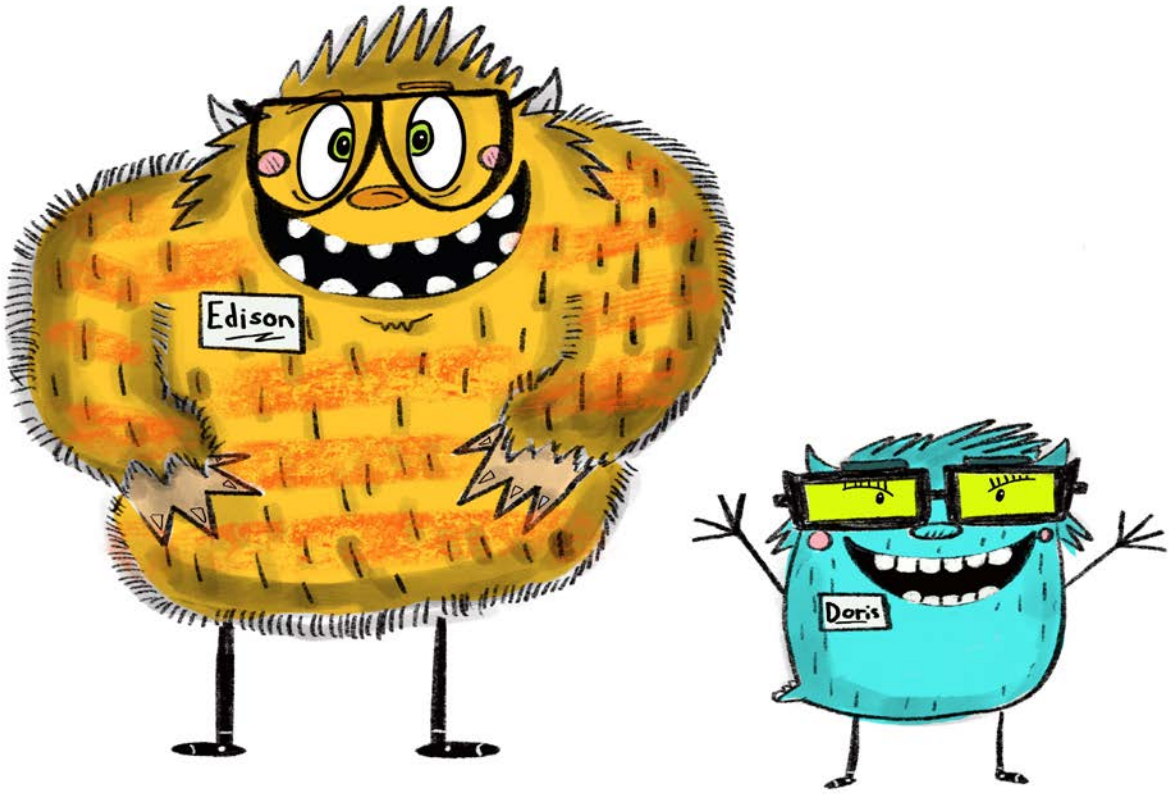
TEACHER'S HANDBOOK

Biology Kit

Adventures with Edison and Doris

Exploring Biomedical Engineering, CSI: Forensics, and Zoology



STEM on the Go! Program

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Lesson 6 – CSI: Escape Room Challenge/Breakout Box
Ages 12-14
Students use forensic evidence, teamwork, and critical thinking to solve this CSI Escape Room Challenge. Students will analyze 4 different pieces of evidence (fingerprints, shoe prints, an unknown powder, and handwriting samples) to figure out who committed the crime.

Zoology
The study of animals and their behavior

Lesson 7 – Dinosaur Dig
Ages 6-11
“How do we know what dinosaurs looked like?” video
Students will infer what the outside of an animal looked like by using clues about their skeleton. They will then perform a dinosaur dig and excavate dinosaur bones.

Lesson 8 – Animal Adventures
Ages 12-14
“How many different kinds of animals are there?
Students examine how scientists organize animals into groups based on their unique characteristics. In the activity, students sort animals and animal cards into groups and then classify any ‘challenge’ animals based on their classification system.

Lesson 9 – Frog Dissection Simulation
Ages 15-19
Students will investigate the internal and external features of a frog. They will perform a frog dissection simulation while analyzing the structure and function of specific organs.

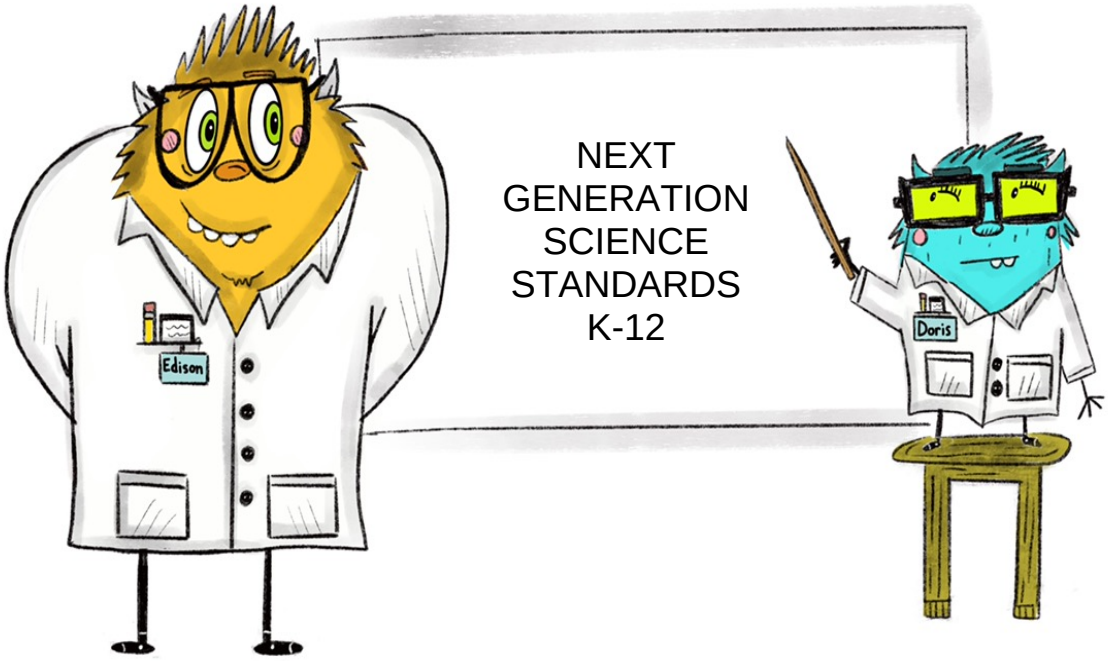
Biology Kit

NGSS Science Standards Addressed

Lesson	1	2	3	4	5	6	7	8	9
NGSS National Science Standards: K-5									
K. Forces & Interactions: Pushes and Pulls	X		X						
K. Interdependent Relationships in Ecosystems: Animals, Plants, and the Environment		X						X	
K. Weather & Climate									
K. Engineering Design	X	X	X	X	X	X			
1. Waves: Light & Sound					X				
1. Structure, Function, and Information			X					X	X
1. Space Systems: Patterns & Cycles									
2. Structure & Properties of Matter					X				
2. Interdependent Relationships in Ecosystems		X						X	
2. Earth's Systems: Processes that Shape the Earth									
K-2. Engineering Design	X	X	X	X	X	X	X		
3. Forces and Interactions		X							
3. Interdependent Relationships in Ecosystems: Environmental Impacts		X					X		
3. Inheritance & Variation of Traits: Lifecycles & Traits						X	X		X
3. Weather & Climate									
4. Energy	X								
Lesson	1	2	3	4	5	6	7	8	9

NGSS National Science Standards: K-5									
4. Waves									
4. Structure, Function, & Information Processing			**X**					**X**	**X**
4. Earth's Systems: Processes that Shape the Earth									
5. Structure and Properties									
5. Matter and Energy in Organisms and Ecosystems									**X**
5. Earth's Systems									
5. Space Systems: Stars and the Solar System									
3-5. Engineering Design	**X**	**X**	**X**	**X**	**X**	**X**	**X**		
NGSS National Science Standards: Middle School- Physical Science									
MS. Structure & Properties of Matter									
MS. Chemical Reactions						**X**			
MS. Forces & Interactions	**X**	**X**							
MS. Energy	**X**								
MS. Waves & Electromagnetic Radiation									
NGSS National Science Standards: Middle School- Life Science									
MS. Structure, Function, & Information Processing	**X**	**X**	**X**						**X**
MS. Matter & Energy in Organisms & Ecosystems									**X**
MS. Interdependent Relationships in Ecosystems								**X**	
MS. Growth, Development, Organism									
Lesson	1	2	3	4	5	6	7	8	9
NGSS National Science Standards: Middle School- Life Science									
MS. Natural Selection & Adaptations		**X**				**X**			**X**
NGSS National Science Standards: Middle School- Earth & Space Science									

MS. Space Systems									
MS. History of Earth									
MS. Earth's Systems									
MS. Weather & Climate									
MS. Human Impacts									
NGSS National Science Standards: Middle School- Engineering, Technology, and Applications of Science									
MS. Engineering Design	**X**	**X**	**X**	**X**	**X**	**X**	**X**		
NGSS National Science Standards: High School- Physical Science									
HS. Structure & Properties of Matter									
HS. Chemical Reactions						**X**			
HS. Forces & Interactions									
HS. Energy	**X**								
HS. Waves & Electromagnetic Radiation									
NGSS National Science Standards: High School- Life Science									
HS. Structure & Function	**X**	**X**	**X**						**X**
HS. Matter & Energy in Organisms & Ecosystems									
HS. Interdependent Relationships in Ecosystems									
HS. Inheritance & Variation of Traits									**X**
HS. Natural Selection & Evolution									
NGSS National Science Standards: High School- Earth & Space Science									
HS. Space Systems									
HS. History of Earth									
Lesson	1	2	3	4	5	6	7	8	9
NGSS National Science Standards: High School- Earth & Space Science									
HS. Earth's Systems									
HS. Weather & Climate									
HS. Human Sustainability									
NGSS National Science Standards: High School- Engineering, Technology, and Applications of Science									
HS. Engineering Design	**X**	**X**	**X**	**X**	**X**	**X**			



Biomedical Engineering

Lesson 1- The Heart
Ages 6-11

(Adapted from University of Colorado)

Overview
In this activity, students help Edison and Doris investigate the human heart. Students will squeeze a tennis ball to demonstrate the strength of the human heart. Working in teams, they will think of ways to keep the heart beating if the natural mechanism were to fail. The goal of this activity is to get students to understand the strength and resilience of the heart while thinking like a biomedical engineer.

Engineers design instruments to help (or replace) the heart when something goes wrong. For example, they have designed tiny stents (a wire mesh tube used to prop open an artery during heart surgery) to place in clogged arteries, they have developed a mechanical heart, and they have designed replacements for veins and heart valves. Engineers also develop surgical equipment and medical equipment to locate and monitor heart rates.

Learning Objectives
1. The students will be able to explain the heart as a pump.
2. The students will be able to use data analysis and graphing to describe and model the strength of the heart.
3. The students will be able to think like a biomedical engineer to create a device to help keep the heart strong and functioning.

