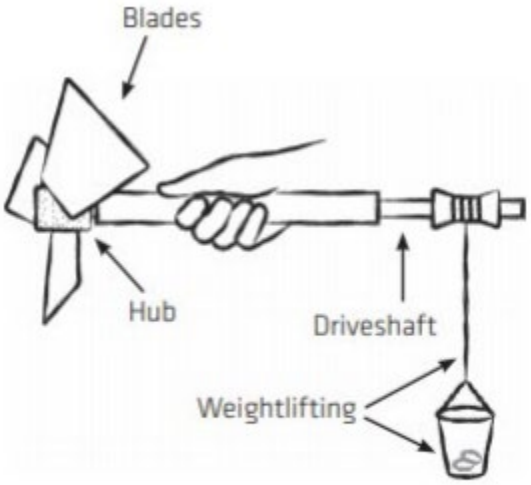
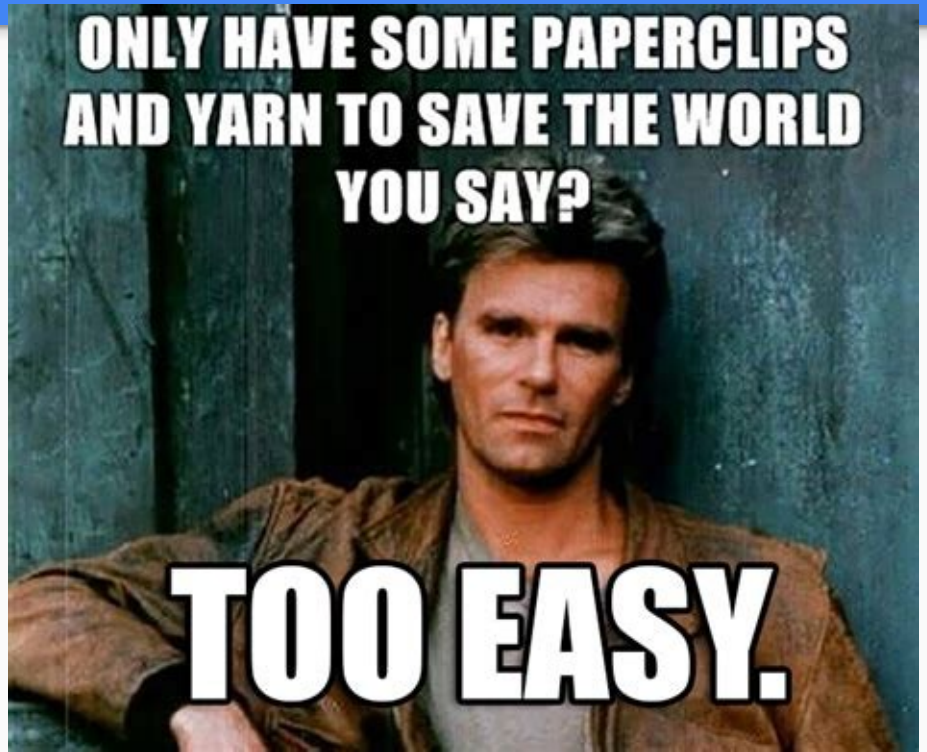
MacGyver Wind Lift - Mentoring Fun!



Who is MacGyver?

Why is it called a MacGyver lift and what are we designing?

MacGyver is a fictional TV character with an extraordinary knack for unconventional problem solving and an extensive bank of scientific knowledge. He would improvise to solve a problem with whatever items he might have in his pockets. Today it means to make or repair something "in an improvised or inventive way, making use of whatever items are at hand." That is what you will be doing, designing a wind turbine to lift as many pennies as possible using materials from your classroom, home or recycling container.



Energy is the ability to cause a change in an object.

Energy sources can be grouped into two types:

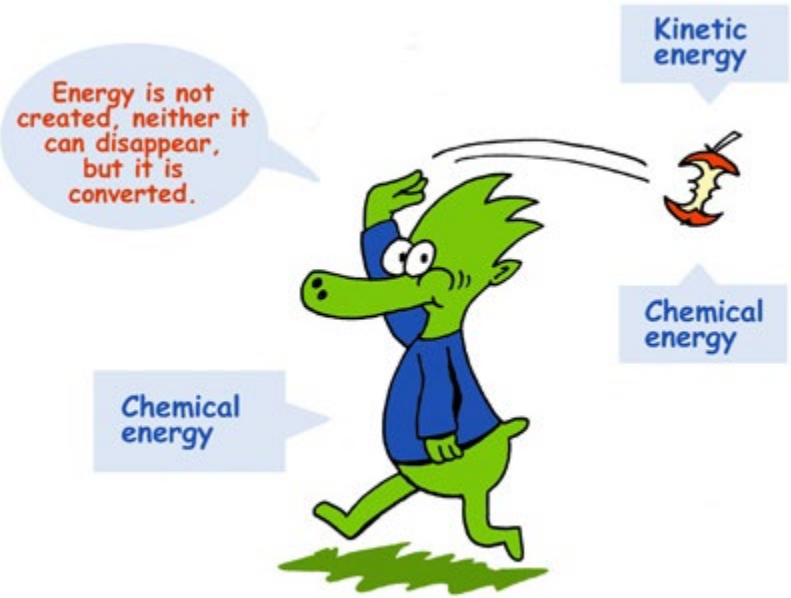
RENEWABLE ENERGY SOURCES	NONRENEWABLE ENERGY SOURCES
This type of energy does not run out. It can be replenished in a short time or will always be there.	This type of energy has a limited supply. Once it is used, it cannot be replaced. It takes millions of years to form.
Renewable Sources: Biomass Geothermal Hydropower Solar Wind	Nonrenewable Sources: Coal Natural Gas Petroleum or Oil Propane Nuclear or Uranium

Each of these sources are obtained or collected in different ways. They are found in different places in Ohio, the United States and around the world. Many are used to make electricity.

