GRAPHITE LIGHT BULB

Energy Transformations and Engineering Design Activity

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Big Ideas

Electrical energy can be produced from renewable and non-renewable sources then converted to other forms of energy to meet a variety needs.

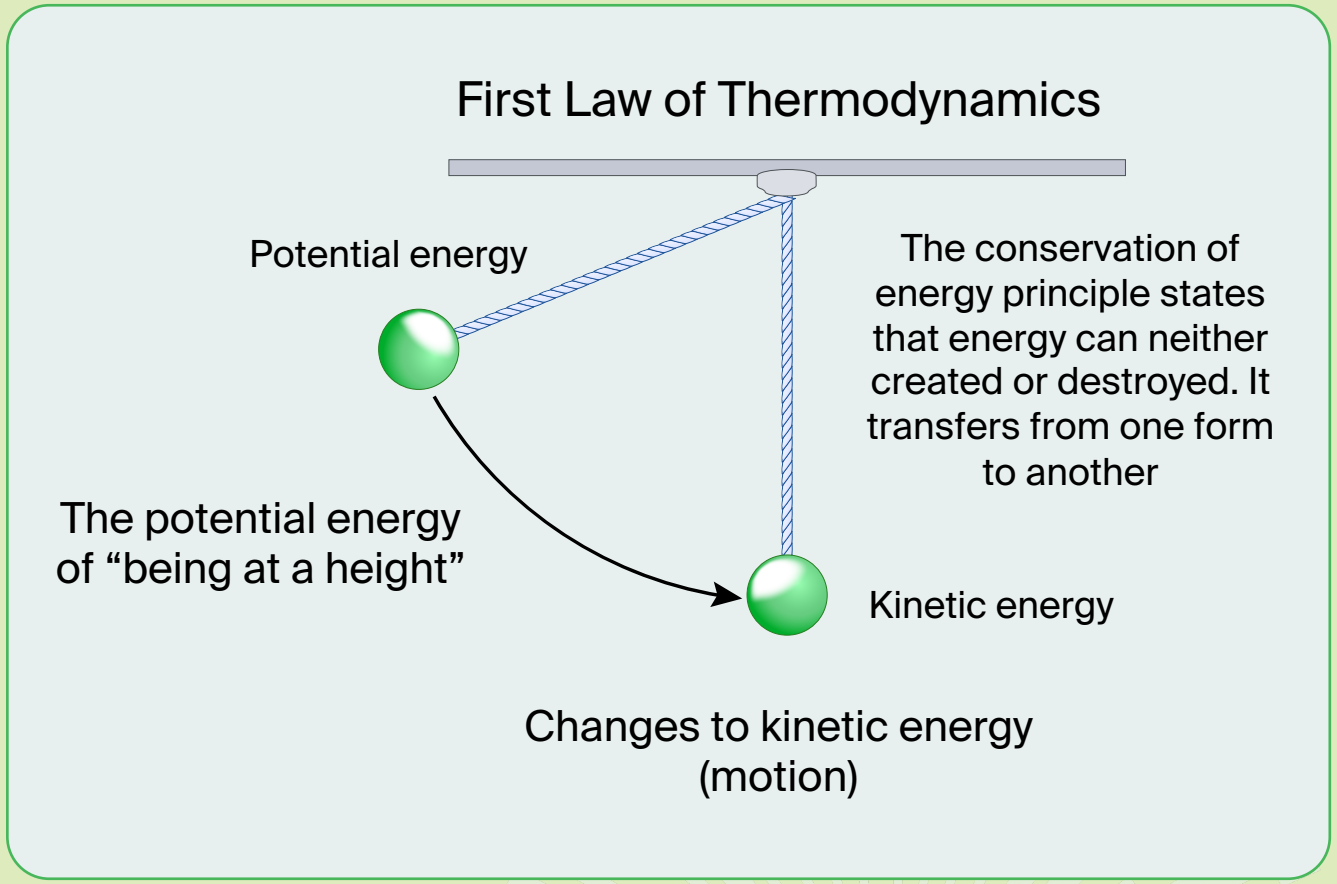
MINDS ON

First Law of Thermodynamics

Energy cannot be created or destroyed; it is transformed from one form to another.