Suggested Timeframe
45 minutes

Materials Required

- Heart Pumping Model
- 1 Dry Erase Protective Sleeve for each student
- 1 Thin Expo Marker for each student
- 1 Dry Eraser
- 1 Tennis Ball for each student
- 1 Heart Worksheet for each student (26 Master Sheets provide)
  Students can place their worksheet inside the protective sleeve and use the dry erase marker to do their work.

Assessment

- Pre-Heart Activity Assessment
- Post-Heart Activity Assessment

Introduction/Initiation

Show students the following video from Mystery Doug on YouTube called, "How does the heart pump blood?" 5 min. 59 seconds
https://www.youtube.com/watch?v=smA1GiVglps

Introduction/Initiation Continued…

The heart is a special muscle that never gets tired. The heart is able to alter the flow of blood through the body depending on the body's requirements.
Have you ever noticed that your heart beats harder when you are exercising, stressed or frightened? Even at times when you heart has to work harder, it has to produce a force strong enough so that blood can reach all the parts of your body. Blood carries oxygen, and even the tips of your fingers and toes need oxygen to work properly.

The heart works like a pump: it pushes blood around your body through your blood vessels. The harder you are working (i.e., exercising), the faster your heart pumps blood through your body. Have you used a pump to get air into a bicycle tire or a basketball? How about pumping water from a well with a hand pump? Either way, you can become tired from pumping too long. The heart has to stay strong and healthy so that it can keep efficiently pumping throughout your entire life. Pumps can break down with use, and the heart can become clogged or break down just like any other pump. Sometimes, the heart can become clogged with fat when we eat too many fatty foods. If the heart stops pumping, our body is in big trouble!

Engineers design instruments to help (or replace) the heart when something goes wrong. For example, they have designed tiny devices to place in a clogged artery to allow blood to flow. Also, they have developed a purely mechanical heart for someone whose heart is no longer working properly, and they have even designed replacements for veins and heart valves. Engineers also develop surgical equipment to assist doctors and help patients survive during surgery.

How strong do you think your heart is? Well, today we are going to do a short activity that will help us discover how strong the heart muscle really is. Then we will take that new knowledge and think like engineers who design devices to help the heart pump work properly.

Procedure

Before the Activity

1. Gather all supplies.
2. Get 1 Heart Worksheet, 1 Protective Sleeve, 1 Expo Marker, and 1 Eraser for each student

With the Students

1. Ask students how strong they think their heart is. Record responses on the board. Let's see if we can be as strong as our heart.
2. Divide students into groups of two.
3. Pass out materials to each group.
4. Tell the students to hold the tennis ball in their strongest hand (generally, their writing hand). Ages 6-7 can squeeze the ball with both hands.
5. Squeeze the ball as hard as possible; then, release the grip without dropping the ball.
6. Tell students that this is very similar to the force of one pump of the heart, but the difference is that the heart does not get tired.
7. Now, have the student squeeze the tennis ball as fast and as hard as they can for ten seconds, 30 seconds, and one minute. Their partner should count the number of squeezes, and record the results on the Heart Worksheet.
8. Switch ball squeezer and counter, and repeat steps 4-7.
9. Share the group results with the entire class. Discuss with the students if it became harder to squeeze the tennis ball as time passed. Did anyone's hand hurt after squeezing for one minute? Imagine if you had to squeeze that tennis ball all day without stopping. You might get tired! That is how strong your heart is!
10. Engineers design devices to fix the heart when something has gone wrong. Ask the students to imagine that they must design a heart. Have them brainstorm ways to keep the heart pumping for ten years, plus have the strength to move blood through the body.

Assessment

Pre-Activity Assessment

Discussion Questions: Solicit, integrate and summarize student responses.

- How strong do you think your heart is? How hard does it need to pump to push blood throughout your body?

Activity Embedded Assessment

Worksheet: Have the students record measurements and follow along with the activity on their Tennis Ball Squeeze Worksheet. After students have finished their worksheet, have them compare answers with their peers.

Post-Activity Assessment

Engineering Poster: Using the knowledge they learned about the strength of the heart, have students create a poster of a design of a device to fix the heart when something has gone wrong. Have them title their posters with an engineering firm

name that they make up (e.g., Shaky Heart Engineering Firm). Have the students work in teams of two to four if possible.

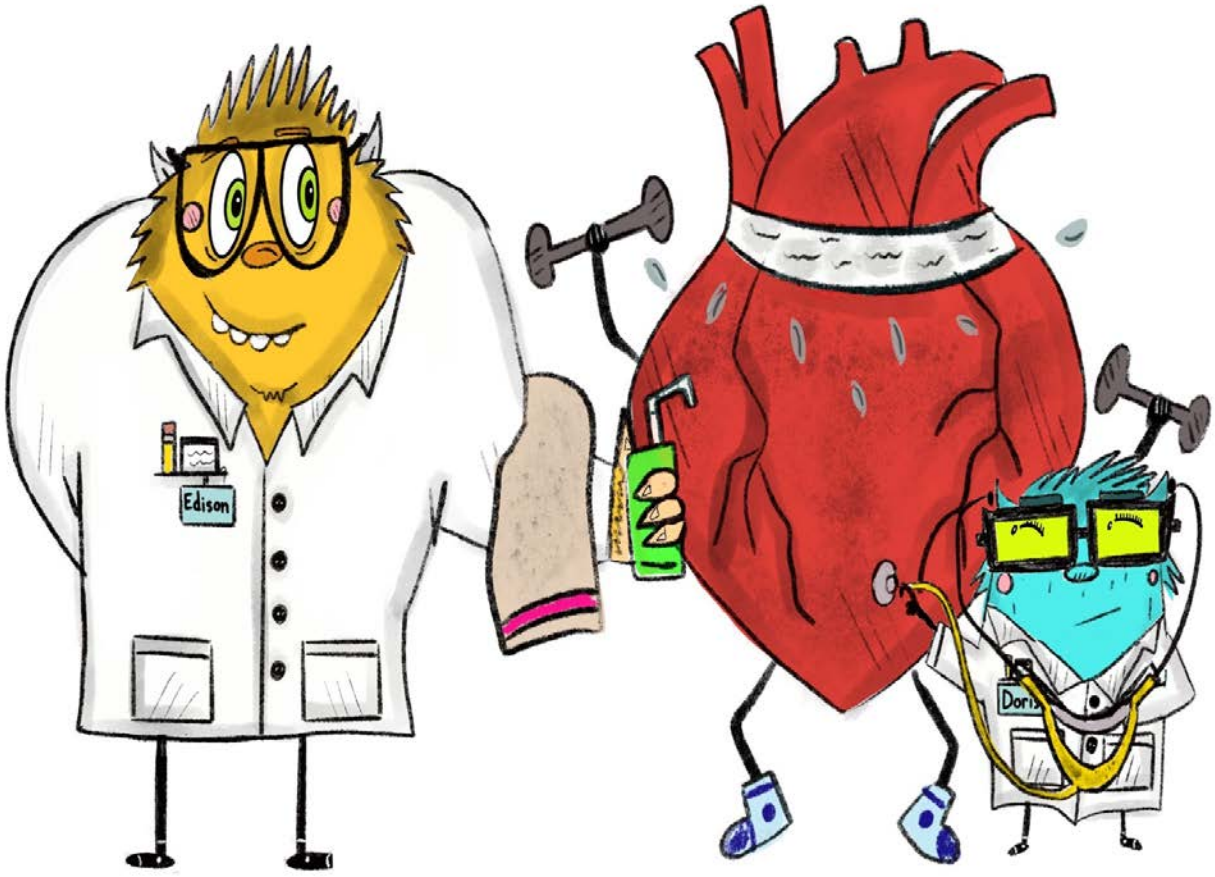
Activity Extensions

- Have students research how heart disease can affect the strength of the heart. What needs to be done to prevent these diseases from occurring?
- Have students pretend that they are speaking as the heart in their own body. Have them write a letter or a daily journal describing the activities that they have to do to keep up their strength.
- Have the students build prototypes of their artificial heart designs using available materials.

Activity Scaling

For older students, have them create a line graph of the number of squeezes over time on the Tennis Ball Squeeze Worksheet. Encourage students to be detailed and creative in their drawings of an artificial heart or pumping device.

For younger students, have the students squeeze the ball with two hands. Conduct the final engineering brainstorm as a short class discussion.



Name _____ Date _____

Lesson 1: The Heart Worksheet

1. Record your data in the chart below:

Name	Number of squeezes in 10 seconds	Number of squeezes in 30 seconds	Number of squeezes in 1 minute

2. Create a bar graph with both group members' results. Be sure to label everything.

30 seconds	1 minute	30 seconds	1 minute

Student #1 _____ Student #2 _____

3. Using only your graph, could you find out how many squeezes you could do in two minutes? How?

_____

_____

_____

4. Engineers design devices to fix the heart when something has gone wrong. Imagine that you are an engineer that must design an artificial heart. How would you keep the heart pumping for ten years, plus have the strength to move blood through the body? On the back of this worksheet, draw a design of your heart

Biomedical Engineering

Lesson 2- The Lungs

Ages 15-19

(Adapted from University of Colorado)

Overview

In this activity, students will help Edison and Doris investigate the human lungs and why fish don't have lungs. They will start by watching a video from Mystery Doug called, "Why can't fish breathe on land?"

Students will then explore the inhalation/exhalation process that occurs in the lungs during respiration. Using everyday materials, each student team will create a model pair of lungs for a fish.

By studying the respiratory system, engineers have created technologies such as the heart-lung machine, which keeps patients alive during heart transplants. Engineers are currently working on creating an implantable, artificial lung to aid people with serious lung diseases. One way that engineers study complicated systems is by creating models, similar to how students create their own model lungs for fish in this activity.

Learning Objectives

1. The students will be able to describe the function of the respiratory system.
2. The students will create a model of the lungs and explain what happens to them when you inhale and exhale.
3. The students will give examples of how their model lungs can help fish survive out of water by giving them a special adaptation.

Suggested Timeframe

45 minutes

Materials Required

- 1 Stuffed animal fish
- 1 Empty plastic bottle with cap for each student
- 1 Plastic drinking straw for each student
- 1 piece of clay for each student
- 2 Balloons for each student
- 1 Elastic for each student
- 1 Bottle Cap Hole Puncher (special tool)
- 1 pair of scissors for each student
- 1 Thin Dry Erase Marker for each student
- 1 Dry Eraser for each student
- 1 Dry Erase Protective Sleeve
- 1 Lung Worksheet for each student (26 Master Sheets provide)
  Students can place their worksheet inside the protective sleeve and use the dry erase marker to do their work.

Assessment

- Pre-Heart Activity Assessment
- Activity Embedded Assessment
- Post-Heart Activity Assessment

Introduction/Initiation

Show students the following video from Mystery Doug on YouTube called, "Why can't fish breathe on land?" 4 min. 59 seconds
https://www.youtube.com/watch?v=9XlIXD97QpQ

Have you ever been on a crowded subway or bus? You probably could not wait to get out where there were not so many people and you could move around freely. This is similar to the process that causes air to flow in and out of your lungs. The air molecules are either crowded outside (in the environment) and want to get into the lungs where there are less air molecules (inhalation), or they want to get outside because they are too crowded inside the lungs (exhalation).

