APPLE

DESIGN A HANDS-FREE HARVEST CONTAINER

PROBLEM:

Apple harvesting is completed by climbing a ladder, hand picking, and filling bags that are carried over the shoulder.

CHALLENGE:

Design a machine/container to reduce overall harvest time and make it easier for workers.

Suggested Materials

- Fabric pieces
- Paper
- Tape or glue
- Yarn
- Popsicle sticks
- Other recycled materials

QUESTIONS TO CONSIDER:

- How will you keep the apples from bruising?
- How tall is an apple tree?
- How can this reduce worker fatigue from carrying heavy bags, climbing up and down ladders, etc.?

Fun Fact

The largest apple ever picked from a tree was grown by Chisato Iwasaki in Hirosaki City, Japan. It weighed 4 pounds 1 ounce!

BEHIND THE SCENES:

Apple blossoms grow in clusters that will then mature into apples. Harvesters have to carry the bags with them and climb ladders to reach the apples, picking the apples one at a time. Once the bags are heavy and full, they climb down the ladder and carefully empty their bags into containers that are attached to a tractor.

BUILD A CATTLE FENCE

PROBLEM:

Beef cattle need some room to move around and graze.

CHALLENGE:

Design a sturdy fence to keep cattle in a grassy area.

Suggested Materials

- Popsicle sticks
- Rubber bands
- Pencils
- Tape or glue
- Paper
- Wire
- Yarn or string

QUESTIONS TO CONSIDER:

- What materials will withstand different types of weather the best?
- Can you calculate the perimeter of fencing you need?
- What if the grassy area is not all flat land?
- How will the farmers and the cattle get in and out of this fenced area?

Fun Fact

11 basketballs, 144 baseballs, or 20 footballs can be made from one cowhide!

BEHIND THE SCENES:

There are many ways to raise beef cattle. Farmers use fencing to keep their animals contained and safe from predators and other dangers. In order to keep these large animals in, fences need to be strong, long-lasting, and reliable.

CORN

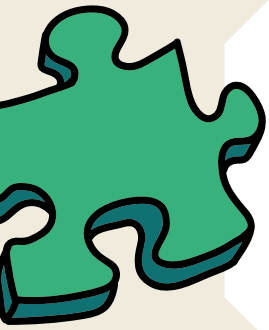
MAKE A NON-NEWTONIAN LIQUID

PHENOMENON:

The molecules in all states of matter (solid, liquid, and gas) behave differently, which changes the physical properties.

Materials

- Bowl
- Fork
- Water
- Cornstarch
- Measuring Spoons
- Food Coloring



CHALLENGE:

Make a type of slime that behaves like a solid AND a liquid!

INSTRUCTIONS:

- Place 4 teaspoons of cornstarch in a bowl.
- Add 2 teaspoons of water to the cornstarch.
- Add a few drops of food coloring to the bowl (optional).
- Blend the mixture with a fork. It should flow when the bowl is tipped but feel solid to the touch. Add water or cornstarch as necessary.
- Play and have fun!

Fun Fact

An acre of corn will give off 4,000 gallons of water in the form of evaporation per day!

BEHIND THE SCENES:

Although Oobleck looks like a liquid, it does not always behave a liquid. Oobleck is a "non-Newtonian" type of fluid. Non-Newtonian fluids respond differently depending on how quickly you try to move it around. When a force is acted on Oobleck quickly, it will behave like a solid because the pressure forces all the particles of the corn starch together. When the force is slower, the particles of the corn starch have time to move around the object, just as a normal Newtonian liquid would.

DAIRY

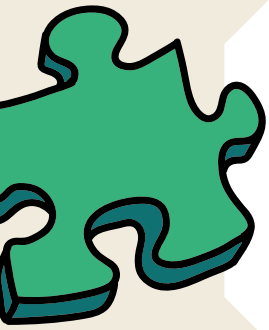
MAKE MILK PLASTIC

PHENOMENON:

Milk contains proteins that are sensitive to different materials that affect their behavior.

Materials

- 1 cup milk
- 4 tbs white vinegar
- Small bowl
- Spoon
- Strainer
- Paper Towels
- Microwave
- Cookie cutters



CHALLENGE:

Turn the proteins in milk into a plastic-like material.

INSTRUCTIONS:

- Add 1 cup of milk to a microwaveable bowl and microwave for 1.5 minutes.
- Stir in 4 tablespoons of white vinegar; stir for 1 minute. The milk will start to form clumps!
- Pour into a strainer. Use your spoon to push the liquid out.
- Transfer to a paper towel and continue to press out the liquid.
- Mold the plastic into a shape by hand or with a cookie cutter.
- Set the formed plastic aside and let it dry for 2 days.

