Section 8
Energy Education

Supply and Demand Issues Surrounding Petroleum Based By-Products

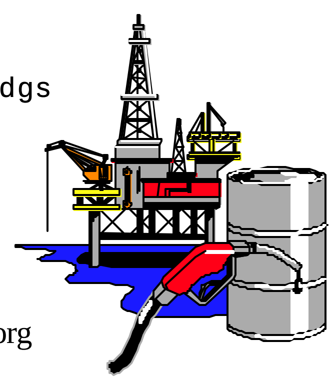
North Dakota's oil and gas is found in rock formations that have the consistency of porous concrete at depths between 3,500 and 15,000 feet. The average depth in North Dakota is about 10,000 below the surface. After primary and secondary recovery techniques have been employed, a considerable amount of oil remains underground. Can your students develop a method of recovering more of the oil and gas from these formations before wells are removed from production and plugged?

A 42-gallon barrel of crude oil can produce, on average, 19.4 gallons of gasoline and 15.8 gallons of fuel oils and jet fuel. The remaining 6.8 gallons include the petrochemicals that provide our economy and society with over 3,000 products used in food production, surgical rooms, cosmetics, medicines, adhesives, clothing, manufacturing, etc.

We can easily reduce our fuel needs for transportation, but how do we reduce the need for communications, medicines, hospital equipment, clothing, etc.? Can your students solve the supply and demand issues surrounding our world's use of petroleum based byproducts?

Resources:

American Petroleum Institute - www.api.org
US Department of Energy - www.energy.gov
Office of Fossil Energy - www.fe.doe.gov
US Environmental Protection Agency - www.epa.gov
North Dakota Geological Survey - www.state.nd.us/ndgs
Tesoro Refining - www.tesoropetroleum.com



Kent Ellis coordinates the Energy Education Program for the North Dakota Petroleum Council. If you would like additional information, please email him at kent_ellis@educ8.org

Present Your Ideas at a Marketplace for Kids Education Day!

On the following pages you will find additional suggested activities from the American Petroleum Institute.

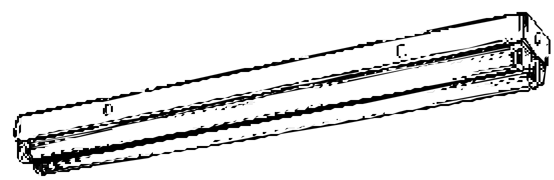
Electricity Activity #1

Light By Friction

Create static electricity! Excite the electrons!

What do you need?

1. **A piece of Saran Wrap or clear plastic wrap**
2. **A piece of fake fur (we don't use real fur)**
3. **A piece of wool**
4. **A piece of cotton**
5. **Pieces of other type of cloth**
6. **A fluorescent lighting tube (an old one will do)**



What to do?

1. In a dark room, hold the tube carefully in one hand and hold the piece of material in the other. Rub the fluorescent tube up and down vigorously with the saran wrap. Watch what happens.

2. Try this again and again with the other pieces of fur and cloth. Watch what happens.

What you'll discover?

A fluorescent tube will glow when there is an electric field inside the glass. Normally this occurs when a current of electricity is passed through the tube when a wall switch is turned on. The electric field causes some electrons to separate from the nuclei of the gas. When the electrons fall back into their regular places, they cause the tube to glow. This is called a "ground state."

When you rub up and down with each of the pieces of cloth, fur or plastic, you create static electricity. This static electrical field excites the electrons.

Does the tube glow brighter with different materials? Why do you think this is? Warning: The electricity being generated is not dangerous. But be <u>VERY</u> careful with the fluorescent tube. If dropped, you could get cut with broken glass.

Present Your Project at a Marketplace for Kids Education Day!

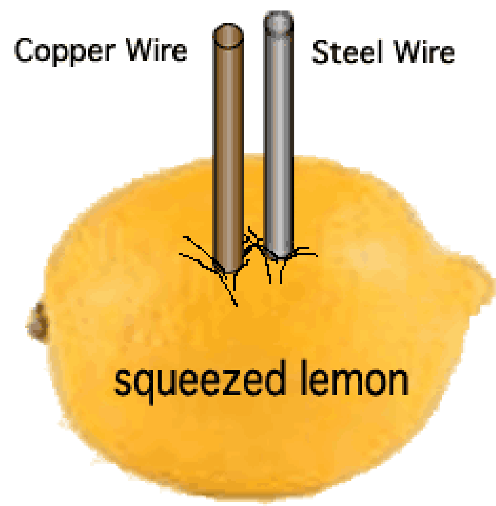
Electricity Activity #2

Lemon Power

What to do with a lemon besides making lemonade!
Project to Make a Battery From a Lemon

What do you need?