What happens to energy?

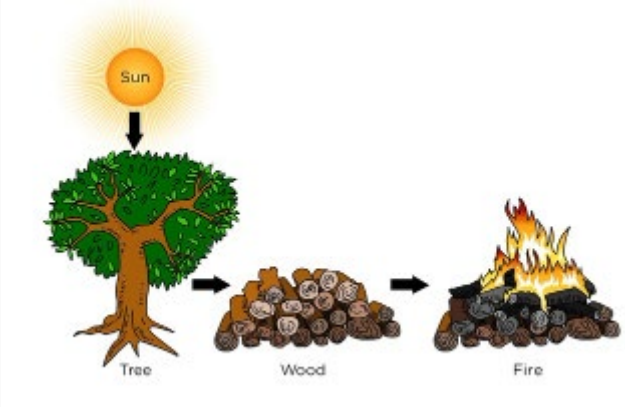
Energy does not disappear. There is the same amount of energy today as there was when the world began.

When we use energy, we do not use it up completely; we change it into other forms of energy.

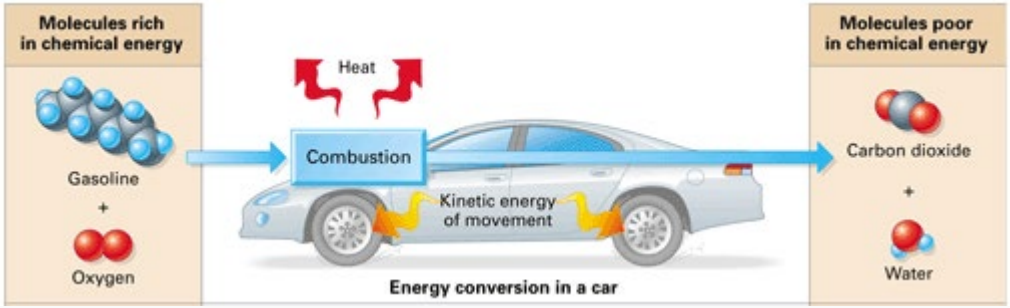


Examples...

When we burn wood, we change its energy into heat and light.

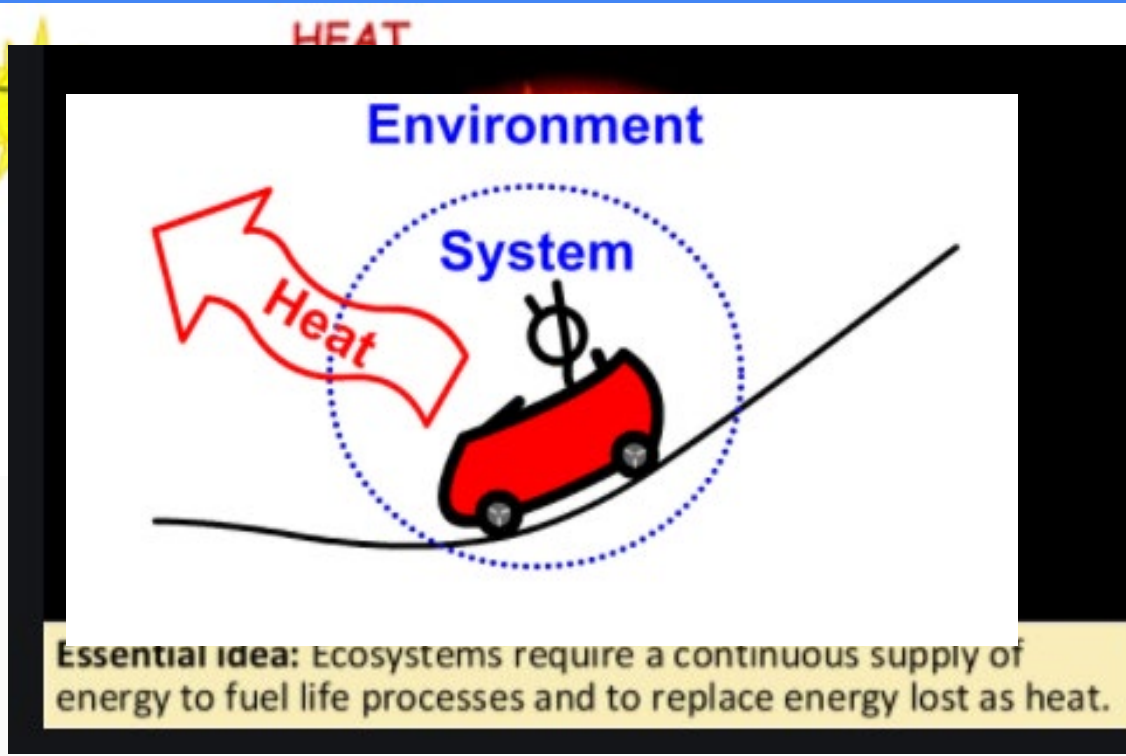


When we drive a car, we change the energy in the gasoline into heat and motion.