When you inhale, your diaphragm muscle contracts downward and rib muscles pull upward causing air to fill the lungs. Can you think of why? Well, when your diaphragm moves down and ribs move up, they make more space in your chest (in the thoracic cavity) for air. This also decreases the pressure on your lungs so the air will flow in from the outside. The opposite happens when you breathe out. Your diaphragm relaxes and the ribs and lungs push in which causes air to be pushed out.

Engineers need to understand the respiratory process in order to design machines and medicines to help people whose respiratory systems function incorrectly or with difficulty. Have you ever known someone who suffers from asthma or pneumonia? Well, chemical engineers design devices and medicines, such as inhalers to help people breathe better. Engineers have also developed artificial lungs that help people breathe while fighting off infections. And engineers also design the systems that help astronauts breathe easily during space flight, when they are far away from the Earth's atmosphere.

Engineers use models to study complicated processes and better understand them.

Hold up the stuffed animal fish and say, "In this activity, you will act like engineers by building models of the lungs in order to study the breathing process and why fish do not have lungs."

Procedure

Before the Activity

1. Gather all supplies.
2. Get 1 Lung Worksheet, 1 Protective Sleeve, 1 Expo Marker, and 1 Eraser for each student
3. In each of the plastic bottle caps, use the 'hole punching tool for bottle caps' to create a hole big enough for a drinking straw to fit through
4. Using a pair of scissors, cut off the bottom of each plastic bottle

With the Students

1. Tell students that they will make a model of the lungs to study the breathing processes. The plastic bottle represents the chest cavity.

2. Place one balloon on the end of the straw and secure it with an elastic band.
3. Tell students that the straw represents the bronchi and the balloon represents the lung.
4. Stick the balloon end of the straw through the bottle opening and tightly screw on the lid.
5. Take a small piece of clay and place it around the straw on the top of the cap where the hole is. (This will prevent air from entering/exiting the bottle)
6. Tell students that the other balloon represents the diaphragm. Place this balloon over the cut off bottom of the bottle. Place an elastic band around the bottom of the bottle to hold the balloon in place.
7. Now you have a finished model of a lung, next it's time to make the lung work!
8. Pull the diaphragm (balloon) down (that is, away from the lungs) in order to inflate the lung. (Note: this makes the chest cavity larger and fills the lung with air, decreasing the pressure.)
9. Push the diaphragm (balloon) in (towards the lungs) in order to deflate the lung. (Note: this makes the chest cavity smaller and increases pressure, causing the air in the lung to deflate.)
10. To conclude, have partners/teams make presentations of their model lungs, as described in the assessment section.

Assessment

Pre-Activity Assessment

Discussion Questions: Solicit, integrate and summarize student responses.

- How do the lungs work? How do you inhale and Exhale?
- Does your breathing change when you exercise? How?
- Why do fish not have lungs? How do they breathe underwater?

Activity Embedded Assessment

Worksheet: Have the students record their observations and complete the lung worksheet.

Post-Activity Assessment

Presentation and Informal Discussion: Have one or more groups use their projects to demonstrate how the lungs work. Next, hypothesize with the class: What would happen to the respiratory system if we punctured it? Discuss with the class: What could engineers design and build to help fish breathe on land like humans do?

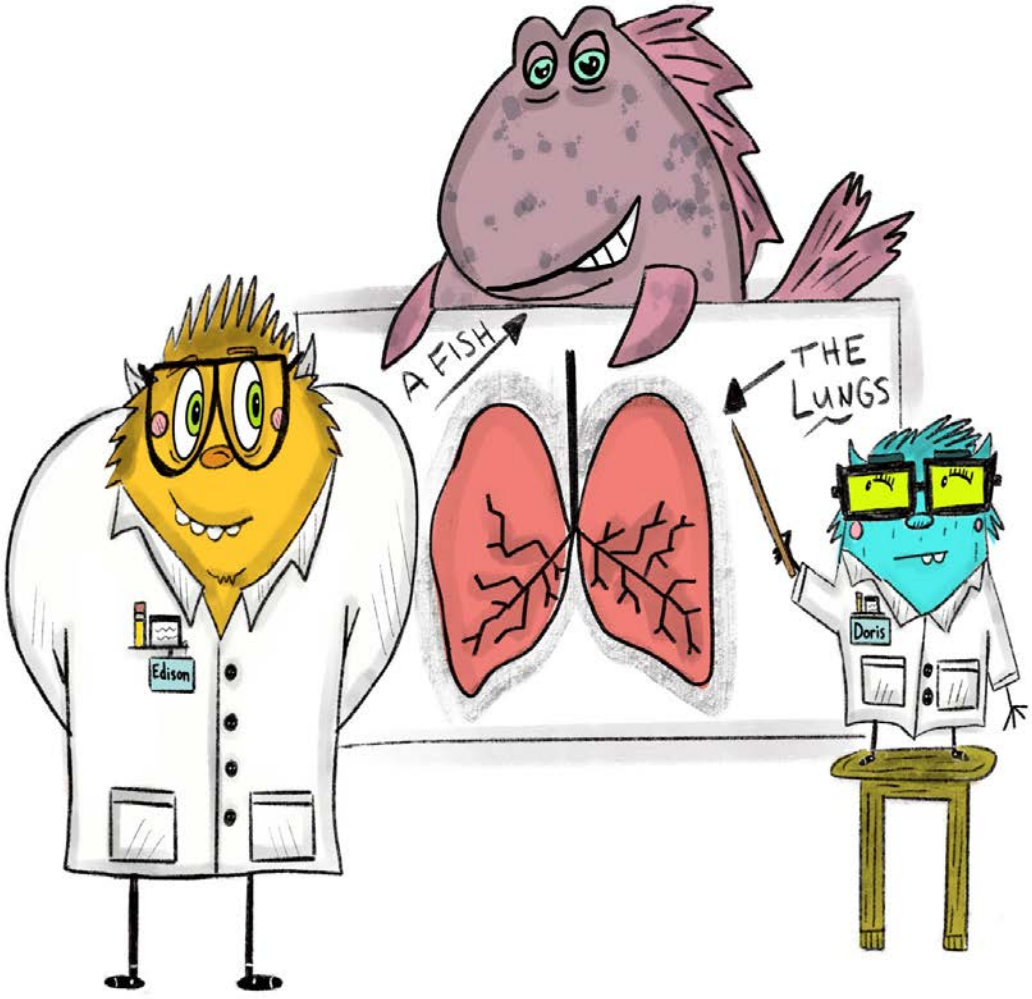
Activity Extensions

- Have students research respiratory diseases and how they affect the function of the respiratory system. Can they alter their model to show what happens to the lungs with these diseases? Can they demonstrate on their models what has been done to help people with respiratory problems?

- Engineers have developed an artificial lung to help people fight infection. The artificial lung is approximately 18-inches long and consists of membranes that pass oxygen to the blood and remove carbon dioxide. It is inserted through a vein in the leg and lodged in the main vein (the vena cava) passing blood to the heart. The blood is re-oxygenated through a catheter attached to an oxygen supply. Have students create a drawing of a machine that could help their model lungs "breathe" without having them pull down or push up on the lower balloon. Explain that this is how engineers might begin to develop life-saving machines.

Activity Scaling

For higher grades, see if they can engineer and design a pair of lungs using a larger plastic bottle (2 liter soda bottle).



Name _____ Date _____

Lesson 2: The Lungs Worksheet

1. Describe what happens when you inhale (when you pull down on the bottom balloon in your model).

   _____
   _____
   _____
   _____

2. Describe what happens when you exhale (when you push up on the bottom balloon in your model).

   _____
   _____
   _____
   _____

3. Why do you think some people can inhale more air at one time than others can?

   _____
   _____
   _____
   _____

4. What might happen if you punctured your chest cavity?

   _____
   _____
   _____
   _____

5. How would lungs as for an adaptation help a fish survive in water and on land?

   _____
   _____
   _____
   _____
   _____

Lesson 2: The Lungs Worksheet
Answers

1. Describe what happens when you inhale (when you pull down on the bottom balloon in your model).

The balloons (your lungs) inflate, take in more air, or get bigger.
Technical Explanation: During inhalation, the diaphragm contracts downward, and rib muscles pull upward, causing air to fill the lungs. (This increases the volume of the thoracic cavity and decreases pressure in the lungs — the air will flow from the higher pressure environment to lower pressure area in the lungs.)

2. Describe what happens when you exhale (when you push up on the bottom balloon in your model).

The balloons (your lungs) deflate, push out the air, or get smaller.
Technical Explanation: During exhalation, the diaphragm relaxes and the lungs contract which causes air to be pushed out from the lungs. (This decreases the volume of the thoracic cavity and increases pressure in the lungs — the air will flow from the higher pressure environment to lower pressure area outside the lungs.)

3. Why do you think some people can inhale more air at one time than others can?

They have a bigger chest cavity, larger lungs or stronger diaphragm muscle.
Technical Explanation: The larger the chest cavity, the more air a person can inhale at one time.

4. What might happen if you punctured your chest cavity?

Your lungs could not take in more air without it leaking out; you could not breathe in and out.
Technical Explanation: The pressure would be the same inside *and* outside the lungs — air and waste products would not be forced in and out of the lungs.

Biomedical Engineering

Lesson 3- Robotic Hand

Ages 12-14

Overview

In this activity, students will help Edison and Doris investigate the human skeleton. They will explore the similarities between how humans move and walk and how robots move, so they come to see the human body as a system from an engineering point of view. They will start by watching a video from Mystery Doug called, "Why do our skeletons have so many bones?" video.

An important aspect of biological engineering is seeing human bodies as functioning, controlled systems, similar to robots. In the biological engineering field, engineers are engaged in research involving the human body and efforts to replicate the functioning of many of its systems. In this activity students will design and create a robot hand modeled after their own hand.

Learning Objectives

1. The students will be able to describe the components of the human body (bones, muscles, and tendons) that are involved in movement, and their interactions in achieving the movement.
2. Compare the functions of the components involved in movement in both a human body and a robot, how they are similar and how they are different.

Suggested Timeframe

45 minutes

Materials Required

- Tape
- 1 Pencil for each student
- 1 pair of scissors for each student
- 1 piece of cardstock paper for each student
- ! Roll of twine per pair of students or group
- 2 Plastic drinking straws for each student
- 1 jumbo straw for each student
- 1 Thin Dry Erase Marker for each student
- 1 Dry Eraser for each student
- 1 Dry Erase Protective Sleeve
- 1 Robotic Hand Worksheet for each student (26 Master Sheets provide)

Students can place their worksheet inside the protective sleeve and use the dry erase marker to do their work.

Assessment

- Pre-Robotic Hand Activity Assessment
- Post-Robotic Hand Activity Assessment

Introduction/Initiation
Show students the following video from Mystery Doug on YouTube called, "Why do our skeletons have so many bones?" video 4 min. 4 seconds
https://www.youtube.com/watch?v=9XlIXD97QpQ

Begin by introducing students to the concepts of the human body that are relevant to movement: senses, muscles, brain and the nervous system, and then show how they work together to generate movement.