Types of Energy

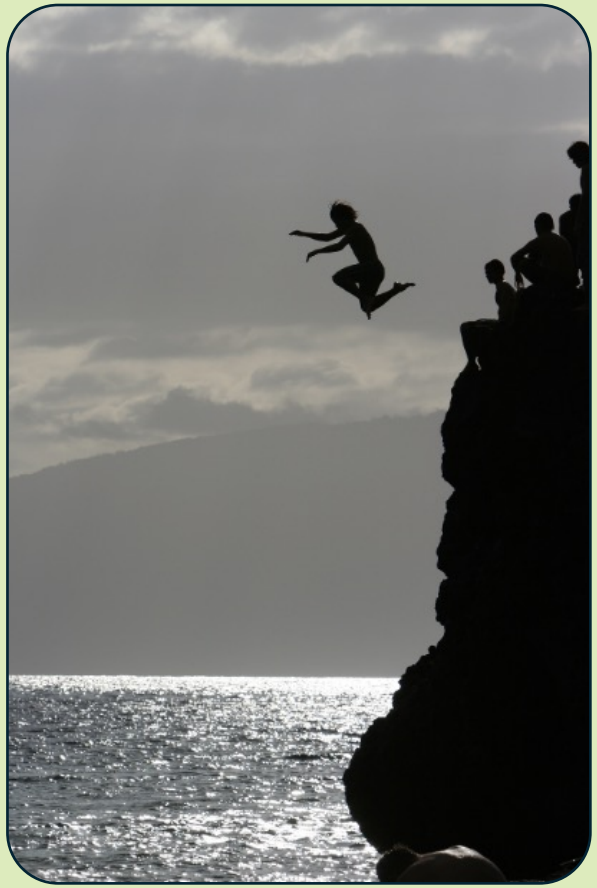
- Gravitational potential energy
- Electrical potential energy
- Chemical potential energy
- Kinetic energy
- Light
- Heat
- Sound



Fun Fact

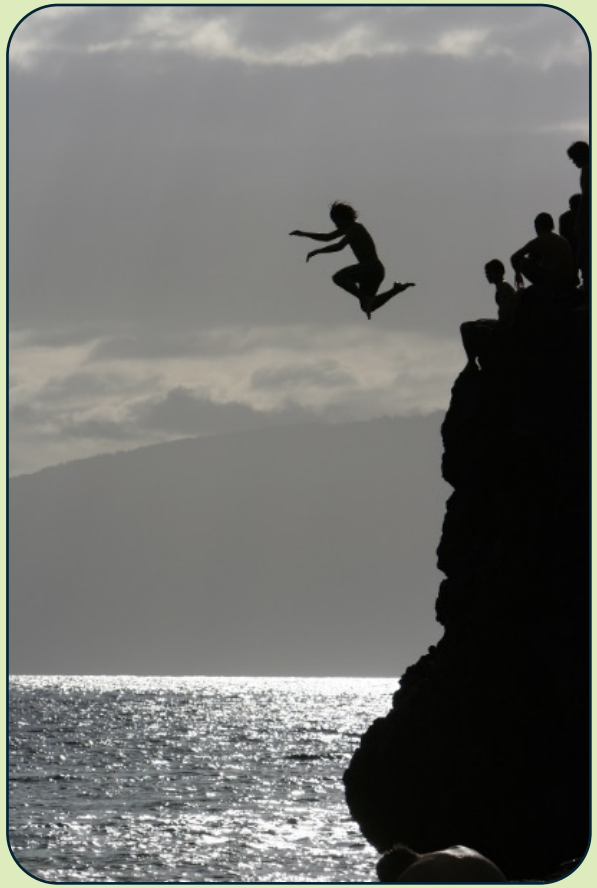
Alessandro Volta created the very first electric battery in 1800. The volt, which is the standard unit for electrical potential, is named after him.

Name the Energy Transformation(s):



Jumping from a height

Name the Energy Transformation(s):



Jumping from a height

Gravitational potential energy → kinetic energy

Name the Energy Transformation(s):

Gasoline in a car engine

Name the Energy Transformation(s):

Gasoline in a car engine

Chemical potential → heat → kinetic energy

Name the Energy Transformation(s):

Sunlight on plant

Name the Energy Transformation(s):

Sunlight on plant

Solar → chemical potential

Identify the Energy Transformation(s):

Using a flashlight

Identify the Energy Transformation(s):

Using a flashlight

Chemical potential → electrical → light + heat

Identify the Energy Transformation(s):

Using a flashlight

Chemical potential → electrical → light + heat

The heat energy of the flashlight is unusable, lowering the efficiency of this device.