1. **18- gauge copper wire (smaller gauge will work too, but 18 gauge is stiffer)**
2. **Wire Clippers**
3. **Steel paper clip (Some people find that a 2-inch strip of zinc works better)**
4. **Sheet of coarse sandpaper**
5. **Lemon**
6. **Help from an older friend or an adult**

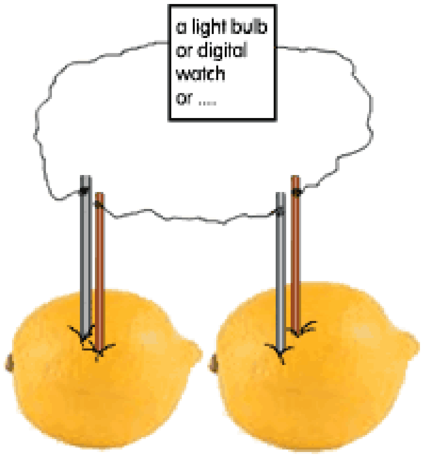


What to do?

1. Have your older friend or an adult strip two inches of insulation off the copper wire. Clip the two inches of bare wire with the clippers.

2. Straighten out the paper clip and cut about two inches of the straightened steel wire, or use a two inch strip of zinc.

3. Use sandpaper to smooth any rough spots on the ends of the wire and paper clip or strip of zinc.



4. Squeeze the lemon gently with your hands. But don't rupture the lemon's skin. Rolling it on a table with a little pressure works great.

5. Push the pieces of the paper clip and the wire into the lemon so they are as close together as you can get them without touching.

6. Moisten your tongue with saliva. Touch the tip of your wet tongue to the free ends of the two wires.

You should be able to feel a slight tingle on the tip of your tongue and taste something metallic.

Electricity Activity #2 Lemon Power, Continued...

What you'll discover?

The lemon battery is called a **voltaic battery**, which changes chemical energy into electrical energy.

The battery is made up of two different metals (the steel paper clip and the copper wire). These are called **electrodes**, which are the parts of a battery where electric current enters or leaves the battery. The electrodes are placed in a liquid containing an **electrolyte,** which is a solution that can conduct electricity.

In a solution of water and an electrolyte, like the acid in the lemon, an excess of electrons collects on one end of the electrodes. At the same time, electrons are lost from the other electrode.

Touching the electrodes to your tongue closes the circuit and allows a small electric current to flow. A single lemon produces about 7/10 of a volt of electricity. If you connect two lemons together, you can power an inexpensive digital watch (uses about 1.5 volts). Use a length of thin, flexible wire to connect the silver wire of one lemon to the copper wire of the other lemon. Then attach thin wires from the other two wires in the lemons to where a battery's positive and negative poles connect to power the watch.

The tingle felt in your tongue and the metallic taste is due to the movement of electrons through the saliva on your tongue.

Note About Lemon Energy

We've had some students do this project and then try to use the lemon "battery" to light a small flashlight's light bulb. The lemons did not work. Why? The reason is that the lemons produce only a very small current (about one milliamp). This is not enough electric current to light the bulb. Even with multiple lemons, the amount of current flowing through the wire is not enough. Though the voltage is high enough (1.5 volts with two lemons), the current is too weak. But it was a great experiment! Even if an experiment doesn't work, it helps us to understand how things work. Good work!!!

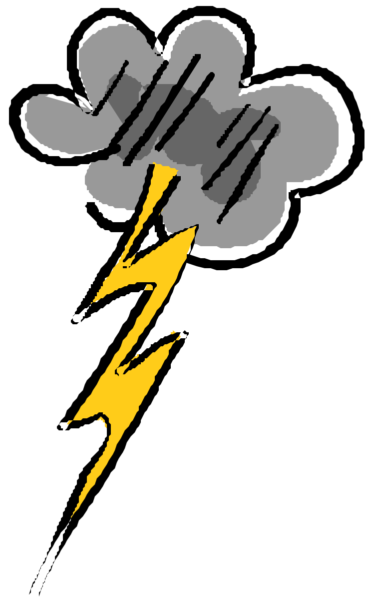
Present Your Project at a Marketplace for Kids Education Day!

