to be the same!) [14]

[14] **The Earth's average velocity orbiting the sun is 107,220 km per hour.**

2. Now, *gently* chew on the straw to soften the tip, and to get the edges to be smooshed together. You would like the two tips to be *almost* touching each other.
3. Now, take the person who can blow really hard, and have them put the pointy end in their mouth, and *blow really hard*. If they do it right (it might take some practice), they will get a very loud sound from the flute!

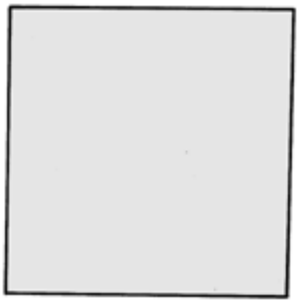
Now, try some of these things:

- Cut the non-pointy end of the straw off. What does this do to the tone?
- Can you cut holes in the straw so that you can play it like a real flute? [15]

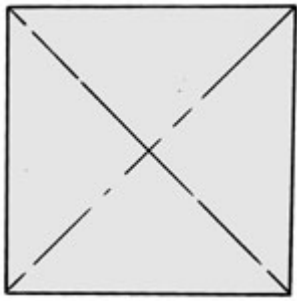
[15] **If you could drive to the sun -- at 55 miles per hour -- it would take about 193 years**

Activity 9: Pin Wheels

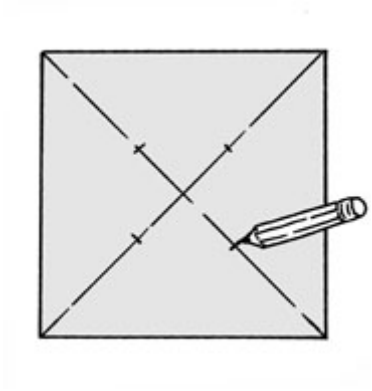
This activity explains how, even though we can't see it, wind makes things move. A pinwheel will spin as the wind pushes it around. Moving air is wind. Wind is caused by warm air rising over cool air.



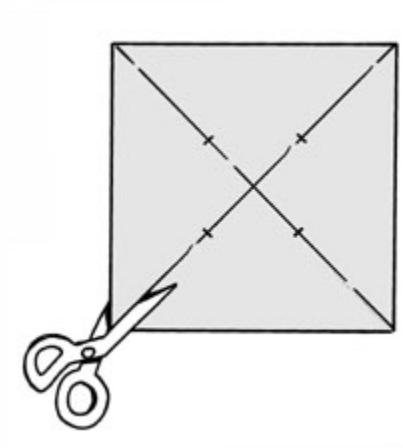
1. Begin with a square of paper.



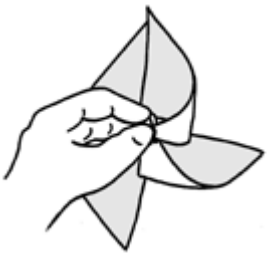
2. Fold your square, corner to corner, then unfold.



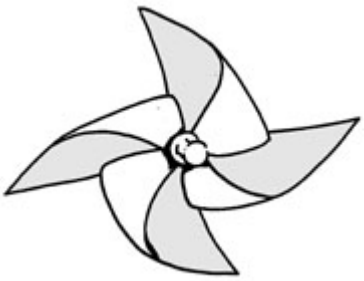
3. Make a pencil mark about 1/3 of the way from center.



4. Cut along fold lines. Stop at your pencil mark.



5. Bring every other point into the center and stick a pin through all four points.



6. The head of the pin forms the hub of the pinwheel.

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[16] **The center of the Sun is about 27 million degrees Fahrenheit (15 million °C).**

7. Turn your pinwheel over - make sure the pin pokes through in the exact center.

8. Roll the pin around in little circles to enlarge the hole a little. This guarantees your pinwheel will spin freely

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9. Stick the pin into a thin dowel.

Hint: Separate your pinwheel from the dowel with two or three beads. Stick the pin through the beads first, then - into the

[17] **Shrimp's hearts are in their heads.**

Activity 10: The Physics Quiz

1. Who discovered gravity after an apple hit him on the head? Sir Isaac Newton
2. What fuel is used in rockets? Hydrogen
3. What sweetener is used in diet drinks? Aspartame
4. What is the speed of sound? 330 m/s
5. What is the speed of light? 300,000,000 m/s
6. Where are NASA based? America
7. What will fall faster a cannon ball or a tennis ball? Cannon Ball
8. What weighs more a tonne of coal or a tonne of feather? Both the same.
9. What is the name of the scientist who came up with $E=mc^2$? Albert Einstein
10. Where were all the elements that make up the world form? In the stars

[18]

[18] **A cat's jaws cannot move sideways.**