Electrical devices are not 100% efficient.

Fun Fact

Incandescent lamps generate enough warmth that specialized ones can be used as heating sources in egg incubators, reptile enclosures and restaurant food warming units.

Energy Transformations in Electricity Generation

Demonstrate Your Understanding:

- In a group, select a type of electricity generation and **identify the energy transformations** required to make electricity from this source.
- **Creatively demonstrate** the energy transformations **to the class.**

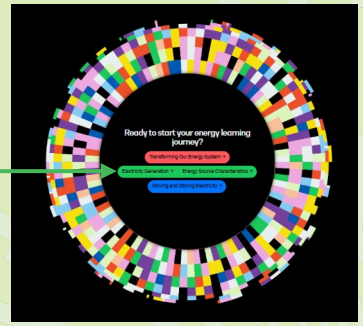
Types of electricity generation in Ontario:

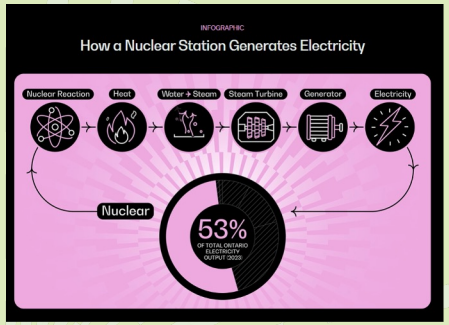
- Nuclear
- Hydroelectric
- Natural Gas
- Wind
- Solar
- Biogas

Need some more info?

Check Out the WattNext website https://wattnext.ca/

→ Click on Electricity Generation

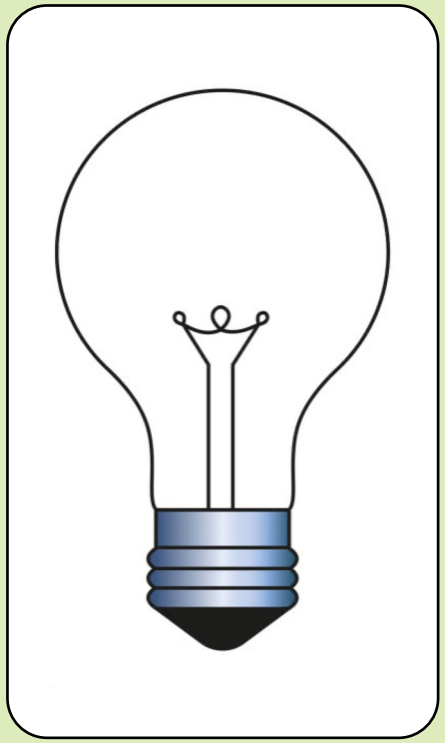




ACTION

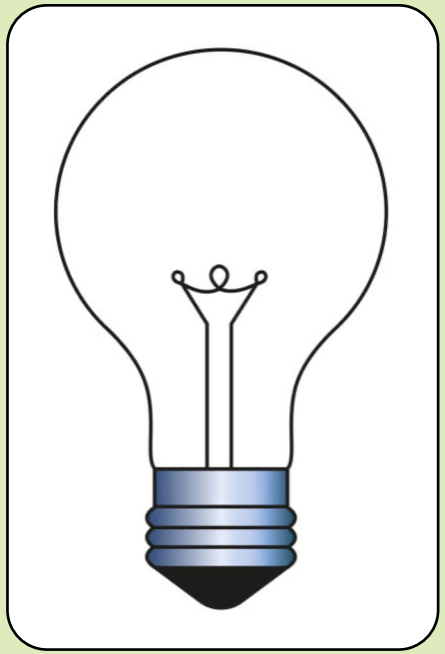
Making a Graphite Light Bulb

The First Light Bulb



- The first light bulbs were incandescent light bulbs.
- **Incandescent light** is produced by heat. The wire, known as a filament, heats up and starts glowing.

The First Light Bulb



HOW?

