

Energy Lab

A LEGOLAND® California Educational Resource Guide Grades 3-6



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Welcome to LEGOLAND California

Education Programs

Energy Lab was developed by the LEGOLAND Education Department in cooperation with LEGO® Education. For information on LEGOLAND Education programs, visit www.LEGOLAND.com/edu.

Arrival and Entry

Please arrive 30 minutes before your scheduled program. Teachers must be present during the 45-minute staff-facilitated program.

Extended Learning in the Park: Lab Notes are provided to guide your experience on recommended rides and attractions, to enhance the Energy Lab-themed educational experience and provide applied learning.

Lunches

Lunches may be pre-ordered when you book your program, or purchased at LEGOLAND restaurants. School groups may bring lunches in disposable containers and use self-storage bins.

Safety

LEGOLAND Parks are built to the highest standards of quality and safety. Height restrictions apply on selected attractions throughout the Park.

Background Information

Energy comes from many sources.

Most of our energy supply comes from fossil fuels, such as oil, coal, and gas. Since fossil fuels take millions of years to form, they are effectively non-renewable. Every time we use oil, coal, and gas, there is less for future use. Also, burning fossil fuels produces waste products that pollute the atmosphere.

Energy also occurs naturally in wind, flowing water, and sunlight. Using these renewable energy sources might offer an alternative power source.

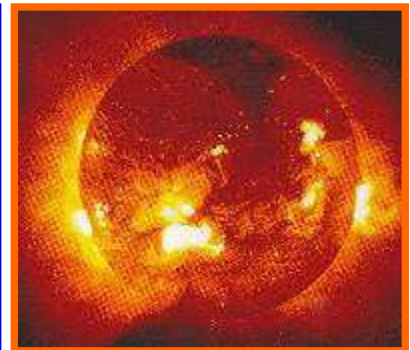


Collecting and Storing Energy

Energy that is naturally available needs to be collected to be useful. Sometimes energy can be used at the place where it is collected, and sometimes it must be stored and transferred. Potential energy is energy stored up and ready to be used. Kinetic energy is the energy of motion.

When energy is transferred from where it is stored to where it is used, some energy escapes as heat.

Power is a measure of how fast you transfer energy. You can lift an object slowly and work at a low power. Lift it quickly and you work at a high power.



Renewable Resources: Wind, Water, and Solar Power

Windmills, grouped into windfarms, can generate electricity. Large rotors have pitched blades to collect wind energy. Windmills convert about 30% of the wind's energy into electricity.

Turbines are powerful waterwheels used in hydroelectric power stations. Water is stored behind a dam. As the water is released, it drives the turbines and generates electricity. Worldwide, water power is the major source of energy, after fossil fuels.

Solar panels collect energy from the sun. One type of solar panel contains a liquid that absorbs the heat energy. Hot liquid passes to a heat exchanger to heat the water in a swimming pool or a home's water heater.

Another type of solar panel converts the sun's rays into electricity. The voltage and power is low, so several cells are connected in each panel.

Before and After the Visit: Minds-On Activities

Balloon Power!

Use renewable energy—air!
Store potential energy, and change it to kinetic energy.
Find out how weight affects speed and distance the balloon travels.



Remember:

Potential energy is energy stored and ready to be used.
Kinetic energy is the energy of motion.

Materials

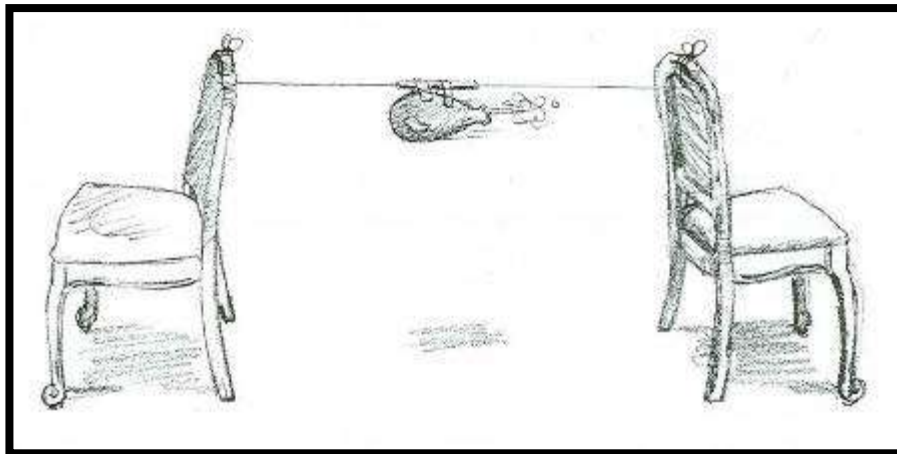
Long balloons
Pennies

Drinking straw
String or fishing line, 6 ft. long

Masking tape
2 chairs

Procedure

1. Thread the drinking straw on the string. Tie each end of the string to the back of a chair.
2. Move chairs apart until the string is taut. Slide the straw to one end.
3. Inflate the balloon, but do not tie it.
4. Hold the balloon with the opening facing the chair. Tape the balloon to the straw.
5. Let the balloon go!



Discussion

1. How far did the balloon go?
2. What renewable energy source powers the balloon?
3. Where is potential energy stored? When is kinetic energy released?
4. Is any energy wasted? If so, how?

Now try this!

1. Tape a penny to the balloon or straw. How does weight affect the speed and distance the balloon travels? Try it with two pennies.
2. Use a different size or shape of balloon. Can you increase the potential energy stored and the kinetic energy released?

