

Teacher Resources

You - The Inside Story



Table of Contents

Animal Senses (<i>Grades K-2</i>).....	1
Lung Capacity Challenge (<i>Grades K-2</i>).....	3
Cats' Eyes (<i>Grades 3-5</i>).....	4
Supersize Fingerprints (<i>Grades 3-5</i>).....	6
Biomedical Building Challenge (<i>Grades 6-8</i>).....	8
To The Point (<i>Grades 6-8</i>).....	11

Animal Senses

Grades K-2

Objective

- To explore how a human's sense of smell and hearing are similar to animal senses.

Materials, per class:

- One small container with a lid per student, such as a film canister or spice shaker
- Three different food extracts or scented oils
- One cotton ball per student

For Extension:

- One small opaque container with a lid per student
- Assorted sound making materials, such as:
 - Pennies
 - Paper clips
 - Rubber bands

Procedure:

1. Before the activity, prepare the scent containers. Put one cotton ball in each container.
2. Divide the containers into three sets, each with its own scent. Put a few drops of a scent on each cotton ball and snap on the lids.
3. Choose three 'pack leaders'. Give each pack leader a container with a different scent and have them stand in different corners of the room.
4. Mix up the remaining scent containers and distribute them to the remaining participants.
5. Have everyone except the pack leaders walk around the room and try to identify which pack leader has the same scent as they do.

Extension:

- Create another set of containers except, instead of different smells, create different sounds by adding pennies, paper clips, or rubber bands to the containers.
- Repeat steps 2-3 from the above procedure using a new sense to find the correct pack leader.

Science Concepts:

Smelling and hearing are two important senses that animals, including humans, use to gather information about the world around them. Special parts in your nose detect chemicals in the air and send information about those chemicals to your brain. Your brain interprets this information as smells, such as the smell of a fire or freshly baked cookies.

The outer part of your ear funnels sound into your inner ear, where nerves carry information about the sound vibrations to your brain. Your brain interprets this information to tell the difference between a sudden loud crash or someone talking.

Animals use smell and hearing to help survive in the wild. Animals use smell to find clean water and food that is safe to eat, to avoid danger, and even to find mates. Many baby animals, such as the mule deer, use their sense of smell to identify and find their mothers.

Many animals use their sense of hearing to communicate with each other. This communication serves many purposes such as attracting mates, warning others of danger, or sharing the location of food sources. For example, frogs croak and crickets chirp to find mates, rattlesnakes shake their rattles as a warning, and birds sing songs to find mates or make calls to sound an alarm. Some bats, whales, and dolphins even use their sense of hearing to navigate the world around them via echolocation.

Animal Senses (continued)

Grades K-2

Curriculum Connections:

Next Generation Science Standards

- 1-PS4-1 Sound can make matter vibrate and vibrating matter can make sound.
- 1-LS1-1 All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.
- 1-LS1-1 Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.

References:

Bradford, A. (2017, October). *The Five (and More) Senses*. Live Science.
<https://www.livescience.com/60752-human-senses.html>

New Hampshire PBS. (2021). *Chemical Communication*. NatureWorks.
<https://nhpbs.org/natureworks/nwep3d.htm>

Lung Capacity Challenge

Grades K-2

Objective

- To explore how lungs are involved in breathing.

Materials, per student:

- Straw
- Cup
- Water
- Timer

For Extension:

- Piece of paper

Procedure:

1. Fill the cup about halfway with water.
2. Insert one end of the straw into the water, take a breath, and blow bubbles into the water.
3. Use the timer and time how long you can blow bubbles without taking an additional breath. Can you blow bubbles for 10 seconds? What about 30 seconds?
4. Notice what you are changing in order to blow bubbles for a longer time.

Extension:

- Run in place or do jumping jacks for thirty seconds. Now, try blowing bubbles in the water again. Is it easier or harder to blow for a long time?
- Instead of water and straws, use a piece of paper against the wall to do the same challenge. Hold the piece of paper against the wall. Stand six to eight inches away and blow as hard as you can. Does the paper stay or fall to the floor? Take another step back and try again. How far can you blow from and keep the paper against the wall?

Science Concepts:

Your lungs are a very important part of your respiratory system. Your lungs allow you to breathe in air that contains oxygen. Every part of your body needs oxygen in order to live.