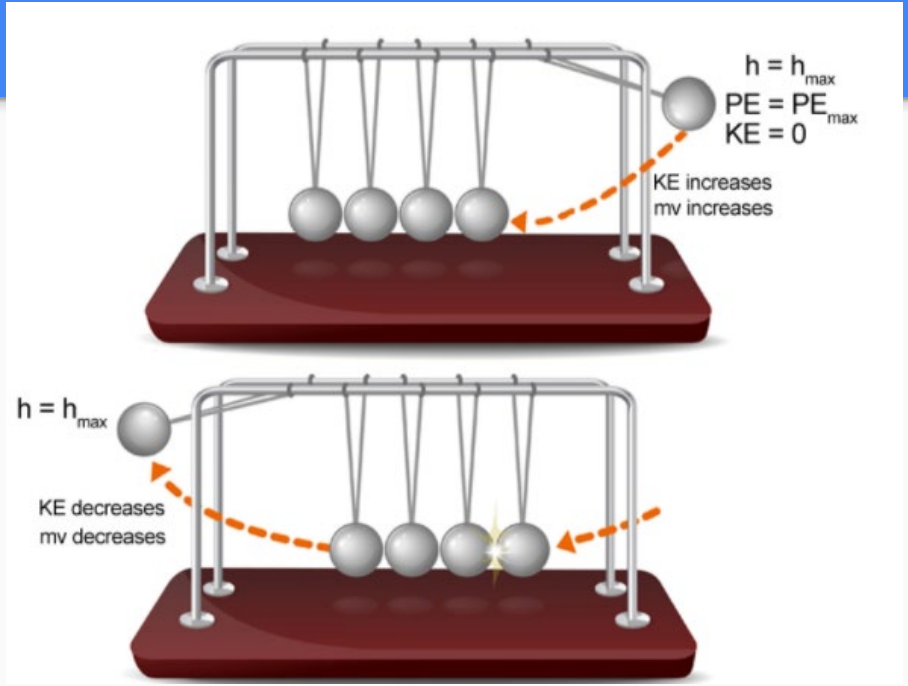
Law of Conservation of Energy

While there will always be the same amount of energy in the world, more and more of it is changed into heat and will go into the air. It is still there, but it will be hard to use.



Kinetic and Potential Energy

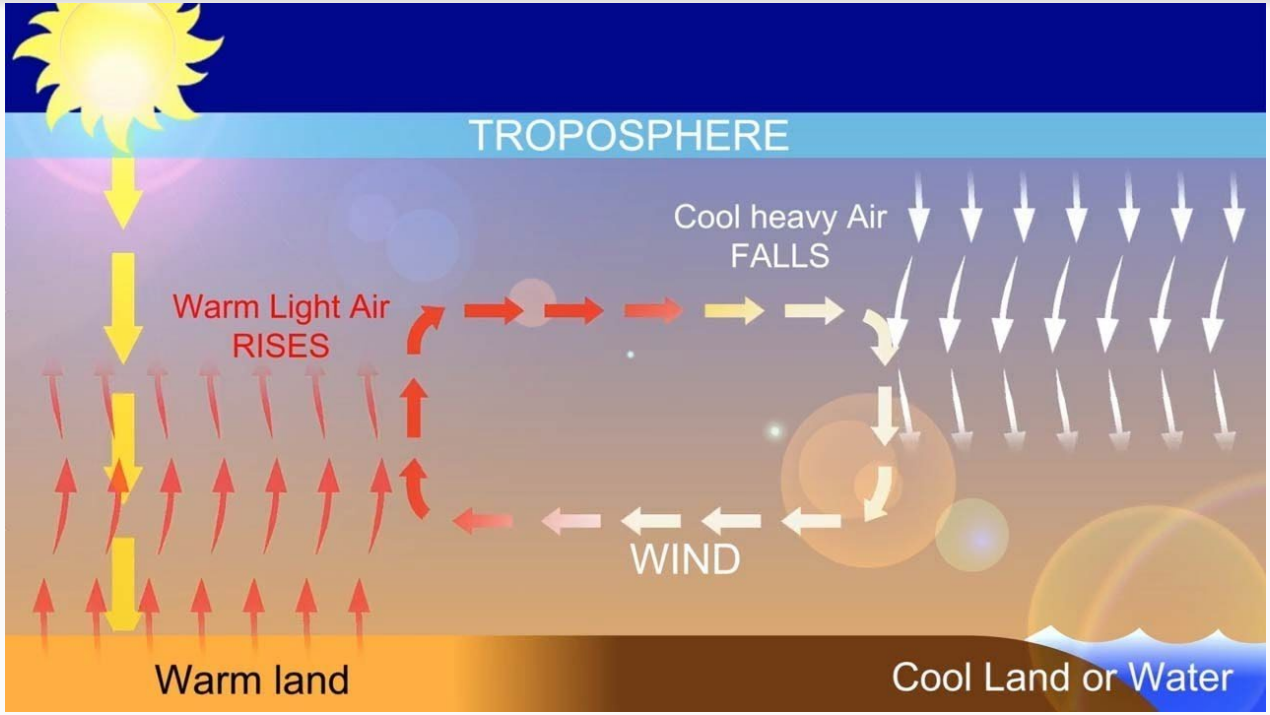
Energy is categorized into two types: kinetic energy or potential energy. Kinetic energy describes the amount of energy an object possesses when it is in motion. Potential energy describes the amount of stored energy that an object possesses