Marketplace for KIDS

Electricity Activity #3

Make Your Own Lightning!

Getting a charge out of the sky!



In a storm cloud, the moving air makes tiny water droplets and ice rub together so they become charged with static electricity. The positive electrical charges float up near the top of the cloud and the larger one with negative charges, stays near the bottom. This separation of electrical charges are very unstable and lightning is the way the charges are equalized or become balanced.

What do you need?

Method 1

1. A large iron or steel pot (not aluminum) with a plastic handle.
2. Rubber gloves.
3. An iron or steel fork.
4. A plastic sheet (a dry-cleaner garment bag is good source).

Method 2

1. Inflated balloons.
2. Wool clothing - like a wool sweater - or a piece of real fur.
3. A metal surface like a filing cabinet or a metal door knob.

Electricity Activity #3 Make Your Own Lightning!, Continued...

What to do?

Method 1

1. Tape the plastic sheet to a table top.

2. Put on the rubber gloves.

3. Darken the room as much as possible.

4. Hold the large iron pot or pan by its insulating handle and rub the pan vigorously to and fro on the plastic sheet.

5. Holding the fork firmly in the other hand, bring its prongs slowly near the rim. When the gap between pot and fork is small, a tiny spark should jump across (a darker room will help you see the spark more clearly).

Method 2

1. Inflate balloons.

2. Darken the room as much as possible.

3. Rub the balloon(s) rapidly against a wool sweater or a piece or real fur about ten times or more.

4. Move the balloon close to something metal like a filing cabinet or a door knob.

What you'll discover?

Method 1

It is as though the pan is the thundercloud, the fork is the lighting rod and you are the Earth's Surface.

Method 2

The balloon is being used to create static electricity. The flash or spark that jumps from the balloon to the metal object is like lighting, though much, much smaller in scale.

Note: **the humidity in the air can affect static electricity. If the air is damp, such as during the winter, then this experiment may not work.**

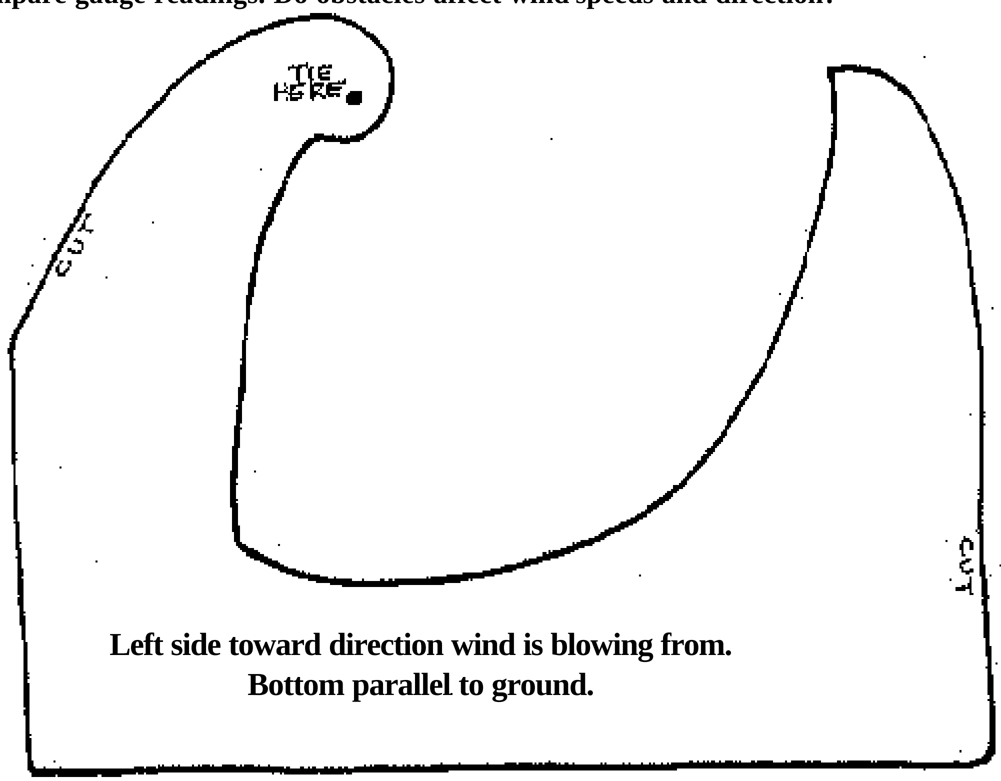
Present Your Project at a Marketplace for Kids Education Day!

