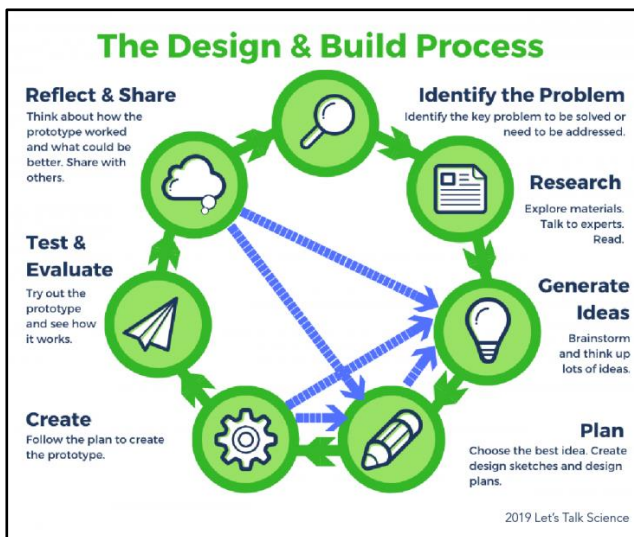


STEMterprise Stage 2: Grade 4 Machine Challenges

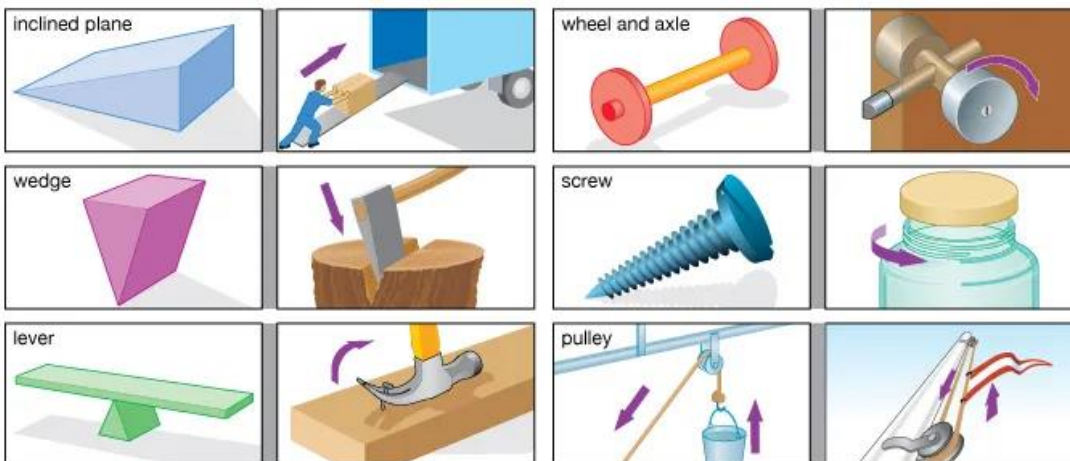


YOUR MISSION is to create and improve a
water well, a flour mill, and a food chain
Ozobot path.



Use the Engineering Design Process to learn about simple machines and food chains.

Go to the challenge your teacher has instructed you to complete.



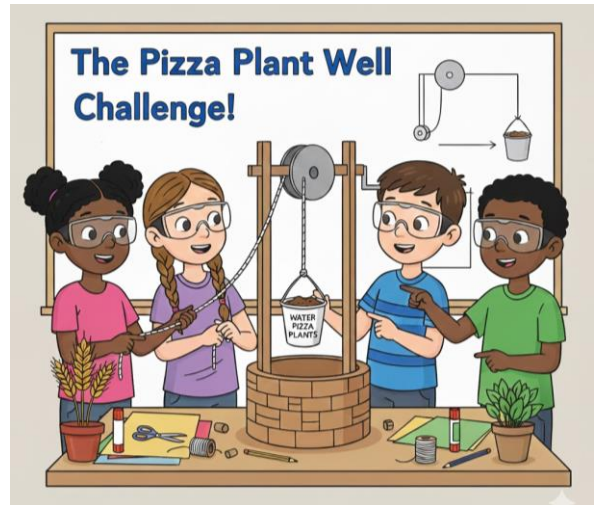
Machine Challenge 1: Pizza Pulley Power

Scenario: Grade 4 Farmers! You have time-travelled 200 years to 1826 and your family has moved to Ontario from Europe. You want to grow grain on your family farm and need a working well to water your plants.