Click to see Newton's Cradle animation

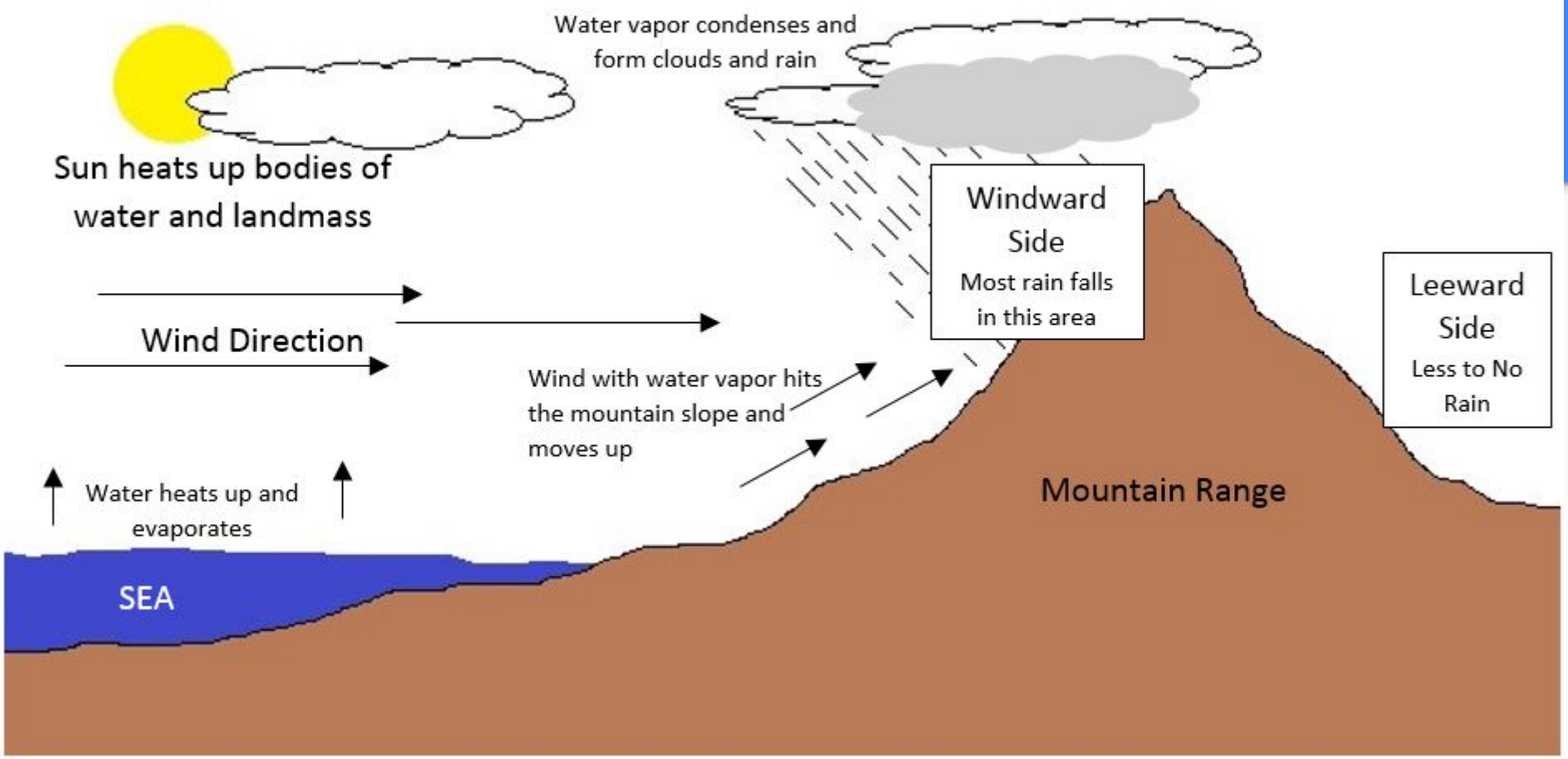
Wind Energy

Wind is simply air in motion. It is produced by the uneven heating of the Earth's surface by energy from the sun. Since the Earth's surface is made of very different types of land and water, it absorbs the sun's radiant energy at different rates.