Wind Energy Activity #4

Building a Wind Gauge

Measure how strong the wind blows.

Here is a simple wind gauge for use in breezes.
It will indicate direction and relative speeds.
Use the wind gauge to find out where the wind blows strongest.
Compare gauge readings. Do obstacles affect wind speeds and direction?



Directions:

1. Trace the pattern onto cardboard.
2. Cut out the light cardboard wind gauge.
3. Tie thread or string in hole.
4. Move gauge until thread is blowing the same way, that the edge furthest from the string is pointing. This indicates wind direction. Keep pointing the gauge in that direction.
5. Where the thread points along arc indicates a relative velocity. Make marks with a pen along the arc to show how hard the wind is blowing

Present Your Project at a Marketplace for Kids Education Day!

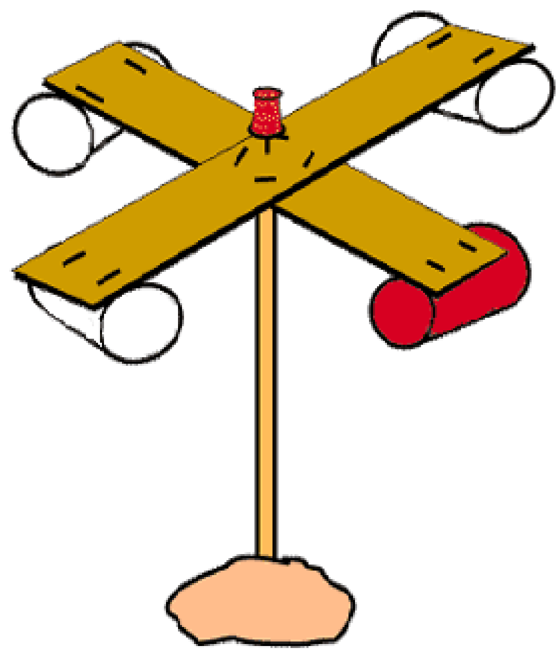
Wind Energy Activity #5

Make an Anemometer!

Measure how fast the wind blows.

An anemometer is a device that tells you how fast the wind is blowing. The device you can build is a model of a wind speed indicator. A real one will be able to accurately measure how fast the wind is blowing. Yours will give you only approximation of how fast it's blowing. It can't give you an exact wind speed.

The energy in the moving wind can be used to generate electricity. But you have to know how fast the wind is blowing before you can harness wind power.



What do you need?

1. Scissors
2. 4 small paper cups (like drinking cups)
3. A marking pen (any color)
4. 2 strips of stiff, corrugated cardboard – the same length
5. Ruler
6. Stapler
7. Push pin
8. Sharpened pencil with eraser on the end
9. Modeling clay
10. A watch that shows seconds

What to do?

1. Cut off the rolled edges of the paper cups to make them lighter.
2. Color the outside of one cup with the marking pen.
3. Cross the cardboard strips so they make a plus (+) sign. Staple them together.
4. Take the ruler and pencil and draw lines from the outside corners of where the cardboard strips come together to the opposite corners. Where the pencil lines cross will be the exact middle of the cross.
5. Staple the cups to the ends of the cardboard strips; make sure the cups all face the same direction.
6. Push the pin through the center of the cardboard (where the pencil lines cross) and attach the cardboard cross with the cups on it to the eraser point of the pencil. Blow on the cups to make sure the cardboard spins around freely on the pin.
7. Place the modeling clay on a surface outside, such as a porch railing, wooden fence rail, a wall or a rock. Stick the sharpened end of the pencil into the clay so it stands up straight.

Wind Energy Activity #5 Make an Anemometer!, Continued...

What you'll discover?

Measuring Wind Speed

This anemometer cannot tell the wind speed in miles per hour, but it can give you an idea of how fast the wind is blowing.

Using your watch, count the number of times the colored cup spins around in one minute. You are measuring the wind speed in revolutions (turns) per minute. Weather forecasters' anemometers convert the revolutions per minute into miles per hour (or kilometers per hour). Keep a record of the wind speeds you're measuring for the next few days.