Procedure
Before the Activity

1. Gather all supplies.
2. Get "Robotic Hand Pre-Assessment Worksheet, Protective Sleeve, Expo Marker, and Eraser" for each student.

With the Students

1. Have students trace their hand on cardstock; they should be tracing their hand with their dominant hand holding the pencil.
2. Cut the traced hand out. When cutting, cut around it a little bigger than the actual tracing.
3. Have the students mark their finger joints on the cutout.
4. Draw straight or curved lines across the fingers to show the finger joints.

   Refer to picture below:

Robotic Hand Directions Continued…

With the Students

5. Fold the fingers at the lines.
6. Cut smaller straws to size (leave a little gap between the lines to help in threading the twine in the next steps).
7. Tape the straw pieces to the hand so that it resembles the bones in the fingers.
8. Thread yarn through the straw pieces. Each finger will have a length of twine/yarn of its own.
9. After, thread all 5 pieces of yarn that is in the fingers through the bigger straw to represent the wrist bone.

Refer to pictures below:

Front of Hand (Palm)

Back of Hand

Assessment

Pre-Activity Assessment

Before starting the lesson, administer the three-question pre-assessment worksheet to help students begin thinking about how human senses are related to

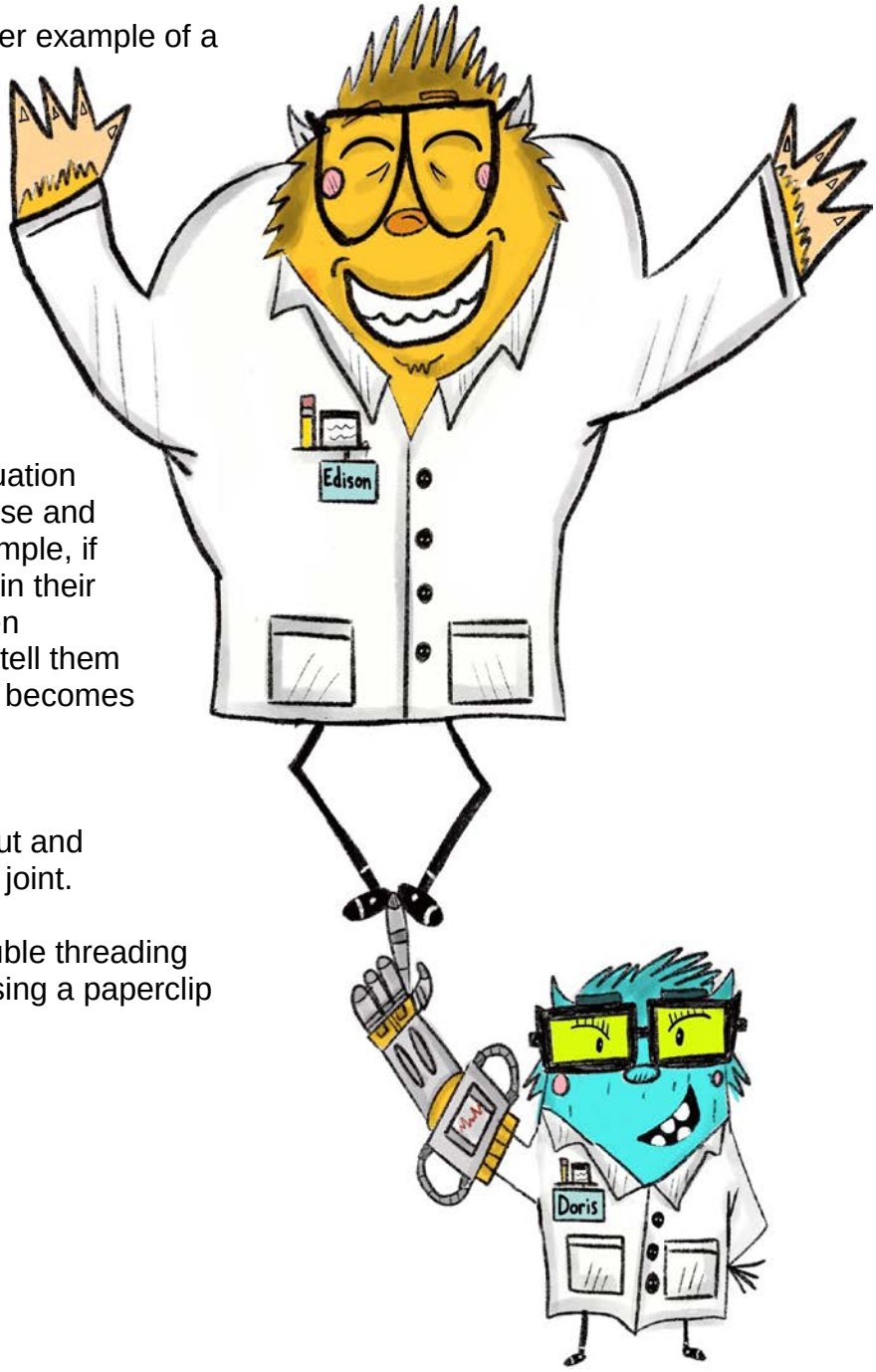
movement. Review their answers to assess their base level of understanding of the subject matter.

Post-Activity Assessment

Administer the four-question post-assessment. The only common question between the pre and post assessment is, "What sensors or senses do we have in the human body?" Compare students' pre and post answers to this question to assess their progress.

Activity Extensions

- Provide students with another example of a person sensing something and moving based on how the brain interprets that sense. Ask students to write down how the human body interprets this. Review their answers to gauge their comprehension of the lesson concepts.
- *As a discussion topic*, ask: What is an example of a situation in which a human could sense and react to something. For example, if a person was holding snow in their hands without gloves on then eventually their body would tell them to drop the snow because it becomes too cold to hold onto.



Activity Scaling

For younger students, help them cut and measure the straws between each joint.

If younger students are having trouble threading the twine through the straws, try using a paperclip as a tool to guide the twine.

Name _____ Date _____

Lesson 3: Robotic Hand

(PRE-ASSESSMENT)

1. What are the 5 senses that humans have?

2. What causes the muscles in your arms and legs to move?

Lesson 3: Robotic Hand

ANSWER KEY

1. What are the 5 senses that humans have?

Seeing, Hearing, Smelling, Touching, Tasting

2. What causes the muscles in your arms and legs move?

The brain sends a message through the nervous system to your muscles to move

Name _____ Date _____

Lesson 4: Robotic Hand

(POST-ASSESSMENT)

1. What sensors or senses do we have in the human body (list as many as you can)?

2. Give an example of a machine (or robot) with sensors and describe how it works.

3. List how robots are similar to humans.

4. List how robots are different from humans.

CSI (Crime Scene Investigation): Forensics

Lesson 4- Fingerprint Lab Investigation

Ages 15-19

Overview

In this activity, students help Edison and Doris take on the role of a fingerprint examiner in order to solve a crime. Students will collect their own fingerprints and compare them to their classmates in order to form a class database, which will be used to catch the culprit!

Understanding patterns is crucial to any engineer, whether it be an electrical engineer who must understand patterns involved in circuitry or an aerospace engineer fitting pieces of a spacecraft together. In the context of this activity, however, engineers need to understand the patterns in the physical world that help them build the tools to expand our knowledge of that world.

Learning Objectives

1. The students will be able to describe the differences and similarities between patterns and fingerprints.
2. Students will be able to understand why pattern recognition is an important skill for engineers.

Suggested Timeframe

45 minutes

Materials Required

- 1 Fingerprint Kit per group (2-3 students)
- Kit should include:
  1 Fingerprint Powder
  1 Dusting Brush
  1 Roll of Clear Packing Tape
- 1 Pair of Gloves for each student
- 1 Pair of Goggles for each student
- 1 Pair of Scissors
- 1 Metal Can
- 1 Magnifying Glass
- 1 Fingerprint Ink Pad
- Wet Paper Towel Sheets
- Class Fingerprint Database (Fingerprint 10 Card collected from each student)
- 1 Thin Dry Erase Marker for each student
- 1 Dry Eraser for each student
- 1 Dry Erase Protective Sleeve
- 1 Fingerprint Lab Sheet for each student (26 Master Sheets provide) Students can place their worksheet inside the protective sleeve and use the dry erase marker to do their work.

Assessment

- Pre-Fingerprint Lab 10 Card

- Post-Fingerprint Lab Activity Worksheet

Introduction/Initiation

Before the Lab (Teacher Directions)

1. Using a paper towel or tissue, wipe the surface of the metal can clean to wipe off the existing prints on the can.
2. Next, place **your** fingerprints onto each of the cans being used in the experiment.
3. Be sure that you complete a 10 card and mix it into the other students' 10 cards the day of the experiment.

The Day of the Lab

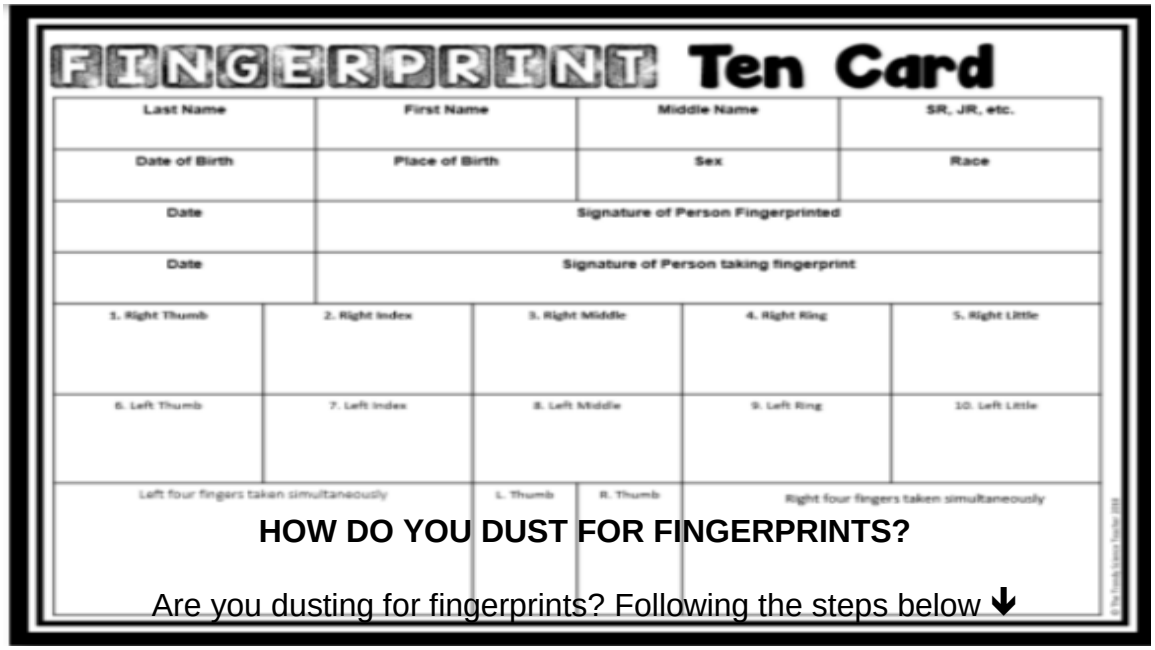
Begin by telling the students that, "I've discovered that books have been missing in the children's section of the library and in place of the missing books are these cans. Today, you will help me determine who has been moving the missing children's books and placing empty cans in its place. The person who has been moving the books has left their prints behind on the cans. Today, we are going to dust for those prints, lift them off, and compare them to our class fingerprint data-base to solve, " The Case of the Missing Books."