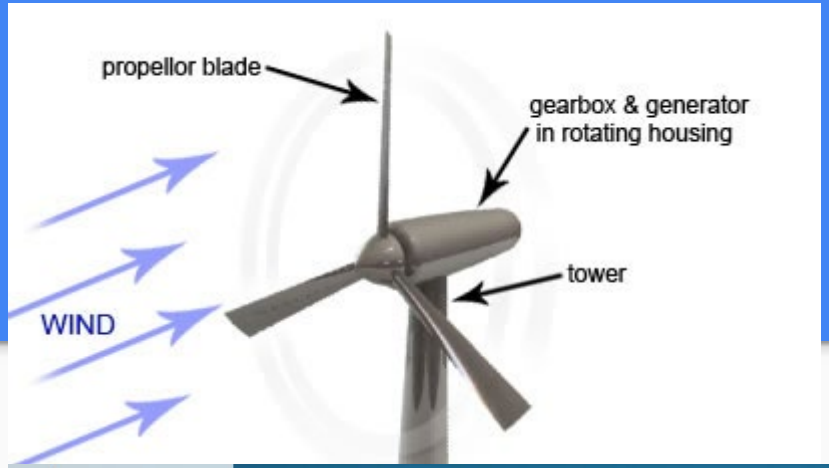
Direction and Strength of Wind

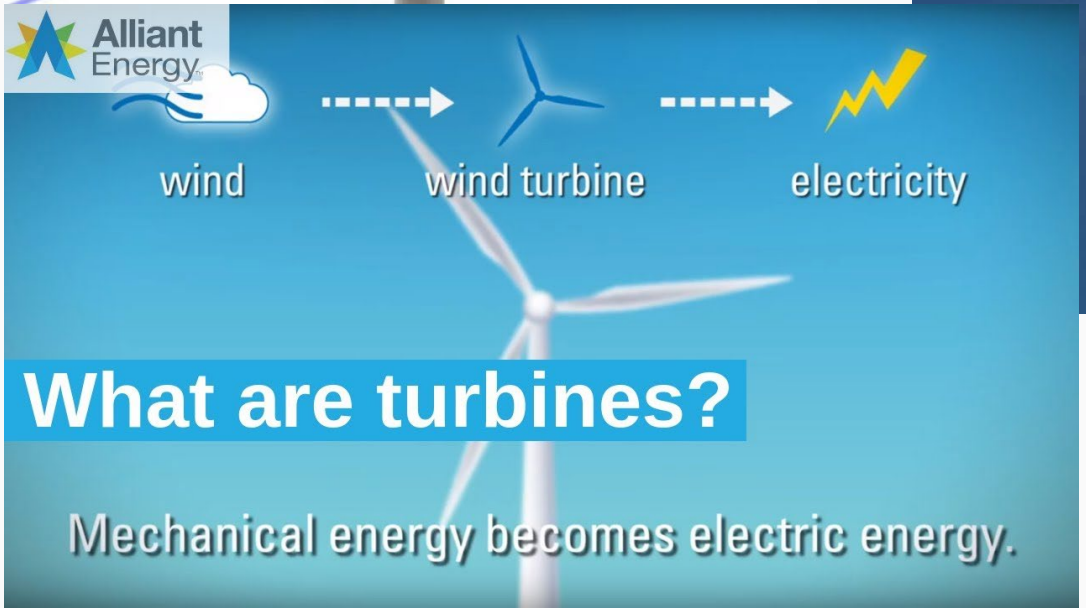
The direction and strength of the wind are changed by the Earth's terrain, bodies of water and vegetative cover. Some locations consistently have strong winds from a particular direction, while other locations have erratic or little wind. Much of this energy is transformed into heat as it is absorbed by land areas, bodies of water, and the air over these formations


Water vapor condenses and form clouds and rain
Sun heats up bodies of water and landmass
Wind Direction
Windward Side
Most rain falls in this area
Leeward Side
Less to No Rain
Wind with water vapor hits the mountain slope and moves up
Water heats up and evaporates
Mountain Range
SEA

Harnessing the Wind

We can harness the energy from the wind using a wind turbine to generate electricity and power our homes and businesses.


propellor blade
gearbox & generator
in rotating housing
tower
WIND


Alliant
Energy
wind
wind turbine
electricity
What are turbines?
Mechanical energy becomes electric energy.

WIND AT A GLANCE

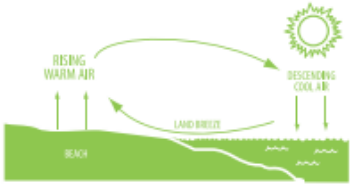
NEED
National Energy Education Development

WHAT IS WIND?

Wind is simply air in motion. It is produced by the uneven heating of the Earth's surface by energy from the sun. Since the Earth's surface is made of very different types of land and water, it absorbs the sun's radiant energy at different rates. Much of this energy is converted into heat as it is absorbed by land areas, bodies of water, and the air overthese formations.