Fun Fact

The greatest amount of milk produced in 1 year was in 1993 by a Holstein cow named Robthom Suzet Paddy who produced over 59,000 lbs. of milk!

BEHIND THE SCENES:

This activity doesn't produce an actual plastic, but instead a substance called casein. Casein comes from the Latin word meaning "cheese" and is one of the several proteins that are found in milk. The acid from the vinegar does not mix with the casein in the milk, causing clumps to form. Basically your end product, the milk "plastic", is the casein proteins from the milk all clumped together.

HORSE

ENGINEER A WALKING PAPER HORSE

PHENOMENON:

Gravity and force can cause objects to change from potential energy into kinetic energy.

CHALLENGE:

Engineer a paper horse that walks on its own down an incline.

Materials

- 1 sheet construction paper
- Ruler
- Scissors
- Pencil
- Materials to build a ramp/incline

INSTRUCTIONS:

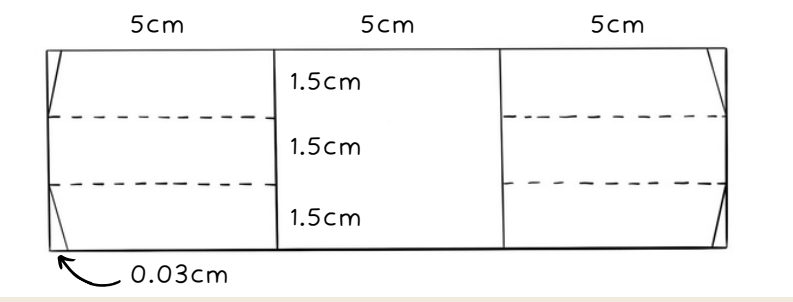
- On the sheet of construction paper, use the ruler to draw the dimensions of the horse template.
- Cut the around the perimeter of the rectangle and on the dotted lines. Then cut the small triangles off the four corners.
- Bend the 'legs,' 'tail,' and 'head' so that the rectangle looks like a horse.
- Build your ramp and place your horse at the top. Give it a small push and see if it walks!
- If your horse doesn't move, how can you bend the paper so that it starts walking? Is there too much or not enough friction on your ramp?

Fun Fact

A horse has larger eyes than any other land animal except the ostrich!

BEHIND THE SCENES:

The horse moves by rocking back and forth on the curved feet like a rocking chair. As the horse rocks to the left, the feet on the right are lifted from the ramp and move forward. The same thing happens to the left feet when the horse rocks to the right.



DESIGN A BOAT SYSTEM

PROBLEM:

Flatboats that use rivers to import and export products can get stuck in shallow waters.

CHALLENGE:

Design a boat or system that can help boats get through shallow waters without getting stuck.

Suggested Materials

- Foil
- Paper
- Tape or glue
- Paper clips
- Other recycled materials

QUESTIONS TO CONSIDER:

- Will the river always be shallow in the same places?
- Are all boats the same shape and length?
- Will the products on the boat be prevented from spilling?

Fun Fact

Abraham Lincoln is the only president to hold a patent!

BEHIND THE SCENES:

In Lincoln's time, river transportation was extremely important to the economy. But the rivers in IL were wide and shallow, and boats were quick to get stuck on sandbars. This made river journeys extremely dangerous. Thanks to changes in technologies, the rivers in IL today can be more easily and safely navigated by enormous barges of goods with the help of our vitally important lock and dam systems throughout the state.

PIZZA

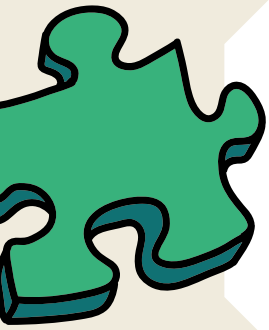
BUILD A SOLAR OVEN

PHENOMENON:

Heat and light from the sun can be converted into energy.

Materials

- Cardboard pizza box
- Aluminum foil
- Black construction paper
- Clear kitchen plastic wrap
- Scissors
- Glue
- Stick or pencil



CHALLENGE:

Build an oven that can use the light and heat energy from the sun to cook food.

QUESTIONS TO CONSIDER:

- Which materials are better for reflecting the sun's light and heat?
- How can you keep the heat from escaping the box?
- What if the sun changes angles because of time or season?

Fun Fact

Naples, Italy is the "Pizza Capital of the World"!

BEHIND THE SCENES:

Different materials and colors can reflect or trap heat (thermal) and light energy that is emitted from the sun. The light energy is reflected from the foil, and the plastic wrap traps the heat in the box, causing the temperature inside the box to increase.