Procedure

Before the Activity

1. Have every student in the class complete a TEN CARD. To do this, give each student a TEN CARD worksheet and a fingerprint inkpad (inkpad can be shared). Each student should fill out their information at the top of the card and then roll each finger across the inkpad and transfer their fingerprint to their TEN CARD.
2. After students have completed their TEN CARD, have them clean their fingers with a wet paper towel. Collect all cards and add yours in.

Example of the TEN CARD each student should fill out:


FINGERPRINT Ten Card

Last Name	First Name	Middle Name	SR, JR, etc.
Date of Birth	Place of Birth	Sex	Race
Date	Signature of Person Fingerprinted		
Date	Signature of Person taking fingerprint		

1. Right Thumb	2. Right Index	3. Right Middle	4. Right Ring	5. Right Little
6. Left Thumb	7. Left Index	8. Left Middle	9. Left Ring	10. Left Little

Left four fingers taken simultaneously	L. Thumb	R. Thumb	Right four fingers taken simultaneously

HOW DO YOU DUST FOR FINGERPRINTS?

Are you dusting for fingerprints? Following the steps below ↓

Refer to pictures:

1. 

Using the brush and a small amount of powder lightly apply the powder to the can in a circular motion. To do this, the student has to be gentle. It's best to gently lower the brush in a circular dabbing motion than to just swipe it, because swiping may smear the print.

2. 

You should be able to see the fingerprint clearly in the powder when you're done.

3. 

Place a piece of clear tape down on the powdered print. Use a big enough piece that you can leave room on the corner of the tape to keep holding it (this will make it easier to pull up). Then very carefully pull the tape up. When you lift the tape, the powdered print should be stuck to it.

Place the tape on an index card so you can see the prints.

After you modeled how to fingerprint the can, students can begin their lab.

With the Students

1. After students have made their TEN CARD, have each student put on a pair of gloves.
2. While wearing gloves, give each pair of students a metal can (evidence sample) and "How do you dust for fingerprints?" direction sheet.

3. Using the dusting brush and powder, have each student pair lightly dust the can in a swirling motion until prints appear.
4. When students can see the prints, have them **carefully** place tape onto the print, ensuring that they collect as many fingerprints as possible. ***Have students try their best to not allow the tape to bend over itself**
5. Once the tape is secured, lightly rub over the tape to ensure that all of the prints are transferred to the tape.
6. Carefully peel the tape from the evidence moving from one corner of the tape to the opposite side.
7. Next, place the lifted print onto the white index card.
8. The students will then use the magnifying glass to make observations about the prints they collected off the can.
9. After collecting prints, have each pair of students answer the lab questions and narrow down their suspect field by comparing the prints that they collected to the class database of fingerprints (all of the TEN CARDS from each student).

Assessment

Pre-Activity Assessment – After making TEN CARD

Discussion Questions: Solicit, integrate and summarize student responses.

- What do you notice about your own fingerprints? Do you notice a difference between your fingerprints and your thumbprints?

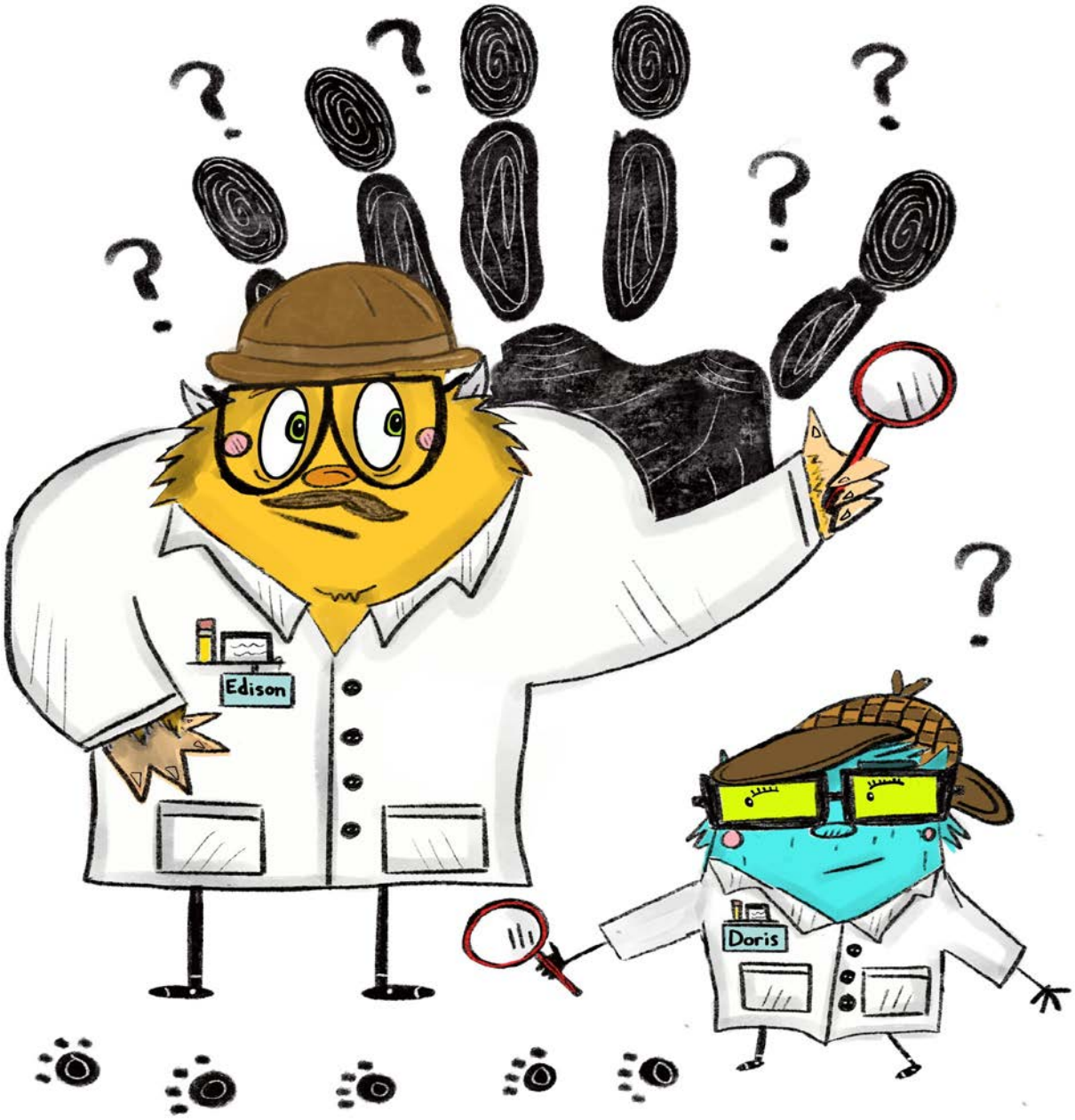
Post-Activity Assessment

Lab Worksheet: Have students summarize the similarities and differences between patterns and fingerprints by reflecting on the lab questions on their worksheet. They should be able to compare and contrast the fingerprints they collected to the TEN CARD database to develop a list of 'suspects'.

Activity Extensions

- *Crime Scene Investigators and Engineering:* Engineers help create technologies to help us identify fingerprints for criminal investigations. For example, they develop the computer programs that recognize specific fingerprint patterns. They also help develop the techniques to retrieve fingerprints from different surfaces, such as metals. Have the students think about the different ways they identified the fingerprints?

- Using the methods they discovered, have them pretend to be engineers and create a written procedure for identification of fingerprints that could be converted into a computer program for their local police department.


Edison
Doris

Name _____ Date _____

Lesson 4: Fingerprint Lab Investigation

Ages 15-19

" The Case of the Missing Books" – Fingerprint Lab Investigation

Help!! Edison and Doris need your Forensics expertise! It seems as though someone has been moving the library books around and putting empty cans in their place. The suspect could be someone in this room right now!

Can you compare the prints on the cans to your classmate's prints and help the Edison and Doris solve the crime?

Materials:

- Fingerprint Kit (Kit includes: Fingerprint Powder, Dusting Brush, White Index Card, and Clear Packing Tape)
- Gloves
- Scissors
- Evidence (1 Can)
- Magnifying Glass
- Class Fingerprint Database (TEN CARDS)
- Fingerprint Ink Pad
- Paper Towels

Procedure:

1. Use fingerprint pad and record your fingerprints on a TEN CARD.
2. When finished, clean your fingers off with a wet cloth and turn your TEN CARD into the teacher.
3. Get a Fingerprint Kit (Kit should include: Fingerprint Powder, Dusting Brush, White Index Card, and Clear Packing Tape).
4. Put on gloves.
5. Obtain the evidence sample (metal can) from your teacher.
6. Using the dusting brush and powder, lightly dust the can in a swirling motion until fingerprints appear.
7. Once fingerprints appear, carefully place tape onto the print, ensuring that you collect as many prints as possible. ***Do not allow the tape to bed over itself.**

Name _____ Date _____

8. Once the tape is secured, lightly rub over the tape to make sure that all of the prints are transferred to the tape.
9. Carefully peel the tape from the evidence moving from one corner of the tape to the opposite side.
10. Next, place the lifted print onto the white index card.
11. You will then use the magnifying glass to make observations about the print.

Answer the questions below:

1. How many prints did you collect off of the evidence can?

_____

2. Can you tell if the prints came from the left or right hand?

_____

3. What patterns do you notice on the prints that you collected?

_____

4. Are there any identifying characteristics on the print that you lifted that would make it unique to its donor (ex: scar, marking, etc.)?

_____

- Now you will compare the prints that you collected to the class database of fingerprints.

Narrow down your suspect field to include three of your classmates. List their names below:

_____ _____ _____

- Take a deeper look and compare your 3 suspects to the evidence.

Who moved the books in the library and replaced them with cans?

CSI (Crime Scene Investigation): Forensics

Lesson 5- Microscope Lab Investigation: The Case of the Missing Books

Ages 6-11

Overview

In this activity, students help Edison and Doris take on the role of a lab technician in order to solve a crime. Students will analyze the "crime scene" and collect evidence. The evidence will then be used to compare and contrast with different known substances as seen under a microscope. The students will then decide based on observations what they believe the 'evidence' is that they collected at the scene and compare the evidence to the list of suspects to solve the crime!

An important aspect of CSI: Forensics is seeing patterns and small details in the evidence. Understanding the importance of small details is crucial to any forensic engineer, especially in the area of investigation. Vital to the field of forensic engineering is the process of investigating and collecting data related to the materials, products, structures or components. This involves inspections, collecting evidence, measurements, developing models, obtaining exemplar products, and performing experiments.