LAND BREEZE

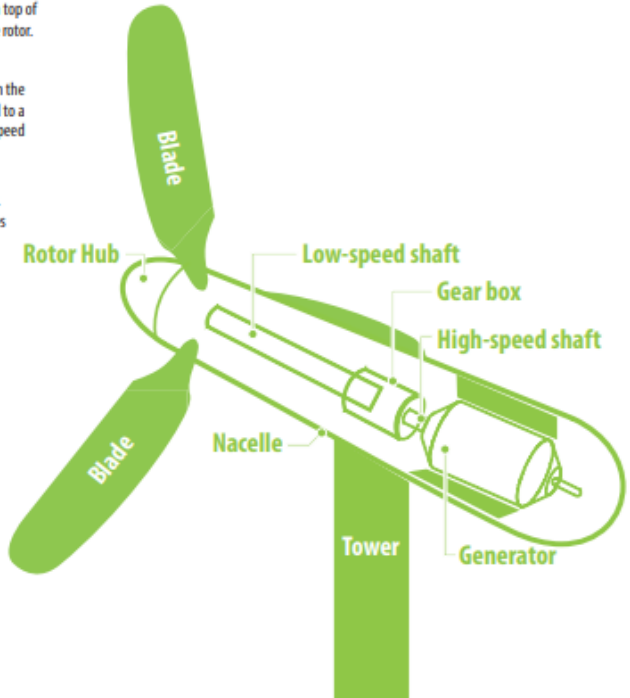
SEA BREEZE



WIND TURBINES

Wind is harnessed and converted into electricity using wind turbines. They convert the wind's kinetic energy into motion energy that generates electricity. The following steps illustrate how.

1. The wind blows and pushes against the blades on top of the tower. The blades catch the wind and spin the rotor.
2. The rotor is connected to a low-speed shaft. When the rotor spins, the shaft turns. The shaft is connected to a gear box. The gears in the gear box increase the speed of the spinning motion on a high-speed shaft.
3. The high-speed shaft is connected to a generator. As the shaft turns inside the generator, it produces electricity.
4. The electricity is sent through a cable down the turbine tower to a transformer and then to a transmission line.



TOP WIND STATES

TEXAS

OKLAHOMA

IOWA

KANSAS

CALIFORNIA

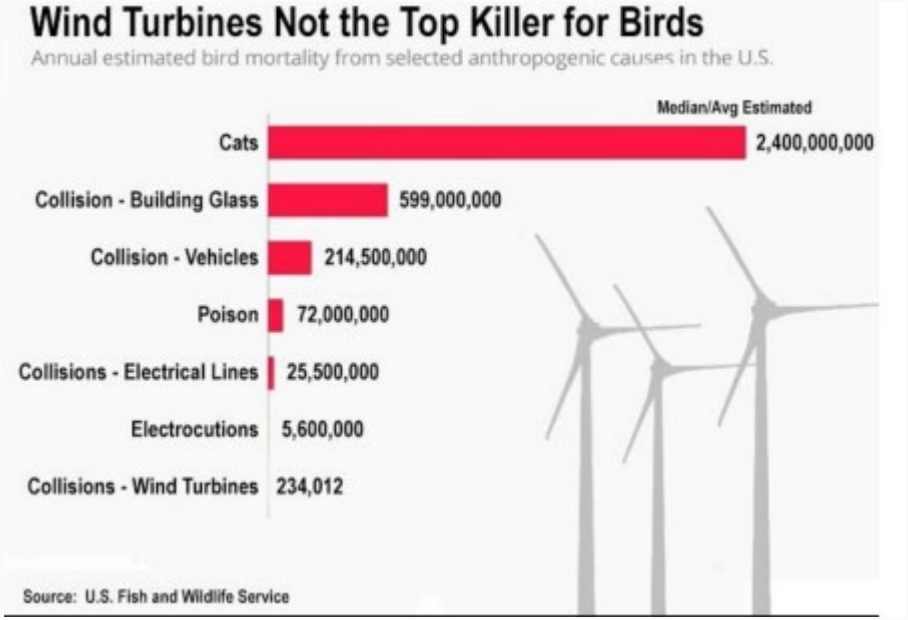
Wind Advantages and Challenges

Why should we use wind energy?

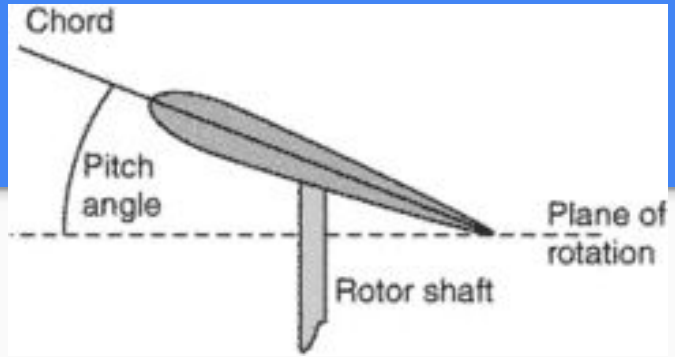
It is a clean source of renewable energy and cost effective. Land based wind is one of the lowest priced energy sources available. There are zero emissions which can help prevent climate change and improve air and water quality. Using clean wind energy can also help reduce our fossil fuel dependence.

Challenges of wind power

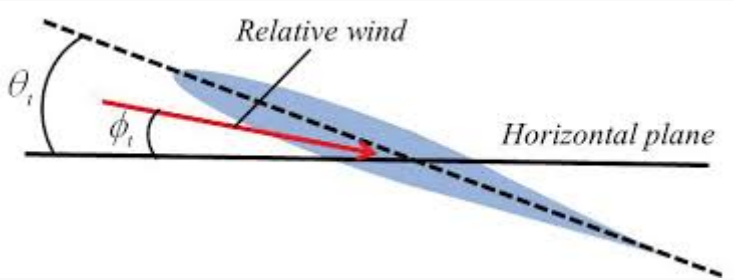
Challenges of wind power include impacting local wildlife (see chart) and building transmission lines from remote wind turbine locations to cities where electricity is needed.



