



PHYSICS & ENGINEERING UNIT

LESSON PLAN 6th-8th grade

Topics

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

Objectives

Students will be able to:

- Give examples of how natural conditions of the environment are used in environmental engineering to solve existing problems and prevent future problems from occurring
- Compare different types of marine vessels and explain the ways they are created to serve their purpose
- Apply simple machines to accomplishing a task
- Apply bio-inspired design to create your own product
- 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*)
Bioinspired Design Challenge Worksheet
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>

<https://oceanservice.noaa.gov/podcast/mar18/nop14-ocean-garbage-patches.html>

Simple Machines

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

<https://oceanexplorer.noaa.gov/explorations/03portland/background/edu/media/portlandsteamed.pdf>

Biomimicry/Bioinspired design

<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

https://aamboceanservice.blob.core.windows.net/oceanservice-prod/education/activity-book/pdf/NOAA_DYW_2017_02_Boat_Building.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: MS-PS2-2

Earth's Systems: MS-ESS2-6, MS-ESS2-4, MS-ESS2-5

Earth and Human Activity: MS-ESS3-3

Engineering Design: MS-ETS1-1, MS-ETS1-2, MS-ETS1-3

ENVIRONMENTAL ENGINEERING

ANSWER KEY

In the video, you learned several ways that environmental engineering addressing problems that already exist in the environment and finding ways to prevent problems from happening.

How environmental engineering address the situation below? What are some things to consider when solving the problem?

A group of scientists is testing the water in a river when they discover something floating on the surface of the water. The river is flowing very fast and the substance is moving towards an area where there are fish laying eggs



Answers may vary, but this answer is based on the video information

This material floating on the water could be some type of oil, which means it will flow fast and will move to a different area of the water very quickly.

One way to solve the problem is to create a boom that either stops the material or soaks it up. In the video the students learned about sorbent booms that only soak up oil.

If they are planning to soak it up, they would need to make sure that the oil can soak into it fast enough. They might want to use a solid boom first to stop it and then soak it up once it is contained.

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

Based on the video, what type of hull do each of these boats have? How does that hull help the boat to move?



This is a planing hull because it looks like the boat is gliding over the surface of the water.

A planing hull lifts out of the water until it is skimming on the surface, which reduces the amount of power and gas needed for it to get from point A to point B.



This is a displacement hull because it belongs to a very large cruise ship, which needs to be very stable as it crosses large bodies of water.

The displacement hull sits lower in the water and plows through wave energy, creating a more stable ride for passengers, especially on voyages overseas where the water can be rocky!

If a large cargo ship has a ballast, when is the best time to fill the ballast with water?

The best time to fill the ballast tanks with water is on the return voyages when the cargo ship has delivered all of its goods and the boat no longer has the weight needed to properly displace the water it needs to remain stable.

SIMPLE MACHINES ANSWER KEY



On the video, you learned how the SoundWaters Schooner contains a series of simple machines that make it work.

For the tasks listed, explain how you can use the materials to solve the task and what type of simple machine is being used.

You need to lift a jug of milk about 3 feet off the ground, but you cannot lift it with your hands. You have a piece of rope a rolling pin, and another person.

Create a pulley system by wrapping the rope around the rolling pin (several times to make it easier). Have a person hold either end of the rolling pin. Attach one end of the rope to the jug and hold the other. Pull on the line making sure that the person does not drop the rolling pin.

A tennis ball is on one end of a table and a bowl is on the other end of the table. You need to get the tennis ball into the bowl, but you cannot throw or bounce it. You have a wooden ruler and a marker.

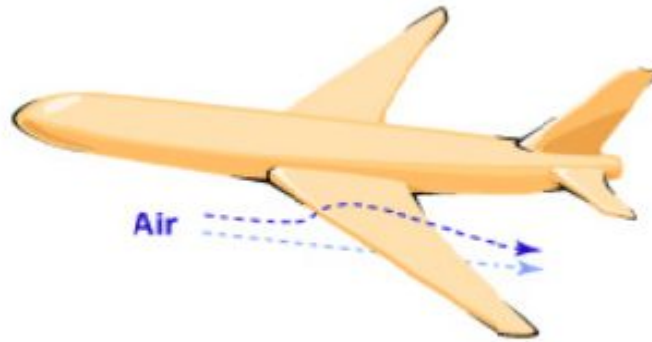
Create a level by placing the marker in the middle of the ruler, but having it be perpendicular to the ruler. Put the tennis ball at one end and push the other end of the ruler like a seesaw. Push hard enough to make the ball go into the air until it lands in the bowl.

You need to get a toy car from the floor to the top of a table, but you cannot lift it with your hands. You have a wooden board (plus the table and toy car).

Use the board like an inclined plane so it rests on the top of the table at an angle. Push the car up the board until it reaches the top of the table.

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.