



UTAH OFFICE OF ENERGY DEVELOPMENT

Gravity Battery

Grade/Subject: Physics

Strand/Standard PHYS 2.3 Develop and use models on the macroscopic scale to illustrate that energy can be accounted for as a combination of energies associated with the motion of objects and energy associated with the relative positions of objects. Emphasize relationships between components of the model to show that energy is conserved. Examples could include mechanical systems where kinetic energy is transformed to potential energy or vice versa. (PS3.A)

Lesson Performance Expectations:

- Students will build a model to show how energy can be stored when using intermittent energy sources such as solar or wind power. The model will be tested.

Materials per group:

- Small motors
- Alligator clips
- Ring stands and rings
- Multimeter
- Pulleys
- Heavy rubber bands
- String, fishing line
- Weights
- Tape
- Glue gun

Time: 90 minutes

Teacher Background Information:

- The idea behind this mechanical “battery” may be new to the US but the principles it is based on are not.
<https://www.bbc.com/news/uk-scotland-56819798>
- <https://www.bbc.com/future/article/20220511-can-gravity-batteries-solve-our-energy-storage-problems>
- <https://www.sltrib.com/renewable-energy/2023/01/28/water-battery-utah-company/>

Student Background Knowledge:

- Students should be aware that one important issue surrounding the use of solar or wind energy is the need for storage of the excess energy produced during times when the sun is shining and the wind is blowing. The stored energy needs to be available when the sun does not shine or the wind does not blow. Students should understand how an electric motor works as a turbine and a generator.
- Students need to know how to operate a multimeter.

Teacher Step by Step: A 3-D lesson should insist that students think deeply. Provide time and space for the students to experience the phenomenon and ask questions. The student sheet provided below provides guidance but is only an example of how students might respond.

1. **Introduce *Phenomenon*:** *Use the picture and text to stimulate student questions.*
2. Students should realize that a source of energy is necessary to lift the sandbag. This energy could come from alternative sources such as wind or solar or it could be a storage system for an electrical grid that has extra electricity during some times. Explain the materials students have to use. If they have not used the motors before, provide a battery and allow them to turn the motors. Describe how the process works in reverse to generate electricity.
3. Ask students to build a model of the gravity battery based on the materials provided and the information they got from reading the phenomenon. If more instruction is needed, an internet search will help.

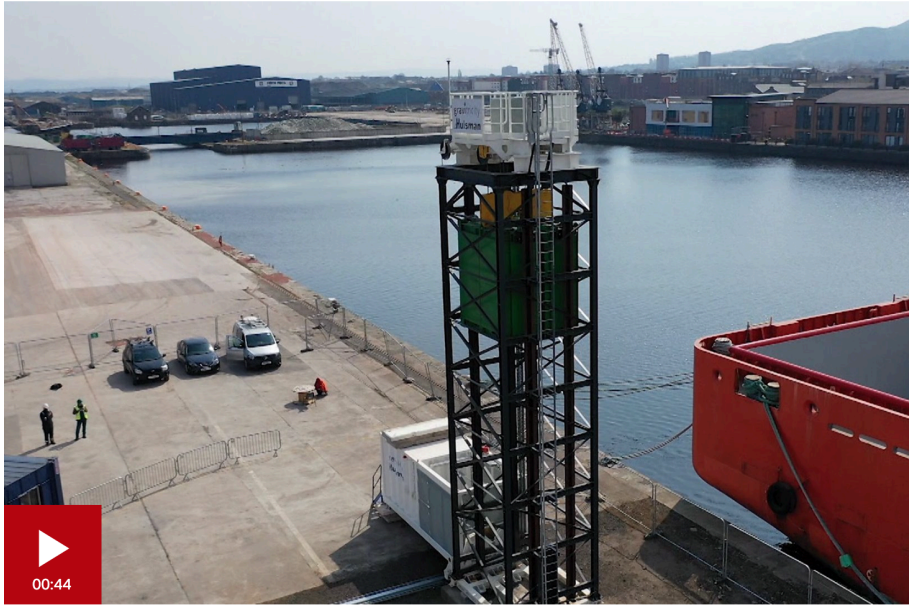
Assessment of Student Learning.

1. What is the purpose of a battery?
 - a. To store energy*
 - b. To create heat
 - c. To transfer energy
 - d. To create energy
2. What type of energy is stored in a gravity battery?
 - a. Potential energy*
 - b. Chemical energy
 - c. Heat energy
 - d. Electrical energy
3. What determines how much energy is stored in the gravity battery? Choose all that apply.
 - a. The height it is raised.*
 - b. The mass of the sandbag*
 - c. The source of the energy
 - d. The volume of the bag
4. What are the advantages of a gravity battery? Choose all that apply.
 - a. They do not require heavy metals.*
 - b. They could be built in many places*
 - c. They could be used over and over.*
 - d. They could store unlimited energy.

Extension of lesson and Career Connections: Investigate how a hybrid electric car recharges its battery when the car is traveling under gas power or downhill. Report to the class.

Title: Gravity Battery

Name _____



'Gravity battery' generates power for first time in Edinburgh

A project to create electricity using gravity has generated power for the first time at a demonstrator site in Edinburgh.

The 15m (49ft) high demonstrator is housed in a tower on the quayside at Leith docks.

The Gravitricity system works by using excess power to raise heavy weights which keep that energy "stored" until it is needed - electricity is generated when the weights are dropped.

It has been designed to be housed in old mine shafts rather than towers, and in the UK could go to depths of 750m (2,461ft) - twice the height of the Eiffel Tower in Paris.

In African countries, where it could be placed in holes specifically built for the job, the depth could exceed 2km (1.2 miles).

🕒 21 April 2021 · [BBC News](#) · [Scotland](#)

What questions do you have about the production of electricity in a gravity battery?

1.

2.

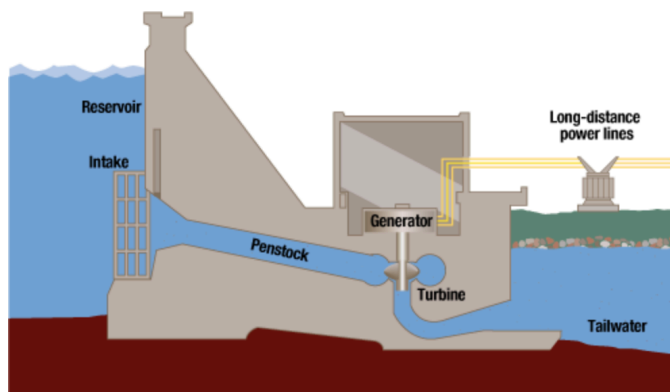
Materials: electric motors, alligator clips, ring stand and ring, weights, multimeter, rubber bands, string/fishing line, pulleys, glue guns.

Procedures:

1. Assemble your battery to capture energy as it is raised (by your hand, the “alternative energy”) and release energy through the motor as it is lowered. Draw your model here:
2. Experiment with different techniques and designs for your model. Record the amount of electrical energy released through the motor on your voltmeter.

Analysis

1. Label the energy transfers in your model. Remember that the energy provided by your hand as you lifted the sand is our “alternative energy” source, perhaps wind or solar power.
2. How is the gravity battery similar to a hydroelectric dam? Match and label the parts of your model to this diagram:



3. What advantages does a gravity battery have over a hydroelectric dam?

Disadvantages?

4. What advantages does gravity power have over chemical batteries?