Learning Objectives

1. The students will be able to analyze and compare substances to evidence collected.
2. Use microscope skills to quantify, document and record substances.
3. Present findings and compare the findings to the suspect list.

Suggested Timeframe

45 minutes

Materials Required

- 6 Substances on Slides: Sand, Baby Powder, Salt, Flour, Sugar, Garlic Powder
- An area where the books went missing (sprinkled with salt)
- 1 Microscope per team
- 1 Thin Dry Erase Marker for each student
- 1 Dry Eraser for each student
- 1 Robotic Hand Worksheet for each student (26 Master Sheets provide) Students can place their worksheet inside the protective sleeve and use the dry erase marker to do their work.

Assessment

- Microscope Lab Activity

Introduction/Initiation

Begin by introducing students to the scene of the crime. Tell the students that books have been going missing in the library for weeks and that there has been

this "substance" left on the shelf. It is going to be their job to analyze the substance found and compare their observations and data to that on the suspect list to help solve the mystery.

Procedure

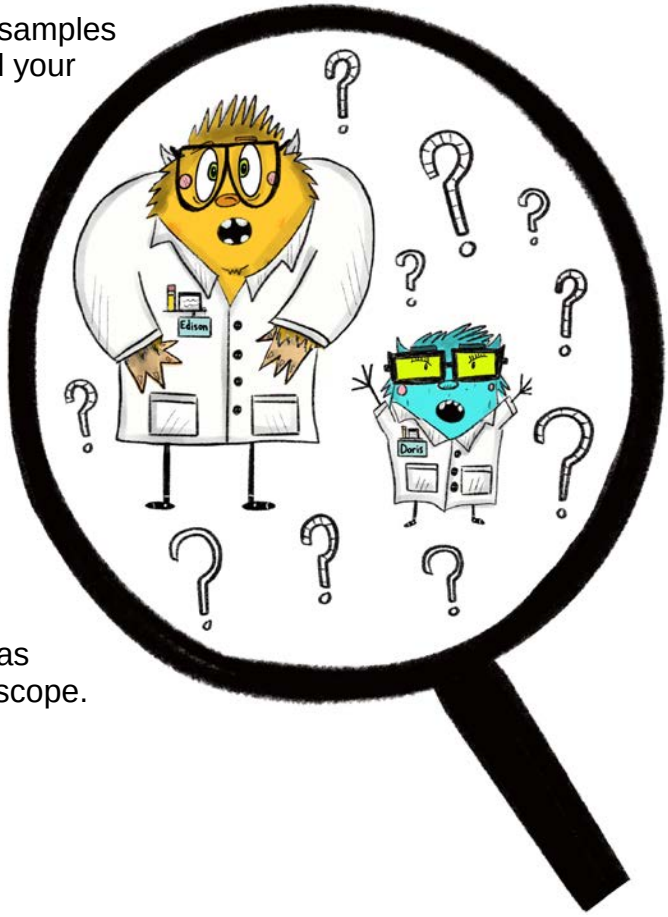
Before the Activity

1. Sprinkle a small amount of salt in the area where "the books were taken from." You will want enough "residue" so that each lab group can collect a sample at the beginning of the investigation.
2. Place students in their teams and provide them with clear tape, a blank slide, and a microscope.
3. Have students read the Suspect Sheet for information on the suspects.
4. Give students prepared slides.
5. As students view each residue, have them complete the questions/observations on their student lab sheet.

With the Students

1. Using a small piece of clear tape, collect a small amount of evidence from the crime scene.
2. Place the evidence tape on a microscope slide and place it under the microscope for viewing.
3. View each of the other six residue samples provided. For each sample, record your observations below.

*__Be sure to view each sample on low and medium power.__



Assessment

<u>Activity Embedded Assessment</u>

Worksheet: Have the student's record their observations for each residue provided and compare their findings to the 'suspect list'. Write a conclusion based on data collected to determine who is responsible for misplacing the books.

Activity Scaling

For younger students, help them identify the difference between 'low and medium' power as well as proper placement of slides in a microscope.

Name _____ Date _____

Lesson 5: Microscope Lab Investigation

Ages 12-14

" The Case of the Missing Books" –Microscope Lab Investigation

Help!! Edison and Doris need your Forensics expertise! It seems as though someone has been moving the library books around and leaving a residue in its place. The suspect could be someone you would least expect!

Can you compare the residue left at the crime scene to the 'suspect list' and help the Edison and Doris solve the crime?

Materials:

- 6 Substances on Slides: Sand, Baby Powder, Salt, Flour, Sugar, Garlic Powder
- A Clean Slide
- Clear Tape
- 1 Microscope per team

Case Information:

Six people had access to the books that have gone missing. These people are considered 'suspects' and have alibis for the time between when the books were last seen and when they went missing. Read the SUSPECT LIST sheet provided to you. Be sure to read carefully and use the clues to solve the case!

Getting Started:

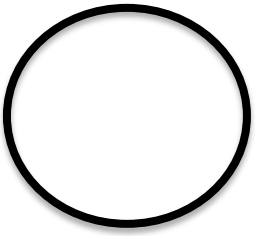
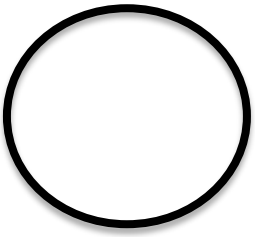
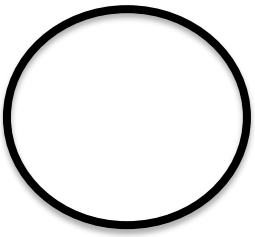
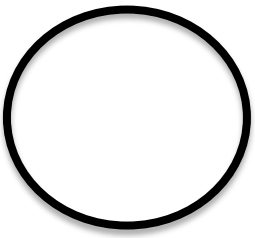
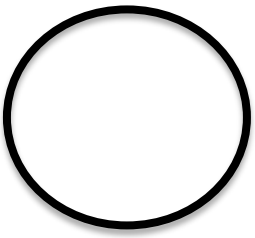
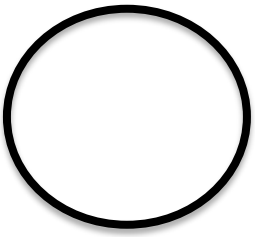
Before viewing your first 'residue', be sure that the stage is lowered and you have cleaned the glass components of the microscope.

Procedure:

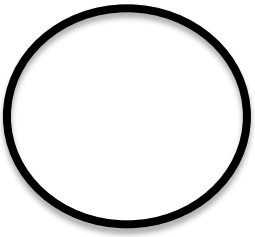
1. Using a small strip of clear tape, collect a small amount of evidence/"residue" that was left at the crime scene.
2. Place the evidence tape on a microscope slide and place under the microscope for viewing.
3. View each of the other six residue samples provided. For each sample, record your observations below.

Name _____ Date _____

*Be sure to view each sample on low **and** medium power before recording your observations.

Evidence Sample Physical Description:	Drawing as seen through microscope: 
Sand Physical Description:	Drawing as seen through microscope: 
Garlic Powder Physical Description:	Drawing as seen through microscope: 
Baby Powder Physical Description:	Drawing as seen through microscope: 
Sugar Physical Description:	Drawing as seen through microscope: 
Flour Physical Description:	Drawing as seen through microscope: 

Name _____Date _____

<u>Salt</u> Physical Description:	Drawing as seen through microscope: 

Conclusion:
Use the data from the table above to draw a conclusion as to who you believe is responsible for taking the library books. Then answer the questions below.

1. Who do you believe is responsible for taking the missing books?

2. What evidence supports your conclusion?

Biology: CSI (Crime Scene Investigation): Forensics- Lesson 5
Name _____Date _____

Lesson 5: Microscope Lab Investigation

Ages 6-11

SUSPECT LIST

Suspect #1 Boo loves baking! Since she loves baking so much, she decided to go to the library early in the morning to look for cooking books. She tried to find the best recipe to make a cake for James.	
Suspect #2 James P. Sullivan "Sully" works at the local pizza restaurant and is known for using a lot of garlic when he cooks. He went to the library after his shift to find books on cooking the best pizza sauce.	
Suspect #3 Mike Wazowski plays a lot of basketball and has smelly feet. He puts a lot of baby powder on his toes since he doesn't wear any shoes. He went to the library to study for a test but swears he didn't check out any books.	

Name _____ Date _____

Suspect #4 Randall Boggs spends a lot of time at the beach. He's known for tracking sand everywhere he goes and always has to sweep behind him. He was known for taking books back in middle school. Could he be back to his old ways?	
Suspect #5 Roz is the Librarian at the Library. Before leaving to go home the other day, she decided to have a sweet snack. Did she grab the book by accident and take it home with her?	
Suspect #6 George Sanderson loves salty snacks. They're always in his pockets, and he's been snacking on them for days. He went to the library to look for his friend Sully and started reading books while he waited. Is it possible he accidentally brought the books home that he was reading?	

Lesson 6- CSI: Escape Room/ Breakout Box Challenge

Ages 12-14

Overview

In this activity, students will use forensic evidence, teamwork, and critical thinking to solve this CSI Escape Room Challenge. Students will analyze 4 different pieces of evidence (fingerprints, shoe prints, an unknown powder, and handwriting samples) to figure out who committed the crime.

Students are immersed in the experience by following a fun and engaging story line that puts them right in the middle of the action. As students complete each activity, they are given a code to use to open a lock on a lockbox. Each activity solved will give them a code to unlock each lock. Once they have completed the final activity, they will have enough evidence to determine who did it.

Learning Objectives

1. Fingerprint Analysis: Students will compare fingerprints found at the crime scene to those of suspects to determine who was at the scene of the crime.
2. Shoe Print Analysis: Students will compare the shoes of the suspects to a muddy footprint found at the crime scene to determine the brand and size of the shoe.
3. White Powder: Students will perform chemical testing on the unknown white powder to see where the evidence leads.
4. Ink Testing: Students will perform a paper chromatography test to determine who left the note at the crime scene.
5. Students will use all the evidence to figure out who committed the crime.

Suggested Timeframe

45-60 minutes

Teacher Materials Required

- 1 Lock Box
- 4 Locks
- Case File for each pair/group of 4 which includes: 5 Suspect Sheets, 1 Crime Log, 1 Evidence Log
- Evidence Tests (Set up one station/set of evidence for each group):
    - Fingerprint Evidence- "Evidence 1 – Fingerprints from the Scene " in a folder marked "Confidential – Evidence #1"
    - Powder Evidence- 5 Small Containers of Baby Powder, Baking Soda, Salt, Sugar, and Unknown Powder (which is Baking Soda)
      3 Dropper Bottles- Vinegar, Water, and Iodine
      1 Wooden Craft Stick
      1 Laminated Testing Page + 1 Directions Sheet

      Powder Evidence Continued…
      1 Tray for Holding Materials
      1 Paper Towel Sheet
    - Shoe Print Evidence- "Evidence 3- Shoeprint from the Scene" in a folder marker "Confidential – Evidence #3"
    - Chromatography Ink Evidence- 4 Different Felt Tip Markers

4 Chromatography Test Strips
4 Cups Filled with 1 cm of Water
1 Ruler
1 Pencil
4 Straws
1 Tape Roll
Printouts of Evidence for directions (Pages and Sample)

Student Materials Required

- 1 Pair of Safety Glasses
- 1 Thin Dry Erase Marker for each pair/group of 4
- 1 Dry Eraser for each pair/group of 4
- 1 Student Introduction Sheet for each pair/group of 4
- 1 Notes and Evidence Sheet for each pair/group of 4

Students can place their worksheet inside the protective sleeve and use the dry erase marker to do their work.