BUILD A BEE HOTEL

PROBLEM:

Natural habitats for native Illinois bees are decreasing because of a variety of causes.

CHALLENGE:

Build a bee hotel to help protect bee populations.

Materials

- Empty, clean aluminum food can with lid removed
- Cardboard and bamboo bee tubes
- Pinecones, bark, small twigs, etc.
- Wire and wire snips
- Paint supplies

QUESTIONS TO CONSIDER:

- What habitats do native IL bees prefer?
- Where will you place the bee hotel?
- What type of foliage would be best to include?

Fun Fact

There are 400-500 native bee species in Illinois that need habitats to raise their young!

BEHIND THE SCENES:

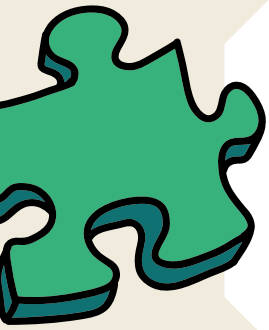
All bees need a place to lay their eggs so that their larvae and pupae can safely develop into the next generation of bees. Bee populations are incredibly important in the process of pollination for many different plants. It is estimated that one in every three bites of food is only available because of the hard work of pollinators.

PORK

DESIGN A PIG BARN

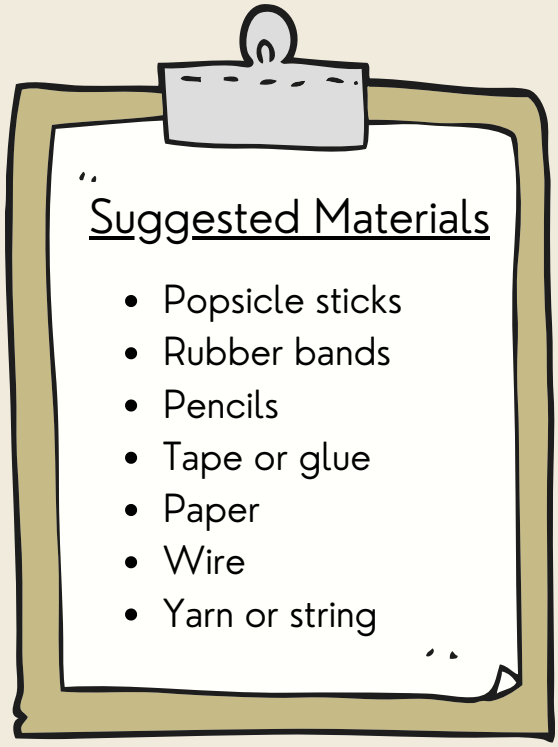
PROBLEM:

Pigs need a healthy, clean, warm place to be raised.



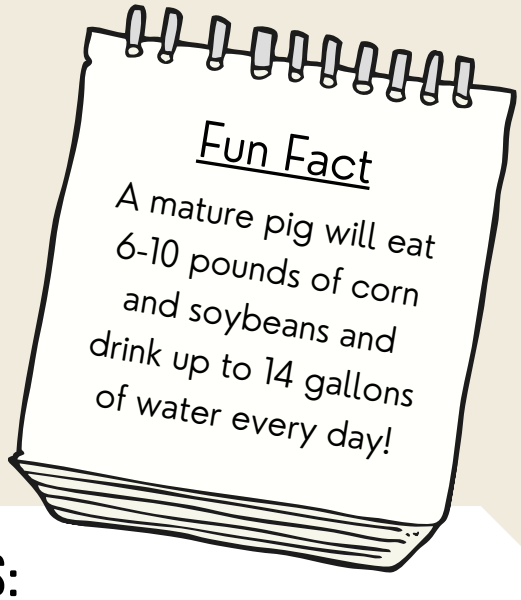
CHALLENGE:

Design a pig barn that meets the needs of pigs.



QUESTIONS TO CONSIDER:

- How will the pigs stay warm?
- Where will the food be stored?
- How will the pigs get food and water?
- Do pigs of all ages stay in same place?



BEHIND THE SCENES:

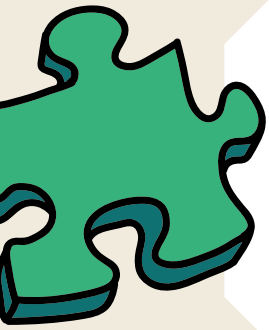
Keeping the pigs in barns keeps them out varied weather conditions and away from predators and harmful infections and diseases. Barns are kept at a constant comfortable temperature and humidity. Pigs don't have sweat glands and can easily overheat. They are also very sensitive to cold temperatures.