When you take a deep breath in, your lungs fill up with air, just like a balloon. Your lung capacity, or the amount of air in your lungs, can change as you grow up, so it's important to keep your lungs happy and healthy!

Curriculum Connections:

Next Generation Science Standards:

- LS1.A Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air.

References:

American Lung Association. (2021, March). *How Lungs Work: The Respiratory System*.
<https://www.lung.org/lung-health-diseases/how-lungs-work>

Cats' Eyes

Grades 3-5

Objective

- To construct a simple eye model to demonstrate the occurrence of eyeshine when certain animals are in the dark.

Materials, per student:

- Toilet paper tube
- 2 thin rubber bands
- 4-inch square of aluminum foil
- 4-inch square of black construction paper
- Scissors
- Flashlight

For Extension:

- 4-inch square of aluminum foil
- Red permanent marker

Procedure:

1. Wrap the aluminum foil around one end of the toilet paper tube with the shiny side facing in. Secure with a rubber band.
2. Cut a $\frac{1}{2}$ inch diameter circle in the center of the black paper.
3. Wrap the black paper around the other end of the tube. Make sure the hole is centered and secure with a rubber band.
4. Turn off the lights in the classroom or find another dark room.
5. Find a partner and stand approximately four feet away from each other.
6. Have your partner hold their tube so the side with the black paper is facing you. Use your flashlight to shine light at the tube. Move the light around and observe what happens when the light enters the tube and hits the aluminum foil.
7. Take turns so your partner can experiment with their flashlight and make their own observations.

This eye model represents the eyeshine effect that occurs in certain animals. Some animals have a reflective tissue layer in their eyes called the tapetum lucidum. This tissue increases the amount of light available to photoreceptors located in the retina.

Extension:

- Use a red marker to color the shiny side of the second piece of aluminum foil. Remove the original foil from the tube and wrap this new piece around the end with the red side facing in.
- Compare the difference in reflection between the two eye models. This model represents the red-eye effect that sometimes occurs in humans' eyes. Discuss how eye structures respond differently when receiving the same information.

Science Concepts:

The pupil regulates the amount of light that reaches the retina. The retina is a tissue layer inside the eye containing cells sensitive to light and photoreceptors that convert visible light into nerve signals. These signals are interpreted as visual perception in the brain.

Eye shine is when the pupil appears to glow in animals that have a unique reflective tissue layer in their eyes called the tapetum lucidum. The tapetum lucidum works similarly to a mirror. This reflective tissue increases the amount of light available to photoreceptors in the retina.

Cats' Eyes (continued)

Grades 3-5

Science Concepts (continued):

While humans don't have a tapetum lucidum, many nocturnal animals have this adaptation that helps them see better at night.

The red-eye effect that can appear in human eyes in photographs is caused by the light of the camera flash hitting the back of the eyes. The light is reflected off a tissue called the choroid, which is rich in blood vessels, causing the reflected light to appear red.

Curriculum Connections:

Next Generation Science Standards

- 4-LS1-2 Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.
- 3-LS3-1 Different organisms vary in how they look and function because they have different inherited information.

References:

Ashish. (2017, June 9). *Why do certain animals' eyes glow in the dark?* Science ABC.

<https://www.scienceabc.com/nature/animals/why-do-certain-animals-eyes-glow-in-the-dark.html>

Chudler, E. (2020, June 29). *Sight (Vision)*. Neuroscience for Kids.

<https://faculty.washington.edu/chudler/chvision.html>

Craycrof, M. (2021). *Can cats see in the dark?* Carrots are Orange.

<https://carrotsareorange.com/can-cats-see-in-the-dark/>

OCLI Vision. (2013, July 16). *Why do we sometimes get red eye when taking photos?*

<https://www.ocli.net/blog/why-do-we-sometimes-get-red-eye-when-taking-photos>

Supersize Fingerprints

Grades 3-5

Objective

- To use fingerprints to explore and identify genetic traits that can be influenced by environmental factors.