Wind Turbine Design

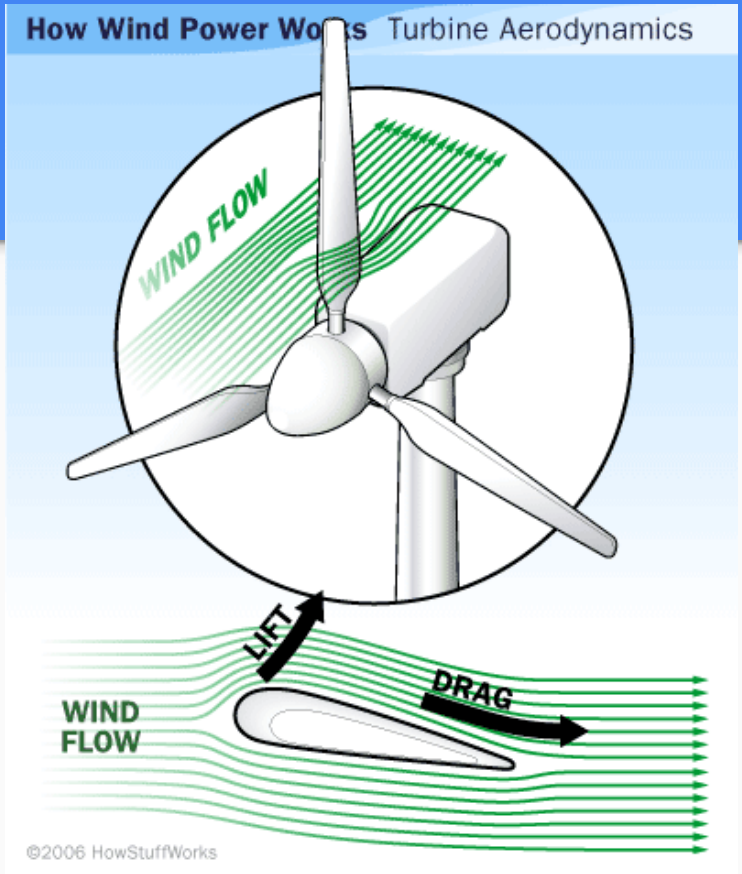


Pitch: Blade pitch is the angle of the blades with respect to the plane of rotation. The pitch of the blades dramatically affects the torque of the rotor. (Torque refers to rotational force or how hard you can push something in a circle, like a wrench.) Pitch also affects the amount of drag encountered by the blades. Efficient blades will provide maximum torque with minimum drag.



Wind Turbine Design

Drag: This is also known as resistance. Friction on the blades against the air molecules as they rotate can slow down the turbine.



Wind Turbine Design-experience pitch/drag

Turn on a fan and place your hand in front of it about 5 feet away.

- Extend your arm toward the fan with your palm facing the floor. What happens to your hand?
- Move your hand so your palm is facing the fan. What happens to your hand?
- Now, place your hand in front of the fan at a 45° angle with your thumb facing up and your palm facing the fan. What happens you your hand?
- Finally, place your hand in front of the fan at a 45° angle with your thumb facing down and your palm facing away from the fan. What happens you your hand?
- Experiment with different angles to determine which angle has the best lift.