Your Challenge: Design, build, and test a pulley system to lift a bucket of water from a well so you can water your pizza plants.

Materials:

For this activity, you will need at least:



- Pulleys - could be small spools, bottle caps, or purchased
- Cardboard or wood pieces
- String
- Skewers or paper dowels
- Small paper cup (bucket)
- Sand, washers or pennies for the load

- Scissors
- Ruler
- Fastener options
 - Pipe cleaners
 - Glue
 - Tape
 - Paper clips
 - elastics

Your Task:

1. **Build a Well** - use cardboard or pieces of wood to build a frame that stands tall enough so the “bucket” can be lifted (at least 30 cm tall). Identify where your pulley system will be attached to the frame.
2. **Design the Pulley System:**
 - a. Test how heavy your load (pennies/washers) feels by lifting it with the string.

b. Sketch your pulley system.

c. Decide how many pulleys you will use and if they will be fixed (attached to the well) or moveable (attached to the bucket)

3. Build and Test:

a. Attach your pulley to the well frame using axles (skewers) and fasteners.

b. Thread the string through the pulley and attach one end to your bucket.

c. Lift the load using only the string and your hand. Note how difficult it is.

d. Now use the pulley system to lift the load.

4. Evaluate and Reflect: Did the pulley system make the job easier? Why did your system provide a mechanical advantage?

Success Criteria:

- Did you successfully lift the entire load of “water” to the top of the well?
-

You can use the box below to brainstorm and design.



Machine Challenge 2: Grain Grinding Gear



Scenario: Grade 4, Engineers! The Miller family needs your help. They have a small farm and grow beautiful wheat, but grinding it into **flour** is hard work! They are currently using a small hand-crank that is too slow and requires too much effort. They've learned that **gears** can help make work easier by changing the **speed** or the **force** (mechanical advantage).

Can you help them by creating a prototype to make the grinding process faster and more efficient?

Your Challenge: Design, build, and test a simple **Flour Mill** that uses a gear system to significantly increase the rotational speed of a small grinding mechanism when a user turns a single, large input handle. Think about what you've learned about mills and gears as you plan your design.



Materials:

For this activity, you will need at least:

- | | |
|--|---|
| <ul style="list-style-type: none">● Gears<ul style="list-style-type: none">○ Knex (if available)○ Cardboard (alternative to K'nex) -see this link on how to make cardboard gears, and this gear template● Cardboard box/cardboard for mill● Skewers, dowels, plastic straws, bottle caps, corks - for axles and | <ul style="list-style-type: none">● Paper cup● Fasteners:<ul style="list-style-type: none">○ Tape (masking & clear)○ Hot glue (with teacher supervision)○ Elastics● Scissors● Hole punch |
|--|---|

crank ● Testing grain ○ Wheat berries, cereal, oatmeal, pearl barley etc.	● Ruler ● Pencil
--	---------------------

1. **Research:** Think about what you saw in the video about gears in the old flour mill. Look for images of gears used in wooden flour grinding mills and these K'nex links for inspiration for your ideas and design: [Gristmill K'nex Instruction](#), K'nex [waterwheel](#) and [waterwheel challenge](#) with a millstone. See this [cardboard gear image](#) for reference.
2. **Ideas and Plan:**
 - a. Draw your prototype showing at least three gears: the largest connected to the handle, the smallest connected to the grinding cup.
 - b. Create your gears if you are using cardboard and skewers.
 - c. Gather your gears and axles if using K'nex.
 - d. If you are challenged to include a grinder to your gears, focus on the gears working together and how they can connect to your 'mill'.
3. **Create:**
 - a. Build the frame of your mill.
 - b. Mark the points the gear axles will pass through.
 - c. Attach the gears. You will need a small, medium and a large gear working together.
4. **Test and Evaluate:**
 - a. Turn your crank slowly.
 - b. Observe if your gears are spinning faster than the handle.
 - c. Can you simulate grinding grain into the cup?