Measure the wind speed at different times of the day. Is it the same in the morning, in the afternoon, or in the evening? Move your anemometer to another location. Is it windier in other places? Do trees or buildings block the wind?

One of our readers, Heather Fluehr, and her mom, Paulina, of Apopka, Florida, devised a clever way to measure wind speed in miles per hour. With a slightly different anemometer, the whole family got into the car. One person drove the car, one held the anemometer out of the window – these two are adults – one held a stop watch, and one counted the revolutions of the anemometer. They drove exactly 10 mph. In one minute their anemometer made 100 revolutions. Assuming there was no wind that day, they determined that with their anemometer 100 rpm's equals 10 miles per hour. If they wanted to they could verify the accuracy of their measurements by using a real anemometer like the ones used by weather forecasters and airports.

Wind speed is important for wind energy. Wind turbines – which are the machines that change the movement of the wind into electricity – need a constant, average wind speed of about 14 miles per hour before the wind turbines can generate electricity. That's why wind farms, where there are a lot of wind turbines grouped together, are located in windy spots. In California these are in three main places – the Altamont Pass east of San Francisco, Tehachapi south of Bakersfield, and in San Gorgonio near Palm Springs and we now have wind turbines located in North Dakota!

Research Wind Energy in North Dakota and Present Your Findings at a Marketplace for Kids Education Day!

Hydro Power/Power Energy Activity #6

H_2O Electrolysis - Splitting Water!

Electricity is "created" when certain chemicals react together. We use chemically-made electricity to power many machines from flashlights to a watch or sometimes a car. Yes, there are cars that run on electricity! The devices that store electricity are called batteries. Electricity can also be used to produce chemical changes.

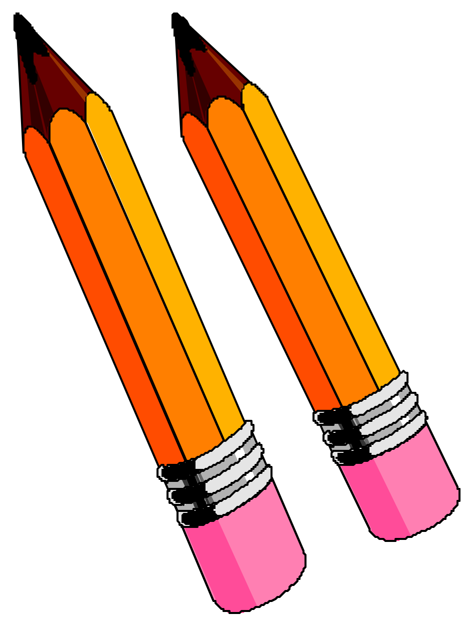
Water is a simple chemical made from two gases – hydrogen and oxygen. Every molecule of water has two atoms of hydrogen for every atom of oxygen. H_2O is the chemical formula for a molecule of water.

If an electrical current is passed through water between electrodes (the positive and minus poles of a battery), the water is split into its two parts: oxygen and hydrogen. This process is called electrolysis and is used in industry in many ways, such as making metals like aluminum. If one of the electrodes is a metal, it will become covered or **plated** with any metal in the solution. This is how objects are **silver-plated**.

You can use electricity to split hydrogen gas out of the water similar to the process called electrolysis.

Try This!
What do you need?

1. **A 9-volt battery**
2. **Two regular number 2 pencils**
   (remove eraser and metal part on the ends)
3. **Salt**
4. **Thin cardboard**
5. **Electrical wire**
6. **Small glass**
7. **Water**

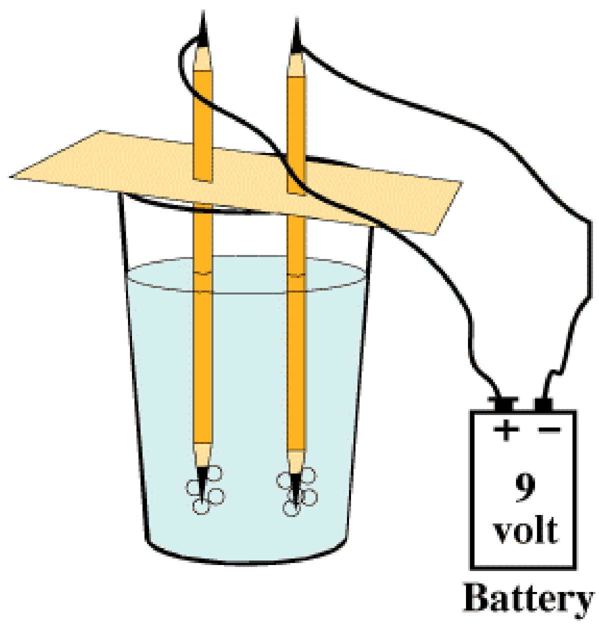


Hydro Power/Power Energy Activity #6 H_2O Electrolysis - Splitting Water!, Continued...

