SCIENCE	TECHNOLOGY	ENGINEERING	ART	MATHEMATICS

STEAM LESSON

SCIENCE	TECHNOLOGY	ENGINEERING	ART	MATHEMATICS

*** TASK: CON 06 ***

Windmill Design

STEAM	✓	OUTLINE
SCIENCE		**AIM:** To build and experiment with their own windmills made from simple household materials. The program closes with a discussion on energy conservation and how our choices and actions can add up to make a difference. **REF:** http://www.sciencenter.org/climatechange/d/cart_activity_guide_wind_works.pdf
TECNOLOGY		
ENGINEERING		
ART		
MATHEMATICS		

OUTCOMES	✓	DIGITAL TECHNOLOGY
ST2-2DP-T		selects and uses materials, tools and equipment to develop solutions for a need or opportunity
ST2-3DP-T		defines problems, describes and follows algorithms to develop solutions
ST2-11DI-T		describes how digital systems represent and transmit data
ST3-2DP-T		plans and uses materials, tools & equipment to develop solutions for a need or opportunity
ST3-3DP-T		defines problems, and designs, modifies and follows algorithms to develop solutions
ST3-11DI-T		explains how digital systems represent data, connect together to form networks & transmit data

COMMENTS

WINDMILL - EQUIPMENT

For the Presenter	Pre constructed	Supplies for blades
➢ Paper and markers for sources of energy list ➢ Fans for wind tunnel stations ➢ Coins for testing windmills ➢ Scale model of a wind turbine	➢ Paper milk carton ➢ Skewer Foam ball ➢ Small paper cup ➢ String	➢ Craft sticks ➢ Index cards ➢ Pencils ➢ Scissors ➢ Tape or glue

SET UP WIND STATIONS

Step 1: Set up windmill building stations, each with a windmill base and materials for blade design and construction.

Step 2: Set up fans and small weights for wind stations and make sure that each group will have access to a wind station

METHOD

1. Use the skewer to poke a hole through the milk carton about two-thirds of the way up
2. Place the dowel through the holes and fit the foam ball on one end
3. Use the string to tie the cup onto the other end of the dowel
4. Design your windmill blades: Use index cards to sketch out blades, cut out the blades, and tape each blade to a craft stick
5. Insert the sticks into the foam ball
6. Test out your windmill! Use a fan or a windy day to see how much weight your windmill can lift

EXPERIMENT

- For this activity you will have the opportunity to work as engineers – people who use science and technology to solve problems. Your challenge is to engineer your windmill to lift and empty cup first, and then slowly increase the amount of work your windmill does by increasing the number of pennies in the cup.
- Each wind station has everything that you need to create your own windmill. [Explain how materials are used] (See steps for creating windmill base below)
- You and your buddy will need to work together to create wind blades for your windmill. Working together, or collaborating, is an important part of being a scientist or engineer.
- Be creative! The design of your wind blade is up to you, feel free to experiment for the best design. [Show sample wind blades]
- Scientists and engineers often have to test out a series of designs before they come up with the best one. Trial and error is an important part of the process.
- Once you have created wind blades you can test out the design at one of the wind stations by your table. It is a good idea to test your windmill with an empty cup first, adding weight as you go along.

EXPLORATION AND TESTING

- Allow time for windmill blade design, exploration and testing

WINDMILL - INSTRUCTIONS

Introduction to Windmills

- For our energy exploration we will focus on one renewable energy source, energy from the wind. We will explore how energy from the wind can be converted from moving kinetic energy into mechanical energy that can be used to lift an object.
- Has anyone every noticed that hot air rises? This is why the upstairs of a house is generally warmer than the bottom floors. The same thing happens with the heat from the sun. When the sun heats up air, the air begins to rise.
- As warm air rises, cold air rushes in beneath it to take its place, and wind is created.
- The energy that we capture from the wind can be used to create electricity and to work for us.
- We will work with these windmills, [Show the group a sample windmill and point out features on the windmill as they arise] which use energy from the wind to do work for us, in this case to lift a weight that is in the cup.
- This wind produces a force that causes the blades to turn.
- This turning motion can be used to do work, like lift the cup for our windmill or to create electricity from a wind turbine. • In this activity you will design and test blades for a windmill and measure the energy production by seeing how much weight the windmill can lift.