Reflect and Share:

Did your gears work together? Did the prototype successfully grind or crush the "grain?"

You can use the box below to make notes, brainstorm and design.

Machine Challenge 3:

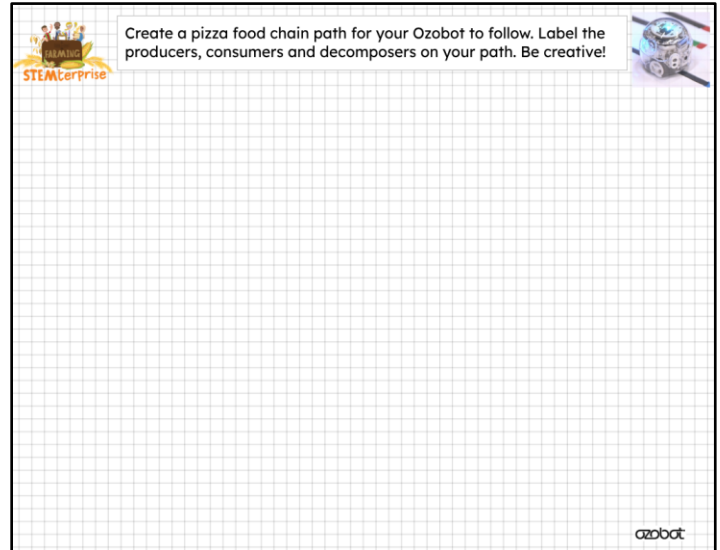
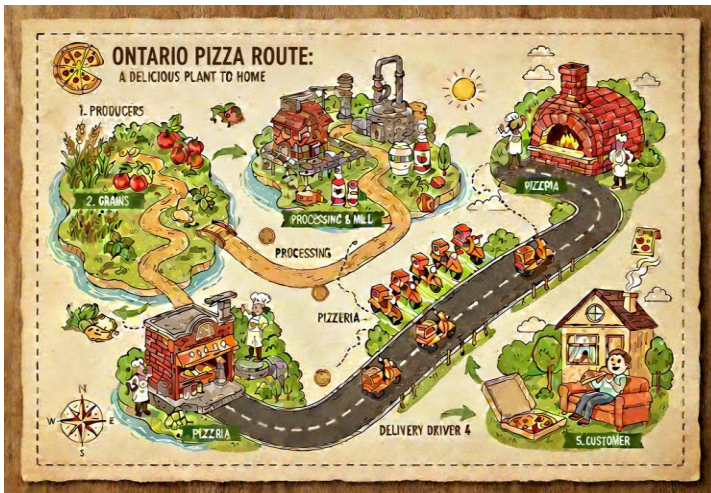
Ozobot Food Chain Challenge

Your Challenge: Create a pizza food chain for your Ozobot to follow. Include some special moves like a tornado, spin, or zig zag. Be creative.

Materials:

For this activity, you will need at least:

● Ozobots ● Ozobot Colour Code Guide ● Markers	● Ozobot Pizza Food Chain doc - printed ● Pencil
--	--



Success Criteria:

- Your food chain includes producers, consumers, and decomposers.
- Your Ozobot successfully follows the path from producer to decomposer.
- Your Ozobot made some creative moves along the path.

Additional Resource:

- Optional [Ozobot Food Chain Lesson](#)

You can use the box below to brainstorm and design.



