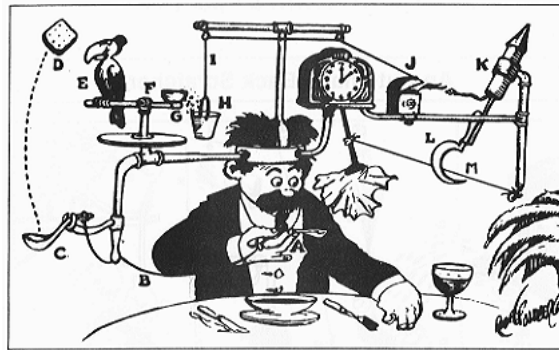




Rube Goldberg Machine Self-Operating Napkin



Rube Goldberg was an engineer and a cartoonist. He became famous for drawing cartoons of people finding complicated ways to do simple tasks. His inventions were based on physics and utilized simple machines. The game *Mousetrap* is an example of a Rube Goldberg machine.

Challenge: to build a Rube Goldberg machine using at least three simple machines

Materials: A variety of materials can be used. Some suggestions: dominoes, ramps, Legos, marbles, etc.

Procedure:

1. Decide what simple task you would like to complete.
2. Make a plan. Draw it out. (Your final product may not look like your original plan.)
3. Collect the materials needed.
4. Begin your build. It may take several times for you to achieve your goal.

Some machine ideas for you to try:

1. Feed your pet.
2. Turn on a light.
3. Turn the page of a book.

For more on Rube Goldberg Machines go to:

https://www.teachengineering.org/activities/view/cub_simp_machines_lesson05_activity1

For a review of simple machines go to: <https://www.vexrobotics.com/vexiq/education/iq-curriculum/simple-machines-and-motion/six-types-of-simple-machines>

Rainbow Walking Water



Capillary action is when a liquid moves up through a solid, much like water going up the stem of a plant. This happens because of adhesion (molecules sticking to an object), cohesion (similar molecules being attracted to each other), and surface tension (the molecules are so tightly packed together, they form a “skin”).

Challenge: to make the colors of the rainbow using capillary action

Materials: seven clear glasses, paper towels, food coloring (red, yellow, blue), scissors

Procedure:

1. Fill four glasses $\frac{1}{2}$ way with water. Leave the other three glasses without water.
2. Place five drops of food coloring in the four glasses with water. i.e. – five drops red in one glass, five drops blue in second glass, five drops yellow in glass three, and five drops red in glass four
3. Arrange glasses so that an empty glass is between each water-filled glass.
4. Roll a piece of paper towel and snip ends.
5. Place paper towel to form a bridge from one glass to another. Make sure the towel is touching the water.
6. Wait. In about an hour, you will begin to see the water “walking” into the empty glasses. Leave overnight to see the full effect.

For more on capillary action go to:

https://kids.kiddle.co/Capillary_action

Deoxyribonucleic Acid Experiment (or Extracting DNA from a Strawberry)



DNA is short for deoxyribonucleic acid. This is the molecule that has the genetic code of all organisms. DNA is in each cell of the organism and tells what the organism will look like.

Challenge: to extract the DNA from a strawberry

Materials: three strawberries, dish soap, salt, rubbing alcohol, coffee filter, plastic spoon, measuring cup, measuring spoons, water, baggie, bowls, funnel

Procedure:

1. Chill the alcohol in the freezer.
2. Mix $\frac{1}{2}$ teaspoon of salt, $\frac{1}{3}$ cup of water and 1 tablespoon of dishwashing liquid in a small bowl. Set aside. This is your extraction liquid.
3. Remove the green stems from the strawberries. Put the strawberries into the baggie, remove the excess air, seal the bag tightly and mash the strawberries into a pulp. Be careful not to pop the baggie.
4. Add three tablespoons of the extraction liquid to the strawberries in the baggie. Once again, push out the excess air before sealing.
5. Squeeze this mixture with your fingers for one minute.
6. Line the funnel with the coffee filter.
7. Pour the mixture from the baggie into the lined funnel. Let the liquid drip into a glass.
8. Measure $\frac{1}{2}$ cup of cold rubbing alcohol.
9. Tilt the glass. Very slowly pour the alcohol down its side. Pour until there is a 1-inch layer of alcohol on top of the strawberry liquid. ***Do not mix.***
10. Soon you will see the strawberries' DNA appear. It looks like a gooey clear/milky white substance.
11. You can spoon it out to examine it better.