Discovery and Learning at LEGOLAND

TECHNIC® Coaster

Ride TECHNIC Coaster!

Think about how TECHNIC Coaster makes the most of potential energy, kinetic energy, and gravity, to speed up and slow down.

Remember:

Potential energy

is energy stored up and ready to be used.

Kinetic energy

is the energy of motion.



TECHNIC® Challenge

1. Where does TECHNIC Coaster have the most potential energy, at the lowest or highest point of the track?

2. How does TECHNIC Coaster gain more potential energy—by going up or down the track?

3. How does the height of the track affect the amount of potential energy that can be stored?

4. When is potential energy changed to kinetic energy? _____

5. How does the dip and climb at the end of the ride help TECHNIC Coaster slow down? How does this help the brakes?

Hands-On Activities



Discover energy and where we find it.

Energy is the capacity to do work or the ability to make things move.

Think about where energy comes from.

What is the difference between renewable and non-renewable energy?

Can you give several examples of each?



Generate energy.

Use the windmill, hand crank, and solar panel to compare the power generated from wind, solar, and mechanical energy sources.

Discover how to use the LEGO® capacitor to collect, store and transfer energy. When energy is stored in the capacitor, it is called potential energy. When the energy is released, it changes to kinetic energy, the energy of motion.



Build a model, then collect and store the energy to power up!

1. Build a LEGO model of a car, with a motor attached.
2. Explore the power of two different energy sources: Mechanical and solar.
3. Collect mechanical energy, then solar energy, in the capacitor.
4. Transfer the power to the motor to make the ride run.
5. Compare the car's performance using the two different sources of energy.

About Energy Lab

Learning Outcomes

- Learn about renewable resources, such as solar and wind energy.
- Experiment with production, storage, and transfer of mechanical and solar energy.
- Test and compare energy sources.
- Define and experience potential and kinetic energy on LEGOLAND attractions.



California Next Generation Science Standards

GRADE 3-5 Engineering Design

- 3-5-ETS1-1. Define a simple design problem...that includes criteria for success and constraints on materials, time, or cost.
- 3-5-ETS1-2. Generate and compare multiple possible solutions...based on how well each is likely to meet the criteria....
- 3-5-ETS1-3. Plan and carry out fair tests...to identify aspects of a model or prototype that can be improved.

GRADE 4, 6 Energy

- 4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.
- 4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by...light....
- 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- MS-PS3-3. Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
- MS-PS3-5. Construct, use, and present arguments: ...when the motion energy of an object changes, energy is transferred to or from the object.

GRADE 5 Earth and Human Activity

- 5-ESS3-1. Obtain & combine information about ways individual communities use science ideas to protect the Earth's resources & environment.

The performance expectations above were developed using NRC Framework for K-12 Science Education:

Science and Engineering Practices

Asking Questions and Defining Problems

- Define a simple problem that can be solved thru development of a new/improved object... & includes...criteria for success....(3-5-ETS1-1)

Construct Explanations and Design Solutions

- Generate & compare solutions...based on how well they meet criteria....(3-5-ETS1-2)
- Use evidence (e.g., ...observations...) to construct an explanation. (4-PS3-1)

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

- ...Different...solutions can be compared on the basis of how well each one meets the criteria for success.... (3-5-ETS1-1)

ETS1.B: Develop Possible Solutions

- ...Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- Communicating with peers about proposed solutions...can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify...difficulties, which suggest elements...that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution

- A great variety of objects can be built up from a small set of pieces. (2-PS1-3)
- (Test) different solutions to determine which best solves the problem, given the criteria and constraints. (3-5-ETS1-3)

PS3.A: Definitions of Energy

- The faster a given object is moving, the more energy it possesses. (4-PS3-1)
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3)

PS3.B: Conservation of Energy and Energy Transfer

- Light also transfers energy from place to place. (4-PS3-2)
- Energy can also be transferred...by electric currents...produced...by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4)
- When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5)

PS3.D: Energy in Chemical Processes and Everyday Life

- The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (4-PS3-4)

ESS3.C: Human Impacts on Earth Systems

- Human activities...have major effects on land (and air)...(C)ommunities (do) things to help protect Earth's resources & environments. (5-ESS3-1)

Crosscutting Concepts

Energy and Matter

- Energy can be transferred in various ways and between objects. (4-PS3-1), (4-PS3-2),(4-PS3-3),(4-PS3-4)
- Energy may take different forms (e.g. ...energy of motion). (MS-PS3-5)
- The transfer of energy can be tracked as energy flows through a designed...system. (MS-PS3-3)

Connections to Engineering, Tech, & Applications of Science: Influence of Sci, Engineering & Tech on Society and the Natural World

- Engineers improve existing technologies or develop new ones. (4-PS3-4)

Connections to Nature of Science: Science is a Human Endeavor

- Most scientists and engineers work in teams. (4-PS3-4) Science affects everyday life. (4-PS3-4)

Common Core State Standards Connections Grades 3-5

5

ELA/Literacy –

- W.5.7** Conduct short research projects that use several sources to build knowledge through...different aspects of a topic.... (3-5-ETS1-1),(3-5-ETS1-3)

- RST.6-8.3** Follow precisely a multistep procedure when carrying out experiments...or performing technical tasks. (MS-PS3-3),(MS-PS3-4)

Mathematics –

- MP.2** Reason abstractly and quantitatively. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)

- MP.5** Use appropriate tools strategically. (3-5-ETS1-1),(3-5-ETS1-2),(3-5-ETS1-3)