Assessment

- Unlock Breakout Box

Introduction/Initiation

You can't believe you are in this mess!! One minute you are the library and about to leave to go home when the 1st edition, autographed copy of Harry Potter and the Sorcerers Stone by J.K. Rowling has gone missing from the display counter. Next thing you know, the library staff finds your backpack on the display counter next to where the book was. Apparently someone took your backpack and put it in its place and now they think you have the book. You admit, it does look suspicious, but you didn't do it! Talk about being in the wrong place at the wrong time!

The staff has gong off to talk with the other suspects leaving you alone. You look around and notice the case file and evidence are in the same room as you. This gives you an idea. There are 4 other suspects to interview and each interview will take time before the staff returns. If you act quickly, you can check out the evidence, solve the case, and prove your innocence!

You need to get going! Luckily, you have a notebook near your to record the information you find. First thing is to look over the case file and suspects list.

Procedure

Student Introduction

1. Students begin the game by reading the student introduction, which sets the scene.
2. They will take notes throughout the case in the Notes and Evidence Log.

Case File

1. Students read through the **Crime Report, Evidence Log,** and **Suspect Info.**

2. Depending on your level of students, this can be done as a class or individually.

Analyzing Evidence

1. Students begin analyzing evidence.
2. Using the bottle cap hole puncher, punch a hole in each bottle cap.
3. After successfully analyzing the evidence, students will be given a code to unlock a “lock” on the lockbox.
4. If students can unlock the lock successfully, they are given the next “clue” document. The clue documents contain additional information to move the storyline along and directions for the next step.
5. Students should move through the evidence in the following order: Fingerprints, White Powder, Shoe Prints, Paper Chromatography Pen Analysis

Finishing the Game

1. After opening the 4th lock/clue, the students will be directed to open the “Final” document. This will be the final part of the activity.

Assessment

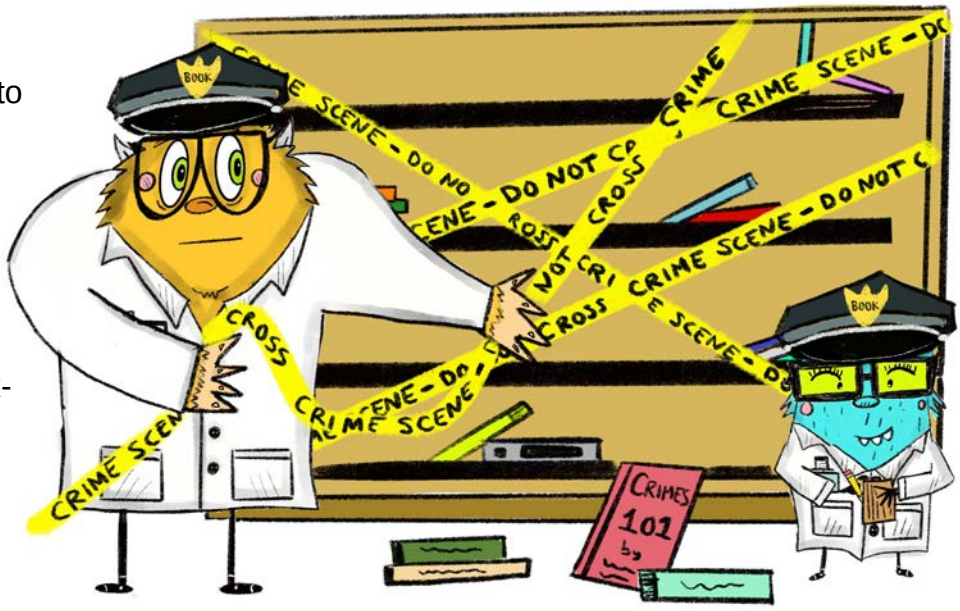
<u>Post-Activity Assessment</u>

After analyzing each piece of evidence, the students are given a code to use to “unlock” a lock on the lockbox to move through the game. If a student does not correctly analyze the evidence, they will not be able to move forward (this makes sure students are on the right track throughout the game).

If the students do unlock a lock on the lockbox, give them additional information and directions for the next step.

Below are the codes to the locks on the lock box:

CSI Clue 1- SUSAN
CSI Clue 2- BAKIN
CSI Clue 3- ASICS
CSI Cue 4- PENC
CSI Final Clue in Box- Chris



Breakout Box – CSI
Student Introduction

You can't believe you are in this mess!!

One minute you are the library and about to leave to go home when the 1st edition, autographed copy of Harry Potter and the Sorcerers Stone by J.K. Rowling has gone missing from the display counter. Next thing you know, the library staff finds your backpack on the display counter next to where the book was. Apparently someone took your backpack and put it in its place and now they think you have the book. You admit, it does look suspicious, but you didn't do it! Talk about being in the wrong place at the wrong time!

The staff has gong off to talk with the other suspects leaving you alone. You look around and notice the case file and evidence are in the same room as you. This gives you an idea. There are 4 other suspects to interview and each interview will take time before the staff returns. If you act quickly, you can check out the evidence, solve the case, and prove your innocence!

You need to get going! Luckily, you have a notebook near your to record the information you find.

First thing is to look over the case file and suspects list.

Breakout Box - CSI

Clue #1

Two sets of fingerprints!? That is strange… Are Chris and Susan in on the book heist together? You can't believe this. You are buddies with Chris and he is one of the nicest, most honest person you know. And Susan? She also seems very responsible and you would never have suspected her.

There must be some other answers here in the evidence to help explain it. Time to check the evidence, the **white powder**. You wonder what this will reveal.

Breakout Box - CSI

Clue #2

All right, you know now the powder is baking soda, but how does this help you? You know that baking soda is often an ingredient in antacid tablets (Tums) that you often see your dad eat after a big meal. But why would that be at the scene?

You better get going. You aren't sure when the library staff and security guard will return and you have 2 more pieces of evidence to analyze. It looks like there is some shoe print evidence.

Breakout Box - CSI

Clue #3

Time is really starting to run out. Now that the shoe print has been analyzed, it is time to work on the final piece of evidence- the note from the scene. Hopefully this will give you enough information to crack the case and find out who took the Harry Potter book.

Breakout Box - CSI

Clue #4

You have had a chance to examine all of the evidence and seems like all the evidence is pointing to one person.

You are ready to tell the library staff and security guard what you found to prove your innocence.

Enter the first name of the person you think committed the crime to open the “Final Clue” inside the box.

Breakout Box - CSI
Final

The library staff and security guard return and you tell them what you found. You think Chris took the Harry Potter book. They are impressed that you were able to put together all the pieces of the evidence, but annoyed that you had messed around with the investigation.

After a few minutes of talking, they let you leave the library. As you walk out of the room you were questioned in, you see Chris sitting at one of the tables with his head hanging down.

He looks up at you and your eyes meet. He says, “Sorry! I didn’t mean to get you mixed up in this. I have been struggling in math and wanted to continue being the top student. I found a great tutor, but my parents couldn’t afford to pay for it. I thought that if I could get the money I could pay for tutoring myself. I know this really great tutor who loves Harry Potter, so I thought if I gave them the autographed copy of Harry Potter they would tutor me for free.”

After talking with Chris, you decided to head home. After all, it’s been a long day.

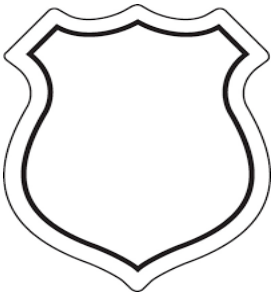
On your way out of the library, the staff gave you back your backpack. You feel lucky that you weren’t blamed for taking the book, but decided helping out a friend is important. So that night you emptied your piggy bank and decided to give Chris all of your saved up money to help him pay for his tutor.

Notes and Evidence Log

Record notes about the evidence as you investigate

What was the Evidence	Notes about the evidence
1	Code:
2	Code:
3	Code:
4	Code:

Who does the evidence point to?

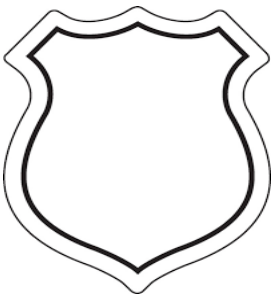


Crime Report

At 2100 yesterday, library staff called security to investigate a missing 1st edition autographed copy of Harry Potter and the Sorcerer's Stone by J.K. Rowling. The book on the display counter was gone. Susan Delaney, a student who works at the library after school, often cleans the display case before going home. She said that she double-checked and the book was in the case before she left.

At the scene, security found no evidence of forced entry into the display case where the book was being stored. There were no broken windows and the digital code to unlock the door of the display case was in working condition. Police collected evidence to be sent to the crime lab for further testing.

Five suspects were at the library during the day the book went missing and have been brought into the security station room for further questioning. Their profiles have been included in the suspect files.



Evidence Log

Evidence #1 – Fingerprints

The door to the display case and the counter around the display case were dusted for prints. Two different sets of prints were found and brought in for further testing. Suspects were fingerprinted on arrival to the station and are included in their files.

Evidence #2 – White Powder

An unknown white powder was found on the handle of the display case. The powder was collected at the scene and brought in for further testing.

Evidence #3 – Shoe Print

Muddy shoe prints were found inside the library near the display case. Shoes from the suspects have been collected and photographed and placed in the evidence file.

Evidence #4 – Ink on the Note

A crumpled handwritten note was found just outside the display case. The note was written in black pen and contained the code to unlock the display case door. The suspects and their bags were searched to find any black pens that may have written the note. Ink from the pen and note will be analyzed to determine if there is a match.

Suspect A

Name: Susan Delaney

Height: 5’2”

Weight: 125 lbs.

Shoe Size: 8.5

Hair Color: Light Brown

Eye Color: Blue

Notes:

Susan works at the Hartford Public Library after school. She reported Harry Potter book was in the display case before she went home for the night. Susan’s teachers at school report that she is a hard worker, earning B grades in all of her classes. Her father recently lost his job. She is known for her sweet personality and “sweet tooth” and is often snacking on cookies, candy, and her favorite – powdered donuts.

Suspect B

Name: Marla Jackson

Height: 5’6”

Weight: 145 lbs.

Shoe Size: 9

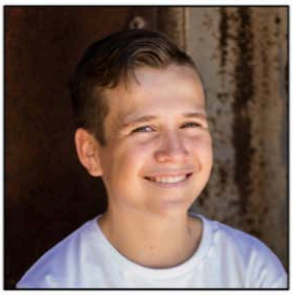
Hair Color: Dark Brown

Eye Color: Brown

Notes:

Marla was seen walking around the Harry Potter display case several times earlier that day. When questioned about it, she says she was babysitting her young sister who loves Harry Potter and wanted to see the book on display.

