



PHYSICS & ENGINEERING UNIT

LESSON PLAN 3rd-5th grade

Topics

Environmental Engineering
Marine Engineering
Biomimicry
Simple Machines
Bernoulli's Principle & The Coriolis Effect

Objectives

Students will be able to:

- Give examples of how environmental engineering is used to solve environmental problems and prevent environmental issues from happening
- Compare different types of marine vessels and explain the ways they are created to serve their purpose
- Compare simple machines and describe the situations they are most useful in
- Evaluate the designs in nature and determine how they can be used to inspire human design
- Identify how air pressure and shape of an object determine how Bernoulli's Principle will affect it

Instructional Materials

Topic Video
Vocabulary Flash Cards

Assessment Materials

Video Reflection Worksheet
Video Quiz
Environmental Engineering Worksheet (*answer PDF available*)
Marine Engineering Worksheet (*answer PDF available*)
Biomimicry Worksheet (*answer PDF available*)
Simple Machines Worksheet (*answer PDF available*)
Bernoulli's Principle & The Coriolis Effect Worksheet (*answer PDF available*)

Related Materials

Links to videos and reading material that provides additional information on topics.

Topic Articles (Lexile level can be adjusted)

**click on article name*

[Giant floating trash collector sets its sights on the large ocean garbage patch](#)

[Rooftop views are growing more green as crops sprout up high](#)



NOAA Resources

The National Oceanic and Atmospheric Administration (NOAA) is a partner of SoundWaters. These are additional resources you may use in addition to the other materials included above.

Environmental Engineering

<https://response.restoration.noaa.gov/about/media/booms-beams-and-baums-history-behind-long-floating-barriers-oil-spills.html>

<https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/spill-containment-methods.html>

<https://oceanservice.noaa.gov/hazards/spills/>

<https://www.noaa.gov/education/resource-collections/ocean-coasts/gulf-oil-spill>

Simple Machines

<https://oceanexplorer.noaa.gov/edu/guide/media/gomdse11calltoarms56.pdf>

Biomimicry

<https://coast.noaa.gov/digitalcoast/training/puerto-rico.html>

Density/Buoyancy (Marine Engineering)

https://www.noaa.gov/sites/default/files/atoms/files/BoatBuilding_Handout.pdf

ROVS https://nmsmonitor.blob.core.windows.net/monitor-prod/media/archive/education/pdfs/rov_lesson.pdf

Bernoulli's Principle & Coriolis Effect

<https://oceanservice.noaa.gov/education/kits/currents/05currents1.html>

https://www.weather.gov/jetstream/ll_flow

NGSS Standards

Forces and Interactions: 3-PS2-1; 3-PS2-2

Motion and Stability: 3-PS2-2

Engineering Design: 3-5-ETS1-1

Structure and Function: 4-LS1-1

Energy: 4-ESS3-1

Earth and Human Activity: 4-ESS3-1

Earth's Systems: 4-ESS3-2

Earth and Human Activity: 5-ESS3-1

ENVIRONMENTAL ENGINEERING ANSWER KEY

Buildings are starting to use more “green design” to help the environment in places like houses where they can use different spaces for growing plants. These are examples of green roof systems or rooftop gardens.

Why would this be an example of environmental engineering? What problems could it be addressing or solving?

Do your own research to get more information about green design like rooftop gardens and a green roof system



Answers may vary

- Green building like green roofs and rooftop gardens take advantage of unused space to add more plants
- Plants are helpful to the earth because they create oxygen and can absorb chemicals from the air like carbon dioxide that leads to global climate change
- They also absorb a lot of water so if there is a large storm, they will soak up some of the water which can prevent erosion in the areas around it
- They also create habitat for different animals. If the roof has flowers, it could encourage pollinating insects that help add new plants around the earth

Marine engineers consider many factors about the water when deciding how to build a boat.