For more on DNA go to:

<https://www.scientificamerican.com/article/squishy-science-extract-dna-from-smashed-strawberries/>

Are You a Whorl, Loop, or Arch? An Exercise in Fingerprint Identification



Fingerprints are patterns formed by the ridged skin on our fingertips. Each person has his/her own unique set of prints. Even identical twins have their own prints. Fingerprints are formed in the womb. While they are often thought of as a form of identification, their purpose is to help us grasp objects.

Whorl: consists of circular ridges

Loop: ridges enter from either side, re-curve and pass out the same side they entered

Arch: the ridges enter from one side, rise in the center, and exit on the opposite side

Try This: Hold a piece of paper between your knuckles. Ask someone to pull the paper out. Now, hold a piece of paper using your fingertips. Ask someone to pull the paper again. What was the difference?

Challenge: to identify the type of fingerprints you have

Materials: ink pad or nontoxic paint, white paper, magnifying glass (if available), balloon (optional)

Procedure:

1. Press the top of your thumb onto the ink pad (If you are using paint, put a small amount onto the paper and press your thumb tip into this). For best results, do not use too much ink. Your goal is to have clean lines.
2. Press your thumb tip onto a clean piece of white paper.
3. Examine your print. Which type best describes your print?
4. Optional: To see the best image of your print, partially blow up a light-colored balloon. Press your fingerprint onto the balloon. Blow the balloon up further to see the intricate details of your print.

Extend the activity: Dusting for Fingerprints

Go to: <https://www.connectionsacademy.com/resources/instructographics/fingerprinting>

The Uniqueness of You



A physical trait is an inherited observable characteristic. Some traits are more common than others. Each individual is a combination of these traits.

Examples

Trait	Frequency in General Population
Tongue rolling	Can roll tongue – 70% Cannot roll tongue – 30%
Handedness	Right-handed – 93% Left-handed – 7%
Hand Clasping	Left thumb on top – 55% Right thumb on top - 44% No preference – 1%

Which traits do you have? An Inventory of My Traits – Survey*

1. I have detached earlobes.	Yes	No
2. I can roll my tongue.	Yes	No
3. I have dimples.	Yes	No
4. I am right-handed.	Yes	No
5. I have freckles.	Yes	No
6. I have naturally curly hair.	Yes	No
7. I have a cleft chin.	Yes	No
8. I have allergies.	Yes	No
9. I cross my left thumb over my right when I clasp my hands together.	Yes	No
10. I can see the colors red and green. (I am not color blind.)	Yes	No
11. The hairline on my forehead is straight.	Yes	No
12. I am a:	Male	Female

*Survey taken from: *An Inventory of My Traits – Genetic Science Learning Center*

Total Cereal “Eating Nails for Breakfast”



Total cereal is advertised as having “all the wholesome goodness of whole grain wheat flakes with 100% of the Daily Value of at least 11 vitamins and minerals.”

This includes 100% of the recommended daily intake for the mineral, iron.

Challenge: to separate and see the iron in *Total* cereal

Materials: iron fortified cereal (must have 100% of the RDA – recommended daily allowance) for iron (*Total* cereal works best), baggie, very warm water, strong magnet, rolling pin (optional)

Procedure:

1. Put a cup or two of cereal in a baggie. Partially seal the baggie so that the air can escape. Crush the cereal by squeezing it. You may wish to roll over it with a rolling pin. Be careful not to pop the baggie.
2. Add very warm (not boiling) water. Put enough water in to make the mixture soupy.
3. Wait about an hour.
4. When ready, slowly rub the magnet in small circle on the *outside* of the baggie. It may take a few minutes, but soon you will see a dark spot form by the magnet. This dark spot is the collection of iron in the cereal that is attracted to the magnet.
5. Have fun moving the magnet around as you watch the iron follow it.