DESIGN A BETTER EGG CARTON

PROBLEM:

Eggs are fragile and can easily crack in cartons during transport to store shelves and to our homes.

CHALLENGE:



Design an egg carton that minimizes chances of eggs cracking.

Suggested Materials

- Cardboard
- Foam
- Bubble Wrap
- Paper
- Tape or glue
- Fabric pieces
- Yarn

QUESTIONS TO CONSIDER:

- Does the shape of the egg affect the position when in the carton?
- Will your carton work for different sized eggs?
- Is it easy to add and remove eggs from the carton?

Fun Fact

Illinois has over 5 million chickens that produce nearly 128 million dozen eggs each year!

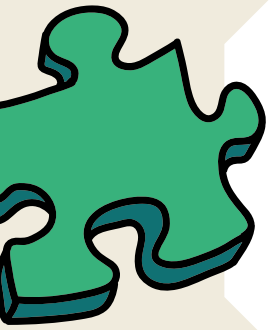
BEHIND THE SCENES:

Egg shells are made up of calcium carbonate which protects the components inside the egg while the chick is developing. While it offers protection, it is also fragile enough to allow chicks to break through when they are hatching. Don't worry, the eggs we buy in the store are not fertilized.

DESIGN A MODEL CATAPULT

PROBLEM:

Farmers must be able to efficiently harvest their pumpkins or the crop will go to waste in the field.



CHALLENGE:

Design a catapult model that will launch pumpkins specific distances.

Suggested Materials

- Large popsicle sticks
- Rubber bands
- Plastic spoon
- Small pumpkin-shaped candy
- Container or bin to launch object into

QUESTIONS TO CONSIDER:

- How can you make the catapult launch an object further in distance?
- What can you do if the object is being launched too far?

Fun Fact

The largest apple ever picked from a tree was grown by Chisato Iwasaki in Hirosaki City

BEHIND THE SCENES:

Most pumpkins in Illinois are used for processing into canned pumpkin that we use for cooking. Farmers use a variety of machines to harvest their pumpkins and deliver them to the processing plant quickly and efficiently. This process can take as little as 2 hours from field to can!

FARMERS MARKET

DESIGN A DESKTOP GREENHOUSE

PROBLEM:

Fruits and vegetables have certain growing seasons and cannot be grown year round because of decreased temperatures and hours of daylight.

CHALLENGE:

Design a small greenhouse that can grow plants all year round.

Suggested Materials

- Clear plastic cups
- Plastic wrap
- Popsicle sticks
- Tape or glue
- Paper
- Other recycled materials
- LED lights and coin cell batteries

QUESTIONS TO CONSIDER:

- What shape is best for the plants you want to grow?
- What if the temperature gets too hot inside your greenhouse?
- How will you water your plants once they're inside the greenhouse?

Fun Fact

Illinois ranks #3 in the nation for the number of farmers markets!

BEHIND THE SCENES:

Greenhouses allow growers to create ideal growing conditions for their plants to thrive. This is called "protected culture." Growers are able to adjust how much water plants get, as well as the temperature, humidity, and air flow to customize growing conditions for certain types of plants.

CREATE A MINI VERMICOMPOSTER

PROBLEM:

Food waste and other organic materials, like grass clippings and leaves, take up landfill space.

CHALLENGE:

Create a composter that uses worms to naturally decompose food waste.

Suggested Materials

- Plastic cup with lid
- Newspaper scraps
- Construction paper
- Soil or compost
- Red wiggler worms

QUESTIONS TO CONSIDER:

- Can all foods go into the vermicomposter?
- How will the worms get ventilation?
- Should sunlight be able to go through the plastic cup?

Fun Fact

Just one acre of cropland is home to more than 1,400,000 earthworms!

BEHIND THE SCENES:

Around 30-40% of all food in America is thrown away every year. Food scraps and other organic materials will naturally decompose, recycling nutrients back into the soil. Worms are decomposers and help speed up this process while creating healthy soil that is beneficial for plants.

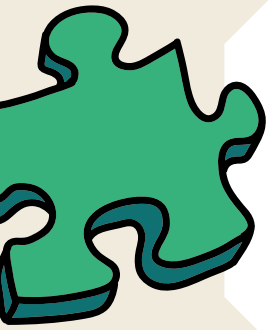
GROW A SOYBEAN PLANT

PHENOMENON:

Plants, like all living things, have basic needs that must be met in order to survive and thrive in their environments.

Materials

- Soybean seeds
- Container to plant seed
- Various types of soils
- Various nutrients and fertilizers (optional)



CHALLENGE:

Grow a soybean seed into a plant.