- Electrical energy travels through a thin filament inside the bulb. As the filament heats up, it produces light. The filament has a high resistance and energy is lost as heat.
- This type of light bulb “burns out” when the filament burns up or breaks, putting a gap in the circuit, stopping electricity from flowing.

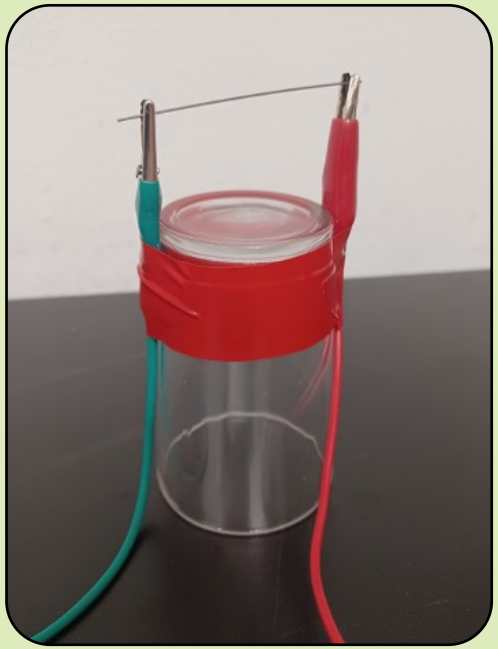
PROBLEM:
What materials could be used that have a high resistance to generate heat and light but do not “burn out” quickly?

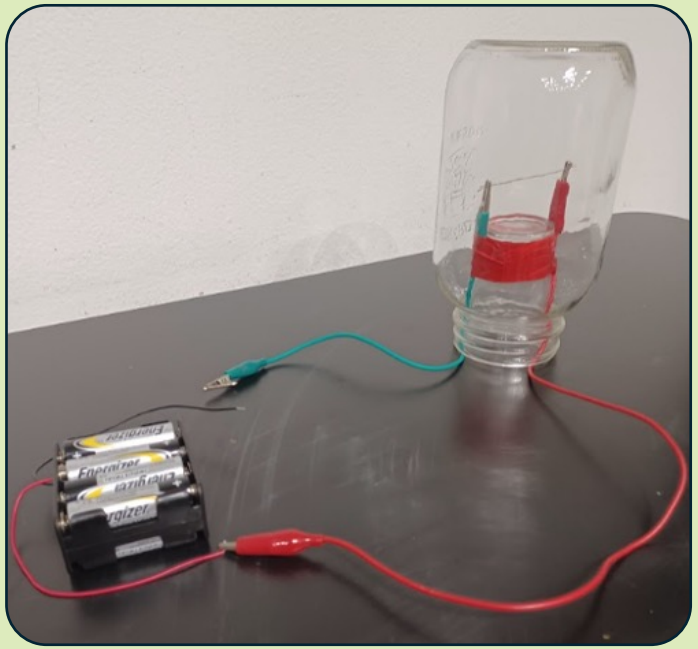
Fun Fact

Thomas Edison didn’t invent the first light bulb...but he did develop the first practical incandescent version for commercial use.

Graphite Light Bulb: Teacher Demo

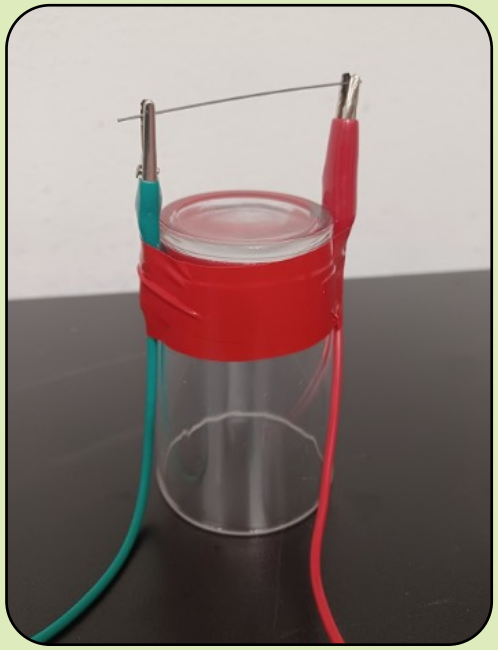
Making a light bulb with pencil graphite





- Don’t forget to dim the lights when you connect the batteries/switch.
- If you’re not working on a heat-resistant surface, a porcelain or glass plate is advised to protect the surface from hot graphite.