Below are pictures that demonstrate the concepts of surface tension and buoyancy from the video. **Label the pictures with the correct concept and explain how it helps a boat to float.**



Surface tension

When water molecules stick together, they create a “skin” on the surface of the water that prevents the object from falling down into the water



Buoyancy

The weight of the boat is spread out over the water and it has a space filled with air. This makes the boat positively buoyant so it floats

A cruise ship is a very large boat that carries many passengers over great distances over the ocean. **Does a cruise ship have a displacement hull or a planing hull? Explain why.**

A cruise ship is a displacement hull. The boat is large so part of the hull is underwater and so the boat pushes through the water instead of on top of it and the water is pushed out around the boat. The cruise ship will also never move fast enough to stay on the surface of the water.

BIOMIMICRY CHALLENGE

Think like an engineer, get inspired by nature! Below are functions that both people and the rest of nature aspire to do. Find an organism in nature that does this function. Explain how the living thing accomplishes the task. See how many examples of things in nature you can think of for each function!

Function

Explanation

Keep clean

Cats lick themselves. Fish produce a slime layer. Monkeys pick bugs out of each others fur.

Protect

Clams, mussels, oysters and snails have shells. Fish have slime. Crabs have exoskeletons.

Collect (could be water, sunlight, food, etc.)

Plants, both in water and on the land, have leaves to help them collect sunlight. Baleen whales have special mouths that help them collect plankton for food.

Insulate (keep warm)

Whales and polar bears have blubber. Many mammals have fur. Birds have feathers.



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SIMPLE MACHINES ANSWER KEY



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On the video, you learned how the SoundWaters Schooner contains a series of simple machines that make it work. Now let's see how a bicycle uses simple machines. Identify what type of simple machine is used in each situation and why.



1) Your feet push on the pedals

The pedals are a level because pushing on them generates force to help it move

2) The bike chain rotates around around the gears

The chain and gears are a pulley because the chain sits on the grooves of the gears and can turn around it. You can change direction with the pulley as well

3) The front and back wheels start to spin

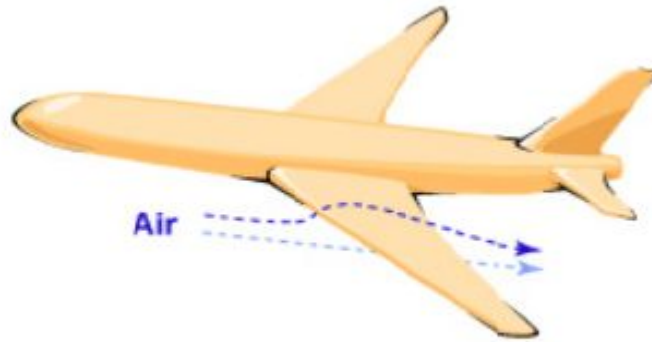
The wheels are a wheel and axle because the wheel rotates on an axle allowing it to move over the land

4) You press the brake with your hand to slow down

The brakes are a level because pushing it generates force to make the wheels slow down

In the video, we learned how the speed of the air moving over a surface affect the air pressure and is the reason that planes are able to fly

Thinking about the demonstration with the leaf blower, answer the following questions about this plane



- 1) Air is moving over the top and bottom of the wing, but where is it moving FASTER? Are the wings the same shape?**

The wings are different shapes, the top wing is rounded which is why the air moves up and over it instead of straight. The air moves faster over the top wing because it has to go around it since they are not the same shape.

- 2) Is the air pressure higher or lower on the bottom of the wing? Why?**

Since the air is moving faster over the top wing, there is less pressure. The air is moving slower on the bottom of the wing so there is higher air pressure. The higher air pressure on the bottom of the wing is what pushes the plane upwards

- 3) What would happen to the airplane if there was a disturbance in the air ABOVE it, while it was flying?**

A disturbance in the air above the plane would change the pressure pushing the plane up and could cause the plane to sink down into the air. The plane can still fly and will resume the way it was flying when the disturbance goes away.