QUESTIONS TO CONSIDER:

- What does a seed need to germinate?
- What does a plant need to grow?
- Can a plant stay in the same size pot as it grows?
- What things might help the plant grow best?

Fun Fact

Soybeans are good for crop rotation because they leave nitrogen in the soil for the next crop!

BEHIND THE SCENES:

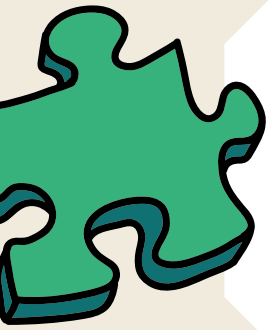
Soybeans are small, round seeds, each with a tiny hilum and made up of three basic parts. Each soybean has a seed coat, cotyledon, and the embryo. Soybean plants generally reach a height of 1 m (3.3 feet) and take 80-120 days from sowing to harvesting. Soybeans, like all plants, require a healthy environment and have specific needs to be able to grow into a full, healthy plant!

URBAN

DESIGN A COMMUNITY GARDEN

PROBLEM:

Interest in gardening continues to increase, but many people don't have access to areas with enough land to grow food.



CHALLENGE:

Design a community garden.

Materials

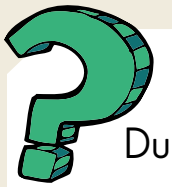
- Paper
- Writing utensils
- Seed catalogs
- Tape measure or ruler

QUESTIONS TO CONSIDER:

- Where could your garden be located?
- Who would use the garden?
- What types of plants could you grow here?
- Who could you share the food with?
- What kinds of work is necessary to keep the garden growing?

Fun Fact

Many crops can be grown without soil. This process, called hydroponics, grows plants using a nutrient-rich water solution!



BEHIND THE SCENES:

During WWI and WWII, Americans were strongly encouraged to grow their own food so more food would be available to send to troops overseas. Nearly 2/3 of U.S. households participated, and by 1943 nearly 40% of the produce consumed in the U.S. was grown in these gardens. These gardens produced a lot of food, but they also helped many Americans feel like they were helping the war effort.

DESIGN A WATER FILTER

PROBLEM:

Many people around the world don't have access to clean drinking water.

CHALLENGE:

Design a filter using common materials that will filter polluted water to make it clean.

Suggested Materials

- Clear plastic bottles
- Coffee filter
- Fabric pieces
- Rocks or pebbles
- Sand
- Mulch or leaves
- Other recycled and/or organic materials

QUESTIONS TO CONSIDER:

- What materials allow water to pass through but not larger pieces in the polluted water?
- What is the best way to layer your materials to achieve the best filtration?

Fun Fact

There are more than 91,000 freshwater lakes and ponds in Illinois!

BEHIND THE SCENES:

Plants, animals, and humans require fresh water to survive. Humans also use fresh water to cook and clean, among many other things. Over 700 million people don't have access to clean water or have the technology to clean it, which can cause a variety of health issues.

WHEAT

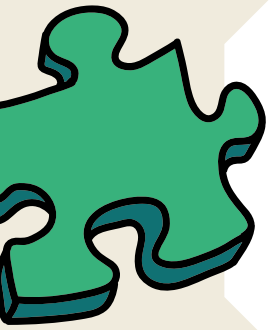
EXTRACT GLUTEN

PHENOMENON:

Gluten is a protein in the kernel, or seed, of the wheat plant that is used to make flour.

Materials

- Various types of flour
- Water
- Bowls
- Spoons



CHALLENGE:

Extract gluten from bread dough.

QUESTIONS TO CONSIDER:

- Add 1 cup of each flour into separate, labeled bowls.
- Slowly add about 1/2 to 3/4 cup water to the flour in each bowl, and knead each mixture until it forms a soft, rubbery ball of dough. Let the balls of dough sit for about 10 minutes.
- Add a few inches of water to each bowl. Knead the dough in the water. You'll notice the water turning milky as it washes away the starch in the dough. Keep pouring out the cloudy water that collects in the bottom of the bowl and add fresh water.
- When the water no longer becomes milky, there is no more starch in the dough, leaving nearly pure gluten.
- Repeat steps 3 through 5 for each of your flour types.

Fun Fact

You could make 5,000 four-inch cookies or fill 53 boxes of cereal with one bushel of wheat!

BEHIND THE SCENES:

Gluten allows wheat flour dough to change shape and to return back to its original shape. This helps the bread rise because it traps the CO from yeast and expands, making breads light and fluffy, ready to bake.