For more on extracting iron from cereal go to:

<https://www.stevespanglerscience.com/lab/experiments/eating-nails-for-breakfast/>

Trash to Treasure
Reduce, reuse, recycle and repurpose!

Shoebbox Foosball



Challenge: to repurpose materials

Materials: shoebox (the narrower, the better), dowels or wooden skewers, 10 clothespins (preferred) or plastic spoons, ping pong ball

Procedure:

1. Carefully cut two openings at either end of the shoebox.
2. Measure hole placements and carefully poke holes for dowels. Make adjacent holes on the other side of the box. Make sure the holes are high enough so that the clothespin players have room to spin.
3. Color the dowels in two different colors to be able to differentiate teams.
4. Color the clothespins to match the dowels. If spoons are being used, secure them to the dowels. Be sure the bowl of the spoon is down.
5. Optional: Decorate the bottom of the box to resemble a field.
Add paper players to the clothespins.

Ball in Cup



Challenge: to repurpose materials

Materials: plastic soda bottle, string, aluminum foil

Procedure:

1. Carefully cut the bottom off a plastic soda bottle.
2. Keep the top and recycle the bottom.
3. Tie a long cord around the neck of the bottle.
4. Make an aluminum foil ball and attach the cord to it.
5. Test your skill! How many catches can you get in a row?

The Incredible Bouncing Egg



You've heard of rubber chickens, why not rubber eggs?

The outer layer of an egg, the eggshell, is made from calcium carbonate. The next layer is made up of shell membranes. Their job is to keep bacteria from entering the egg. Vinegar is an acid. When the eggshell is dissolved, the membranes are visible.

Note: *Please remember to wash your hands after handling raw eggs.*

Challenge: to see the effect of an acid on calcium

Materials: egg (can be raw or hard boiled), clear glass, white vinegar, flashlight (optional), food coloring (optional)

Procedure:

1. Gently place the egg into a clear glass.
2. Add enough vinegar to completely cover the egg. You should immediately see tiny bubbles surrounding the egg.
3. Leave the egg in the glass for 24 hours.
4. Gently remove the egg from the glass and change the vinegar. Return the egg to the new mixture and let it sit for another 2 days.
5. Remove the egg from the vinegar. Rinse and pat it dry. The membranes should now be rubberized. You can *gently* bounce the egg on a counter. Try not to bounce the egg too vigorously! It will break and the inside of the egg is still raw.

Extend the Activity:

1. Darken the room. Using a flashlight, shine the light under the egg. The egg will appear to glow.

or
2. Put in a generous amount of food coloring after pouring the vinegar into the glass. The result is a colorful, rubber egg!

For more on how to make a bouncing egg go to:

<https://www.stevespanglerscience.com/lab/experiments/naked-egg-experiment/>

What is Energy? Interactive Skatepark Simulation



Energy is the ability to do work. What effect do the forces of energy have? Use this interactive skatepark simulation to learn the difference between kinetic and potential energy, the role friction has in motion, and how thermal energy is produced.

To enjoy the skatepark go to:

https://phet.colorado.edu/sims/html/energy-skate-park-basics/latest/energy-skate-park-basics_en.html

Solar Pizza Box Oven



Challenge: to build a workable solar oven

Materials: pizza box, ruler, black marker, box cutter or utility knife, heavy duty aluminum foil, page protectors or plastic wrap, glue, tape, scissors

Procedure:

For detailed directions on how to build the pizza box solar oven go to:

<https://www.stevespanglerscience.com/lab/experiments/solar-oven/>

To make solar s'mores go to:

<https://www.littlepassports.com/blog/food/solar-oven-smores/>