Materials, per student:

- Dark colored inkpad
- Two light colored balloons
- Fingers

For Extension:

- Students' completed balloons

Procedure:

1. Lay an uninflated balloon on a flat surface and flatten an area of the balloon, ensuring no creases and allowing enough space to print a finger.
2. Press your finger into the ink pad firmly.
3. Press the inked finger onto the balloon, gently rolling your finger to capture the entire fingerprint.
4. Blow up the balloon and tie it off.
5. Explore your fingerprint and try to determine which pattern is present. There are three basic patterns: loops, whorls, and arches.



loop



whorl



arch

6. Identify any changes to your fingerprints due to environmental factors, such as scars from cuts and burns.
7. Use the second balloon and follow the same steps to make prints of some of your other fingers. Multiple prints can be made in separate areas on the other balloon. Compare all the prints and identify the basic shape, patterns, number of lines, and spacing.

Extension:

- Create a classroom chart including data from all students' fingerprints. Identify the basic shapes and patterns present in the classroom. Which prints are the most common among the students?

Science Concepts:

Every person has a unique fingerprint, which can be used as identification. Fingerprints are patterns of skin ridges, called dermatoglyphics, present on our fingers, toes, palms of our hands, and soles of our feet. The skin ridges serve to increase touch sensitivity.

Genetic factors influence the basic size, shape, and spacing of these ridges. However, our fingerprint details can be influenced by environmental factors inside the womb and changes to our skin after birth. Therefore, even identical twins, who have the same DNA, will have different fingerprints.

The basic fingerprint shapes are loops comprising 70% of all fingerprint patterns, whorls comprising 25% of all fingerprint patterns, and arches comprising 5% of all fingerprint patterns.

Supersize Fingerprints (continued)

Grades 3-5

Curriculum Connections:

Next Generation Science Standards

- 3-LS3-2 Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.

References:

Science Fun. (2021). Giant Fingerprint. <https://www.sciencefun.org/kidszone/experiments/giant-fingerprint/>

Science Struck & Buzzle.com. (n.d.). *Fingerprint patterns: Identifying the different types easily*. <https://sciencestruck.com/identifying-types-of-fingerprints-patterns/>

U.S. National Library of Medicine. (2020, September 10). *Are fingerprints determined by genetics?* <https://medlineplus.gov/genetics/understanding/traits/fingerprints/>

Biomedical Building Challenge

Grades 6-8

Objective

- To design and test a surgical tool to solve a medical challenge.

Materials, per 3-4 students:

- Toilet paper tube
- Marble
- Tape
- Scissors
- Assorted craft materials, such as:
 - Popsicle sticks
 - Rubber bands
 - Craft foam
 - Pipe cleaners
 - Straws
 - Aluminum foil

For Extension:

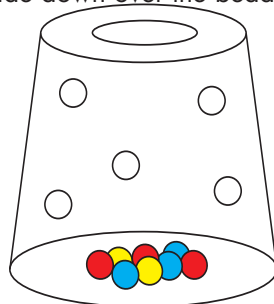
- Plastic cup
- Small beads
- Hole punch

Procedure:

1. Stand the toilet paper tube upright on a table and drop the marble inside the tube. This represents a challenge that a surgeon may face – to remove a tumor while preserving healthy tissue surrounding it.
2. Brainstorm a list of tools that surgeons may use for this procedure. What challenges might a surgeon face during this procedure?
3. Use the craft materials provided to build a tool that can remove the marble without damaging the tube (no bumping, moving, or knocking over).
4. Once the tool is finished, test it out. If the tool doesn't work or causes damage to the tube, try making modifications and re-test. If you are successful, try making modifications that make it easier to use or even more effective.

Extension:

- Once groups have completed their tool design, have them switch tools with another group. Is the tool intuitive enough for other students to use successfully without any additional assistance or directions?
- Create a different surgical situation that may require different tools or techniques. Make a one-inch hole in the bottom of a plastic cup and use a hole punch to make several small holes around the cup. Place a few small beads on a table and place the cup upside down over the beads.



Biomedical Building Challenge (continued)

Grades 6–8

Science Concepts:

Surgery is a procedure that uses instruments to alter tissue in order to treat an injury, cure an illness, or find out what is causing an issue.

Biomedical engineers design devices, tools, and equipment to solve health or medical related problems. This can include prosthetic limbs, artificial joints, specialized tools and robots for surgery, and machines for diagnostic procedures such as MRIs and x-rays.