What to do?

1. Sharpen each pencil at both ends
2. Cut the cardboard to fit over glass.
3. Push the two pencils into the cardboard, about an inch apart.
4. Dissolve about a teaspoon of salt into the warm water and let sit for a while. The salt helps conduct the electricity better in the water.
5. Using one piece of the electrical wire, connect one end on the positive side of the battery and the other to the black graphite (the "lead" of the pencil) at the top of the sharpened pencil. Do the same for the negative side connecting it to the second pencil top.
6. Place the other two ends of the pencil into the salted water.

What you'll discover?



As the electricity from the battery passes through and between the electrodes (the pencils), the water splits into hydrogen and **chlorine** gas, which collect as **very** tiny bubbles around each pencil tip.

Hydrogen collects around the cathode and the chlorine gas collects around the anode.

How can you get chlorine from H_2O? Good question! Sometimes in experiments, a secondary reaction takes place. This is what happens in this experiment.

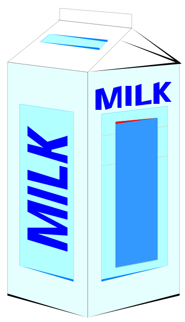
Oxygen is not given off in this experiment. That's because the oxygen atoms from the water combine in the liquid with the salt to form hydroxyl ions. Salt's chemical formula is NaCI - sodium chloride. The chlorine gas is from the chloride in the salt. The oxygen in the hydroxyl ions stays in the solution. So, what is released in this reaction is not oxygen but is chlorine gas that collects around the pencil tip. Around the other pencil is hydrogen gas.

In real electrolysis systems, a different solution is used, and higher levels of electricity help to split the water molecules into hydrogen and oxygen without this secondary reaction.

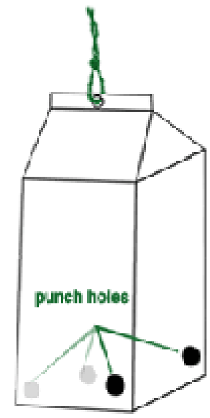
Present Your Project at a Marketplace for Kids Education Day!

Hydro-Power/Water Energy Activity #7

Make a Turbine



For every action there is an equal and opposite reaction!



What do you need?

1. A quart or half gallon milk carton
2. String
3. A nail
4. Water in another larger container
5. Masking tape

What to do?

1. Using the nail, punch a hole in the bottom right corner of each side of the milk carton. Punch another hole exactly in the middle of the top section of the carton.

2. Push the string through the top hole of the carton and tie securely so the carton will hang from the string. Tape up each hole with masking tape.

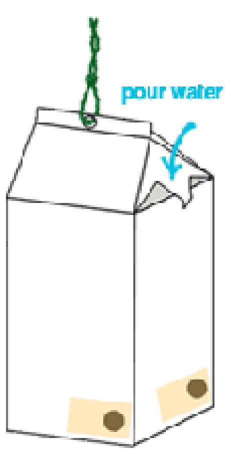
3. Go outside and hang the carton from a low tree branch or another place where the carton can hang freely and you won't mind if the ground gets wet underneath. Fill the carton with water.

4. Pull off the tape on one corner. Watch what happens.

5. Pull off the tape on two corners opposite each other. Watch what happens.

6. Pull off the tape on all corners and watch what happens.

What you'll discover?



Sir Isaac Newton discovered the principle that for every action there is an equal and opposite reaction. This is called his Third Law. The water pours out of the small hole and its force pushes the carton in the opposite direction. This is what makes it turn. The more holes there are, the faster the carton turns.

This is similar to some turbines. Some turbines use water or steam that is forced at high speed through many small holes to turn a turbine around. The turbine is connected by a shaft to an electrical generator, which makes electricity when it is turned.