Windmill Station Review

- [Discuss the windmills]
- What blade shape worked the best? How much weight was your windmill able to lift? What happened when you changed the speed or direction of the wind?
- Has anyone seen a wind turbine before?
- [Show the group the scale model wind turbine.]
- This is a scale model of a wind turbine, but they are actually much larger than this.
- Scientists and engineers use the same trial and error process we just used to design windmills and wind turbines. They have experimented with the design and have been working on new technologies to make wind turbines that are getting better and better and capturing energy from the wind to do work and make electricity.
- What is the difference between a windmill and a wind turbine? (A wind turbine is like a windmill except instead of doing work for us, wind turbines use the energy from wind to make electricity.)

Wrap Up: Conservation is Best!

- Although using renewable energy sources that don't release carbon dioxide, like energy from the wind, are a good option, it is best if we conserve, or save, energy.
- As a society we can conserve energy by insulating buildings so heat doesn't escape, using more efficient means of transportation, or conserving forests.
- What are ways that we can conserve energy in our homes or at school? (turning off lights, recycling, no waste lunch, etc.)
- Sometimes the small steps that we take really add up. If we all made small changes to conserve energy, it will make a big impact on the amount of carbon dioxide that is released into the air and help reduce climate change.

WINDMILL - BACKGROUND INFORMATION

Climate Connection

Renewable energy sources such as solar, wind or geothermal are good alternatives to carbon-based fossil fuels. Because they are not carbon-based, they do not contribute to the increased levels of CO2 that are responsible for climate change. Furthermore, unlike fossil fuels, these renewable energy sources can be replaced within a short period of time. Once we use fossil fuels up, they are gone. Recent developments in wind technology have created excitement from scientists and engineers about the potentials for wind technology as a way to reduce our reliance on carbon based energy sources.

A study from the U.S. Department of Energy estimates that wind could produce 20% of electricity by 2030. Recent technological innovations in both the efficiency and cost of wind turbines make wind energy one of the most promising ways to reduce fossil fuel consumption and to prevent the release of greenhouse gases that contribute to climate change.

Energy from the wind is captured using a windmill or a wind turbine. Both methods involve a rotating machine that converts kinetic energy from wind to mechanical energy. If the energy is used directly to do work, it is referred to as a windmill – just like the windmills used in this program. If the mechanical energy is converted to electricity, the term wind turbine is generally used.

Where Does Energy Come From?

- Where are some places that energy comes from? (sun, water, wind, coal, oil, natural gas, etc.) [As visitors list energy sources, write them on the board, using one colour to represent renewable energy sources such as sun, water, wind, and another colour for non-renewable sources such as coal, oil, and natural gas.]
- What is different about these two groups of energy sources? (One group is renewable, the other non-renewable.)
- The energy sources in the first group are renewable energy sources because they don't get used up over time.
- Coal, oil, and natural gas are all non-renewable energy sources because they can be used up: once we use the energy it is gone. Coal, for example, takes thousands and thousands of years to create. Once coal is burned and used it is gone as an energy source.

How Can We Prevent More Carbon From Going into the Air?

- We know that when we use coal for power or electricity we release carbon dioxide into the atmosphere.
- But we also know that there are other places that we can get energy from. What are some of the ways we can get energy without releasing carbon? (from the sun, wind, water, etc.)
- When we use non-renewable energy sources, what gas is released into the air? (carbon, which combines with oxygen to create carbon dioxide)
- Renewable resources on the other hand do not release carbon dioxide; this is why they are often considered "clean" energy sources.