Minimally invasive surgeries are performed through very small incisions rather than opening up large areas of the body. These procedures use robotic assistance, specially designed tools, and video technology. This type of surgery can lower the risk of infection, result in less pain, and shorten recovery time for patients.

Curriculum Connections:

Next Generation Science Standards

- MS-ETS1-2 There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.
- MS-ETS1-4 A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.

References:

Bureau of Labor Statistics, U.S. Department of Labor. (2021, September 8). *Occupational Outlook Handbook, Bioengineers and Biomedical Engineers*.

<https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm>

Johns Hopkins Medicine. (n.d.). *Minimally Invasive Surgery*.

https://www.hopkinsmedicine.org/minimally_invasive_robotic_surgery/types.html

Oregon Museum of Science and Industry. (2018). *Engineering Activities and Resources*. Designing Our World.

Regents of the University of Colorado. (2021, September 30). *Biomedical Engineering and the Human Body*.

https://www.teachengineering.org/curricularunits/view/cub_biomed_curricularunit

To The Point

Grades 6-8

Objective

- To conduct a two-point discrimination test to compare the sensitivity of different parts of the arm.

Materials, per student:

- Large paper clip
- Metric ruler
- Paper and pencil
- Partner

Procedure:

1. Unbend a paper clip so you have a straight wire, then bend the wire so you have a wide “U” shape.



2. Use the ruler and adjust the end points so they are approximately 60 millimeters apart.
3. Hold out your arm palm side up and close your eyes. Have a partner gently poke your lower arm, just until you can feel the points.
4. At this distance, it should feel like two separate points poking you. Have your partner gently squeeze the ends together to make the “U” a little narrower and test again.
5. Keep testing the same area, bringing the points closer together a little more each time until they feel like one single point instead of two.
6. Use the ruler to measure the distance between the final points and record your data.
7. Switch roles and test your partner. Then, repeat the procedure to test the palm of your hand and the end of one of your fingers.

For this experiment, if the final points of the paper clip are close together, there are more nerve receptors in that area. If the final points of the paper clip are far apart, there are less nerve receptors in that area. After this test, which part do you think has more nerve receptors – your finger or your forearm?

Extension:

- Have students repeat the above procedure using a different set of body parts. Students should choose three new body parts and before testing, hypothesize which will be more sensitive.
- Gather data from the entire class and compare the results. Which areas of the body are most densely populated with nerve receptors? Which areas are least densely populated?

Science Concepts:

The skin is the largest sensory organ of the human body. Nerve receptors in skin detect a variety of stimuli and send signals to the brain allowing us to experience sensations including temperature, pain, and pressure.

Sensory neurons are specialized cells that respond to stimuli and carry signals to the brain. Neurons involved in sensing pressure collect information from an area of skin called a receptive field. A large receptive field allows a neuron to detect pressure in a wider area, but with less precise perception. Areas of skin that detect fine detail have many densely packed neurons each with a small receptive field.

To The Point (continued)

Grades 6-8

Science Concepts:

Generally, people can distinguish two separate points on their fingers at a distance of two millimeters and their upper lip at five millimeters. Larger areas of the body tend to be less sensitive. The threshold for two-point sensation on the back is 39 millimeters and the calf is 45 millimeters.

Two-point discrimination tests can be used as an assessment tool by doctors examining patients for neurological problems or injury. This type of test is often used with upper extremities of the body including arms and hands.

Curriculum Connections:

Next Generation Science Standards:

- MS-LS1-8 Each sense receptor responds to different inputs (electromagnetic, mechanical, chemicals) transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories.

References:

Chudler, E.H. (2021). *Touch Experiments*. Neuroscience for Kids.
<https://faculty.washington.edu/chudler/chtouch.html>

Elsevier B.V. (2021). *Two-Point Discrimination Test*. ScienceDirect.
<https://www.sciencedirect.com/topics/medicine-and-dentistry/two-point-discrimination-test>

Wolfe, K. (n.d.). *Testing the Sense of Touch at Home*. Fisher Science Education.
<https://www.fishersci.com/us/en/education-products/publications/headline-discoveries/2020/spring-summer-issue/testing-sense-touch-at-home.html>