



Engineering:

Introduction to Engineering Principles

Background Information: Engineering is all about solving problems and building things to make our lives better. Engineers use science and math to design and create everything from bridges and cars to clean water systems and electrical circuits. By doing fun and simple projects like building a strong bridge, making a wind-powered car, creating a water filter, and building a simple circuit, you can learn how engineers think and work. These activities help you understand important engineering ideas and show you how you can be an engineer too!

September 5: Building a Strong Bridge

Objective:

Youth will learn about structural engineering by building a bridge and understanding the importance of design and materials in creating strong structures.

Engineering Principles:

Load distribution: Understanding how weight is spread across the structure.

Tension and compression: Learning how forces act on different parts of the bridge.

What you will need:

- Popsicle sticks
- Glue (hot glue recommended with supervision)
- String
- Small weights (e.g., coins or washers)
- Recycled materials (e.g., cardboard, plastic containers)

What you will do:

1. Introduction to Bridges:
 - a. Discuss different types of bridges (e.g., beam, arch, suspension) and how they support weight.
 - b. Explain how engineers design bridges to distribute load and handle tension and compression.
2. Designing the Bridge:
 - a. Give youth time to sketch their bridge design using popsicle sticks and recycled materials.



- b. Encourage them to think about how they will distribute weight and where the tension and compression will be.
3. Building the Bridge:
 - a. Have youth construct their bridges using popsicle sticks and glue.
 - b. Use string to add additional support, mimicking suspension bridges if desired.
4. Testing the Bridge:
 - a. Place small weights on the bridge to see how much it can hold before collapsing.
 - b. Discuss the results and what design elements contributed to the bridge's strength or weakness.

Debriefing

- What part of your bridge held up the best under weight?
- How did adding string support change the strength of your bridge?
- What would you change in your design to make the bridge stronger?



September 12 Building a Wind-Powered Car

Objective

Youth will explore mechanical engineering by building a simple wind-powered car and learn about the principles of motion and energy conversion.

Engineering Principles:

Motion: Understanding how force causes movement.

Energy conversion: Converting wind energy into mechanical energy.

What you will need:

- Plastic bottles or cardboard boxes (for the car body)
- Bottle caps or large buttons (for wheels)
- Straws (for axles)
- Skewers or wooden dowels
- Balloons
- Tape
- Scissors

What you will do:

1. Introduction to Wind Power:
 - a. Discuss how wind can be used to move objects, such as sails on a boat or wind turbines generating electricity.
 - b. Explain the basic concept of converting wind energy into mechanical motion.
2. Designing the Car:
 - a. Show youth examples of simple car designs using recycled materials.
 - b. Have youth sketch their own designs, thinking about how the wind will push the car forward.
3. Building the Car:
 - a. Cut the plastic bottle or cardboard box to form the car body.
 - b. Attach straws to the bottom of the car to serve as axles, then insert skewers through the straws.
 - c. Attach bottle caps or buttons to the ends of the skewers to serve as wheels.



- d. Tape a balloon to the top of the car, with the opening facing backward.
4. Testing the Car:
 - a. Blow up the balloon and release it to see how far the car travels.
 - b. Experiment with different balloon sizes and car designs to see what works best.

Debriefing

- How did the size of the balloon affect the distance your car traveled?
- What changes did you make to your car design to improve its performance?
- How does wind energy make the car move?



September 19 Building a Water Filtration System

Objective

Youth will learn about environmental engineering by creating a simple water filtration system and understanding the importance of clean water.

Engineering Principles:

Filtration: Understanding how materials can remove impurities from water.

Environmental impact: Learning the importance of clean water and sustainable practices.

What you will need:

- Plastic bottles
- Coffee filters
- Sand
- Gravel
- Activated charcoal (optional)
- Dirty water (e.g., water mixed with soil)
- Scissors
- Rubber bands

What you will do:

1. Introduction to Water Filtration:
 - a. Discuss the importance of clean water and how engineers design systems to filter water.
 - b. Explain the basics of how filtration works to remove particles and impurities.
2. Designing the Filter:
 - a. Cut the bottom off a plastic bottle to create a funnel shape.
 - b. Show youth how to layer different materials (sand, gravel, charcoal) inside the bottle to create a filter.
3. Building the Filter:
 - a. Place a coffee filter inside the bottle neck and secure it with a rubber band.
 - b. Layer the materials inside the bottle in the following order: gravel, sand, and charcoal (if available).
 - c. Pour dirty water through the filter and observe the filtration process.
4. Testing the Filter:



- a. Collect the filtered water and compare it to the dirty water.
- b. Discuss the effectiveness of the filter and what could be improved.

Debriefing

- What changes did you observe in the water after it passed through the filter?
- Which materials were most effective in removing impurities?
- How can engineers improve water filtration systems in real life?



September 26 Building a Simple Circuit

Objective:

Youth will explore electrical engineering by building a simple circuit and understanding the basics of electricity and how circuits work.

Engineering Principles:

Electricity: Understanding how electric current flows through a circuit.

Circuits: Learning the components of a simple circuit and how they work together.

What you will need:

- AA batteries and battery holders
- Small light bulbs or LEDs
- Copper wire
- Electrical tape
- Scissors
- Small switches (optional)

What you will do:

1. Introduction to Circuits:
 - a. Discuss how electricity flows and the importance of circuits in powering devices.
 - b. Explain the basic components of a circuit: power source (battery), conductor (wire), and load (light bulb).
2. Designing the Circuit:
 - a. Show youth a simple circuit diagram and explain how the components connect.
 - b. Have youth sketch their own circuit design.
3. Building the Circuit:
 - a. Connect the battery holder to the AA battery.
 - b. Attach one end of the copper wire to the positive terminal of the battery holder and the other end to the light bulb.
 - c. Connect another wire from the light bulb back to the negative terminal of the battery holder.



- d. Secure connections with electrical tape and test the circuit by ensuring the light bulb lights up.
4. Adding a Switch (Optional):
 - a. Insert a small switch into the circuit by connecting it between one of the wires.
 - b. Show how the switch can open and close the circuit, turning the light bulb on and off.

Debriefing

- What happened when you completed the circuit?
- How did adding a switch change the way your circuit worked?
- What other devices use similar circuits to work?