Identifying Pros and Cons of this Light Bulb



- What was good about this light bulb? How do you know?
- What could be improved? How would you measure this?

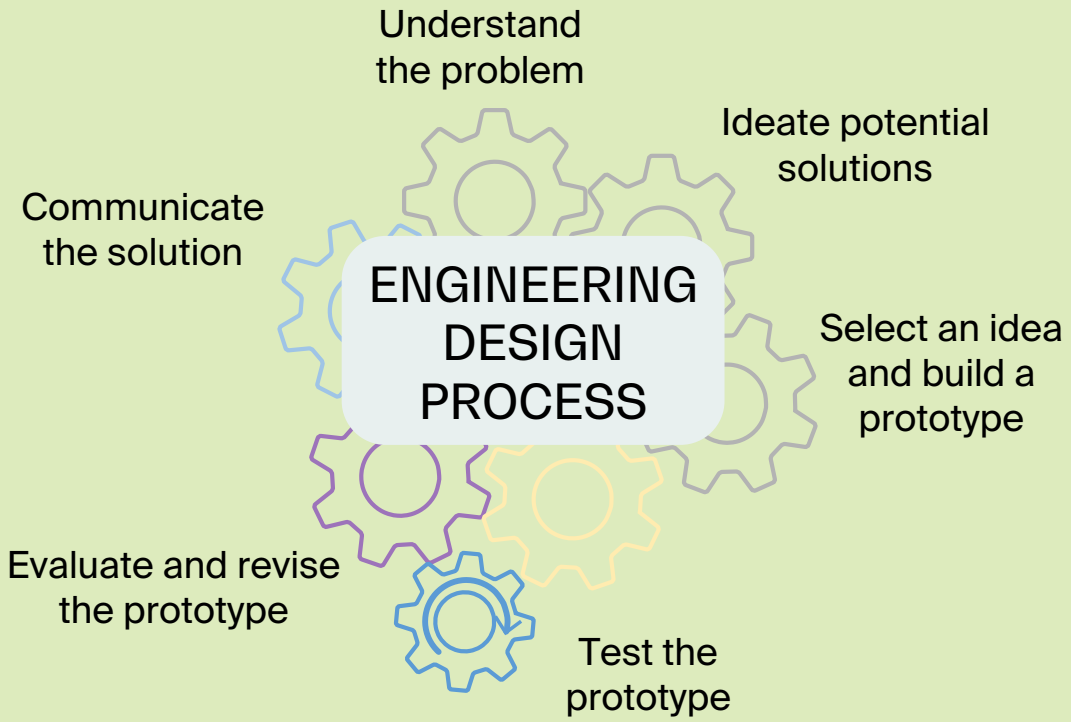
Engineering Design Process

How to make a better light bulb?

IDEATE:

Consider how you could alter the circuit to make the light bulb better.

What will you measure to see if there is an improvement?



Add your observations to the class table

Ideate and Test:

IDEATE: Consider how you will alter the circuit to make the light bulb better? e.g. make the graphite rod smaller		**TEST:** What will you measure to determine improvement? e.g.: brightness, duration	
Group #	**What will you change?**	**What will you measure?**	**Test result**

Making a Better Light Bulb

Test Your Changes – Procedure:

1. Set up your apparatus (Making a Better Light Bulb Student, steps 1-5) with your change.
2. Your teacher will provide you with the batteries.
3. Connect the circuit to the batteries.
4. Record your observations in the class table.

Circuit Troubleshooting

Circuit not working? Double check:

- [ ] All the connections are intact
- [ ] Batteries are working
- [ ] Batteries are all facing the same direction/properly installed in holder
- [ ] Graphite is not broken

Conclusion: Class discussion

- Which changes showed an improvement over the original design?
- Identify one change and, using your knowledge of electricity, explain why the results changed (better or worse).
- If time and materials allow, what other changes might you make to improve the light bulb?

Optional Extension Activity

Thought Lab

There are several types of light bulbs: incandescent, halogen, CFL and LED. How could you compare how much energy is lost as heat with each different type?

- When comparing the light bulbs, what factors should remain constant to ensure your experiment is fair?
- What measurements would you take?
- How would you set up and carry out this experiment?
- Can you use this information to rank the efficiency of different types of light bulbs?