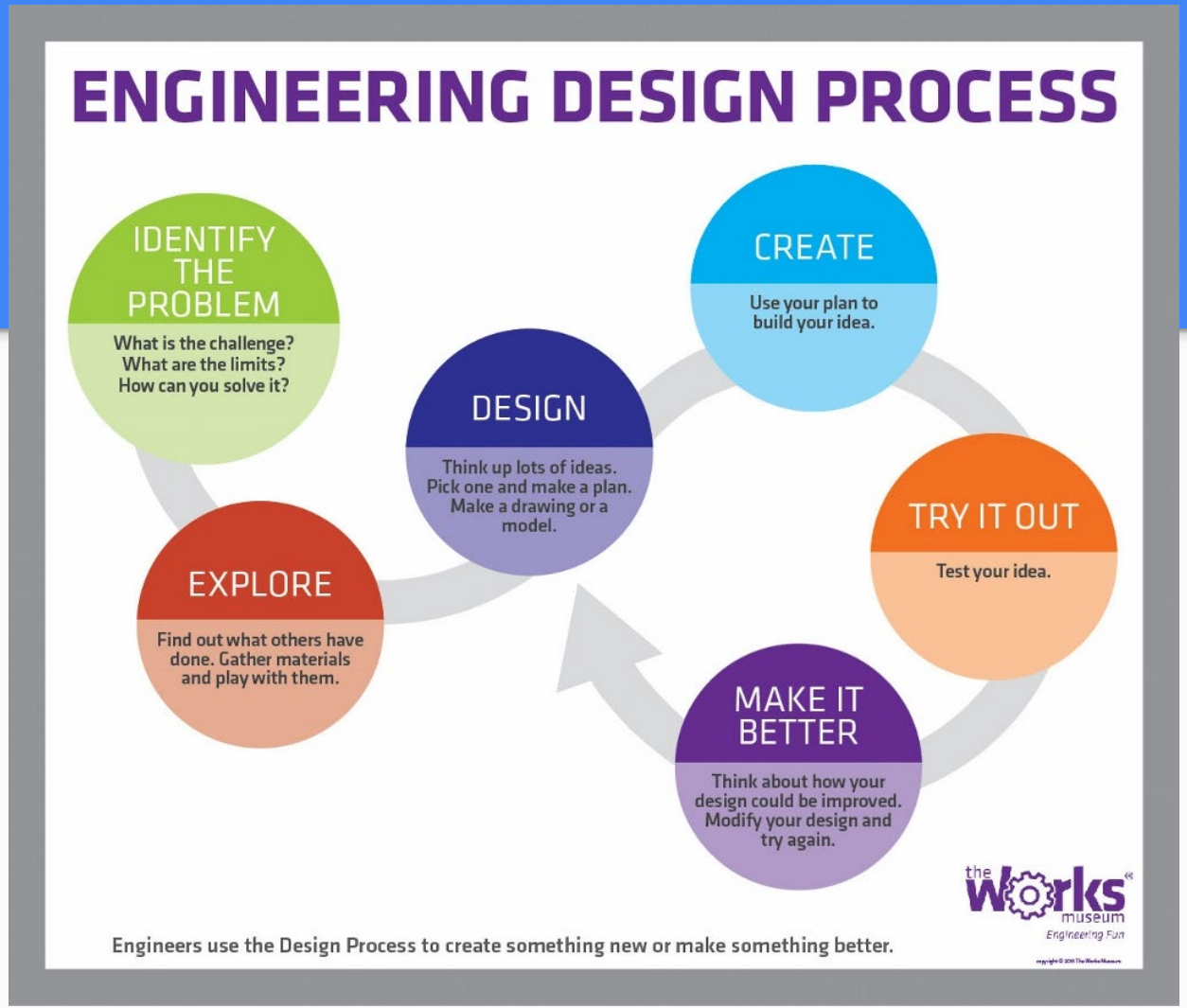
What if we move our hand flat, like it's cutting through the wind?

Now our hand is out, fingers together like we're making a wall. What happens to our hand?

What happens if we tilt our hand, thumb pointing upward?

What happens if we tilt our hand, thumb pointing downward?

Engineer Design Process

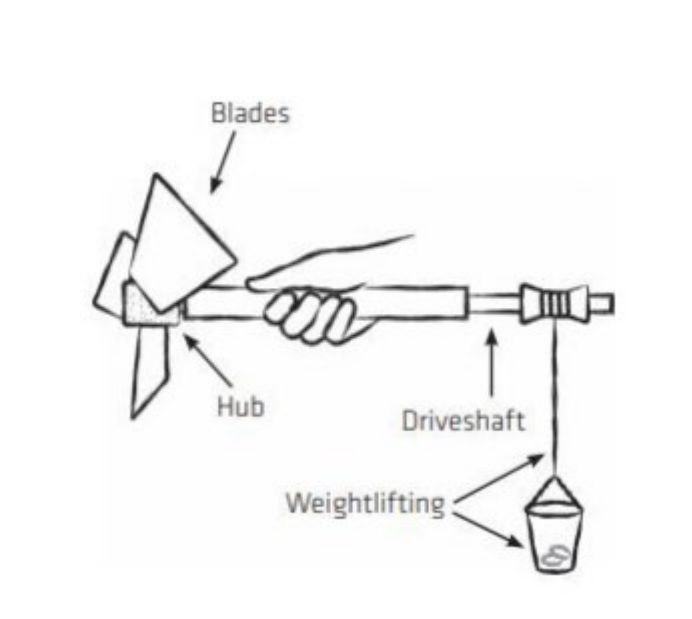


Resources

- Learn about wind and take a tour of a wind farm with Caitie's Classroom
- Take a tour of a wind turbine at One Energy in Findlay, Ohio

How to build the MacGyver Wind Lift

How to Build the MacGyver Wind lift



Pointers and Tips (you are the teacher):

● Pre-cut the pool noodle into 1” sections (one for each student.) A serrated or bread knife will easily cut the noodle.

● Pre-cut students string at .6 meters (60 centimeters) for ease of time. (The challenge is for the wind lift to raise the cup .5 meters. By pre-cutting lengths of .6 meters, you allow enough string to attach to the cup and spool.)

● If it is slipping, hot glue the driveshaft into the pool noodle.

● Do not glue the blades into the pool noodle, students will be adding and removing these as they test their lift. 6

● Do not make the blade bigger than the fan you have. Students make very long blades thinking bigger is better. This can also add drag so consider the blade size before constructing.

● Keep the fan setting the same for all testing to remove this variable and keep data reliable. May want to test your own turbine first to see which setting is best.

● Test all the wind lifts at the same distance from the fan. A piece of tape on the floor or table can ensure students are in the correct spot.

● Help students think about changing pitch using the diagram