Teachers report that Marla gets mainly A’s and B’s. Her teachers say she is often sleepy in class but always works hard and helps others study. Both parents work more than one job and Marla is often in charge of her younger brothers and sisters.



Suspect C

Name: Chris Fulton

Height: 5’11”

Weight: 165 lbs.

Shoe Size: 11

Hair Color: Brown

Eye Color: Brown

Notes:

Chris is one of the top students at the school and puts a lot of pressure on himself to succeed. He earns A’s in all of his classes and also works as a peer tutor to help others. He was seen studying in the library around the time the book went missing. He has stomach troubles and regularly eats antacids (Tums) to deal with the problem.

Suspect D

Name: Nhi Nguyen (aka Mrs. N)

Height: 5’5”

Weight: 135 lbs.

Shoe Size: 7

Hair Color: Black

Eye Color: Brown

Notes:

Mrs. Nguyen was an employee at the Hartford Public Library for the past 10 years. Students, parents, and the public report she is quiet but gets the job done.

Miss Nguyen and her family were moving to Boston, so last week was her last full week of work. Despite no longer working for the Library, Mrs. Nguyen was seen at the tables near the display case eating a salted pretzel. Students say they saw her researching J.K. Rowling the day the book went missing.

No Picture Available

Suspect E

Name:

Height:

Weight:

Shoe Size:

Hair Color:

Eye Color:

Information Not Available at this Time – Suspect Waiting in the Security Office

Notes:

This suspect's backpack was reported to be near the display case after the book was reported missing. The backpack has the student's name written inside.

An anonymous tip led library staff and security to this suspect stating that the suspect was seen wearing a Harry Potter shirt underneath their coat. The suspect states that their backpack was stolen.

Fingerprints from the Scene
Evidence #1

The following prints were recovered from the scene and brought back to the lab for analysis.

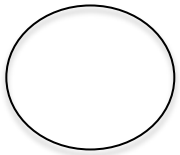
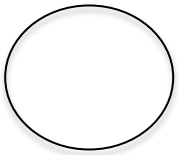
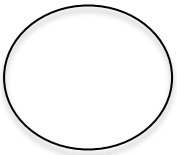
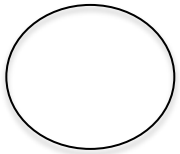
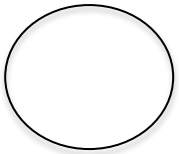
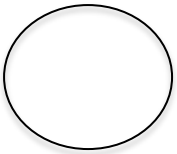
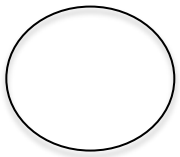
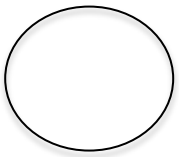
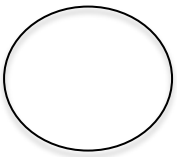
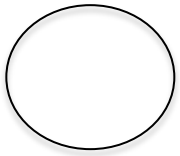
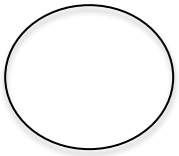
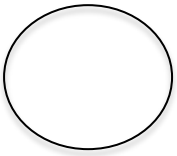
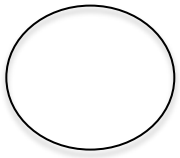
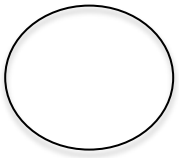
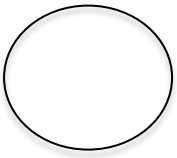
Who do the fingerprints belong to?

To get you next clue, write down the first name (or names) of the suspects that match the fingerprints. If there is more than one person, write the first names in alphabetical order. One of the names will unlock the lock.

White Powder from the Scene Evidence #2

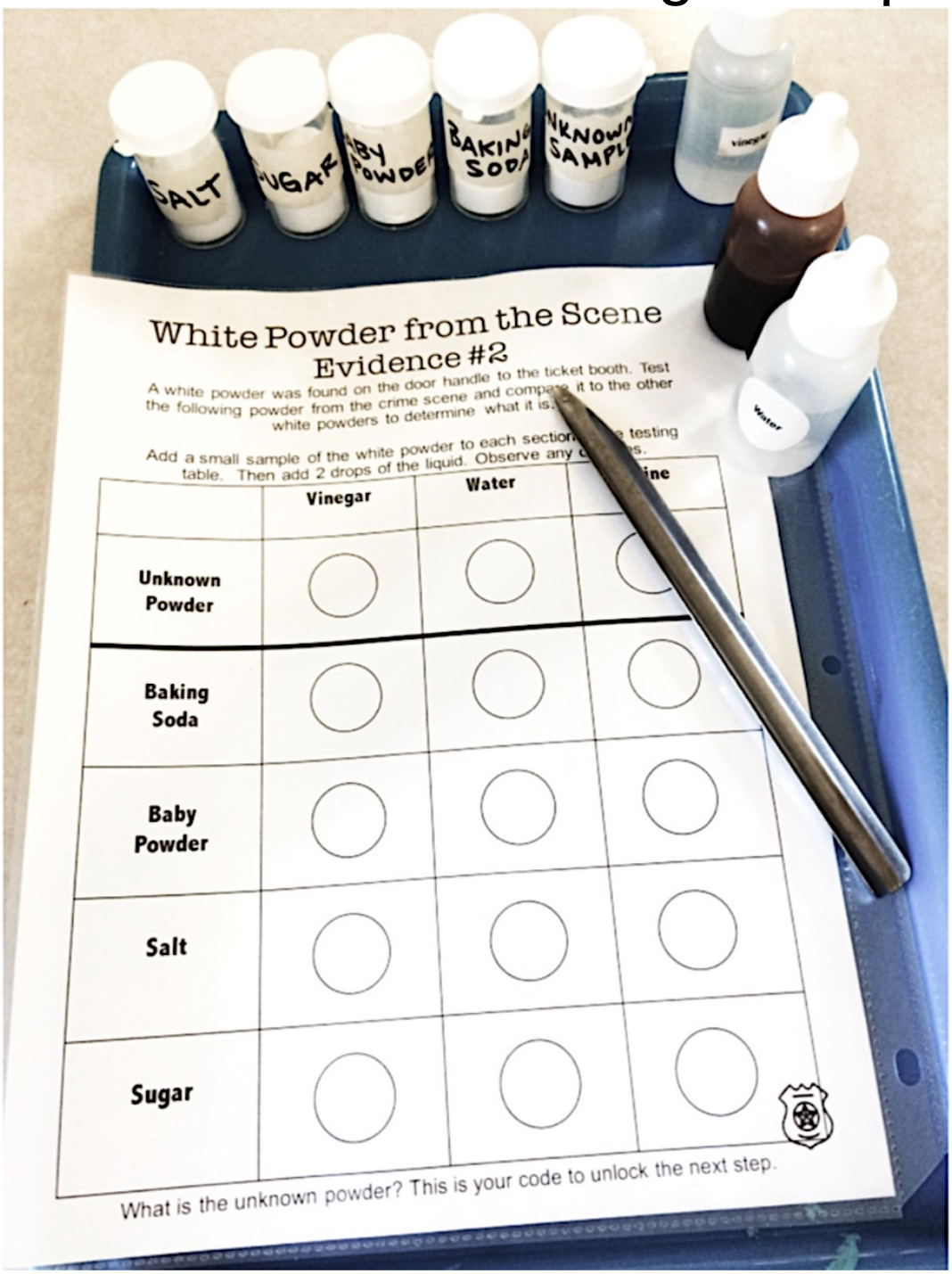
A white powder was found on the door handle of the display case. Test the powder from the crime scene and compare it to the other white powders to determine what it is.

Wearing safety glasses, add a small sample of the white powder to each section of the testing table. Then add **2** drops of the liquid. Observe any changes.

	Water	**Vinegar**	**Iodine**
Unknown Powder			
Salt			
Baby Powder			
Sugar			
Baking Soda			

What is the unknown powder? This is your code to unlock the 1st lock on the box and uncover your next clue.

White Powder from the Scene Evidence #2 – Testing Set Up



White Powder from the Scene Evidence #2

Testing Directions

1. Add a small sample of the unknown powder to the 3 circles in the top row.

2. Add a small sample of the know powders (salt, baby powder, sugar, baking soda) to the 3 circles in the chart.

3. Add **2** drops of each testing liquid to the powders in each column. Compare the unknown powder to the 4 known powders to identify what it is.

4. Once you have identified the powder, wipe the powder and liquids into the waste container.

5. Return materials neatly to the tray.

6. Your code to unlock the 2nd lock on the box is the name of the unknown powder.

What is the unknown powder? This is your code to unlock second lock for the next clue.

Shoe Print from the Scene
Evidence #3

This muddy footprint was found on the floor of the library near the display case. What is the brand and size of the shoe? The brand is your code to unlock the 3rd lock and retrieve the next clue. Example- Nike

Suspect Shoe
Evidence #3a

Suspect: Susan Delaney
Brand: Mizuno Size: 8.5

Suspect Shoe
Evidence #3b

Suspect: Marla Jackson
Brand: New Balance Size: 9

Suspect Shoe
Evidence #3c

Suspect: Chris Fulton
Brand: Asics Size: 11

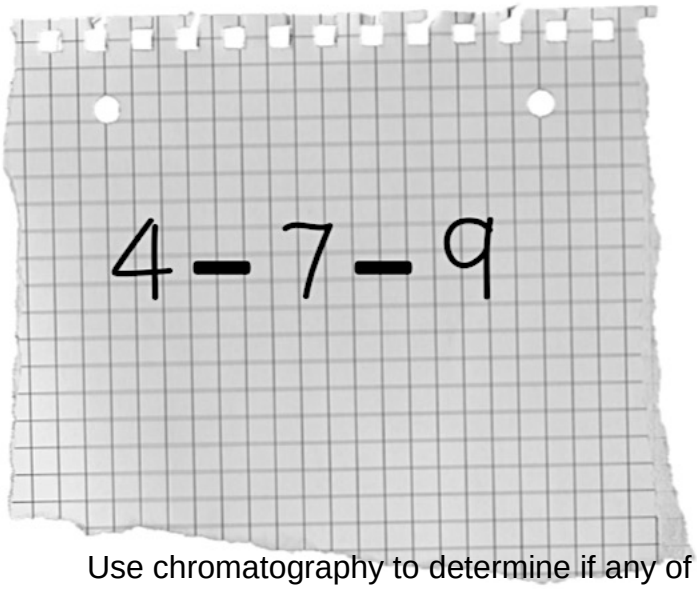
Suspect Shoe
Evidence #3d

Suspect: Nhi Nguyen
Brand: Keen Size: 7

Suspect Shoe
Evidence #3e

Suspect: YOU
Brand: Adidas Size:

Ink on Note from the Scene
Evidence #4



The note to the left was found at the crime scene and is the code to the digital lock to open the display case holding the Harry Potter book.

Analyze the ink to determine which pen wrote the note.

Each suspect and their belongings were searched to find black pens. Four of the suspects had black pens on them or in their backpack. Mrs. Nguyen did not have a pen.

Use chromatography to determine if any of the pens were used to write the note.

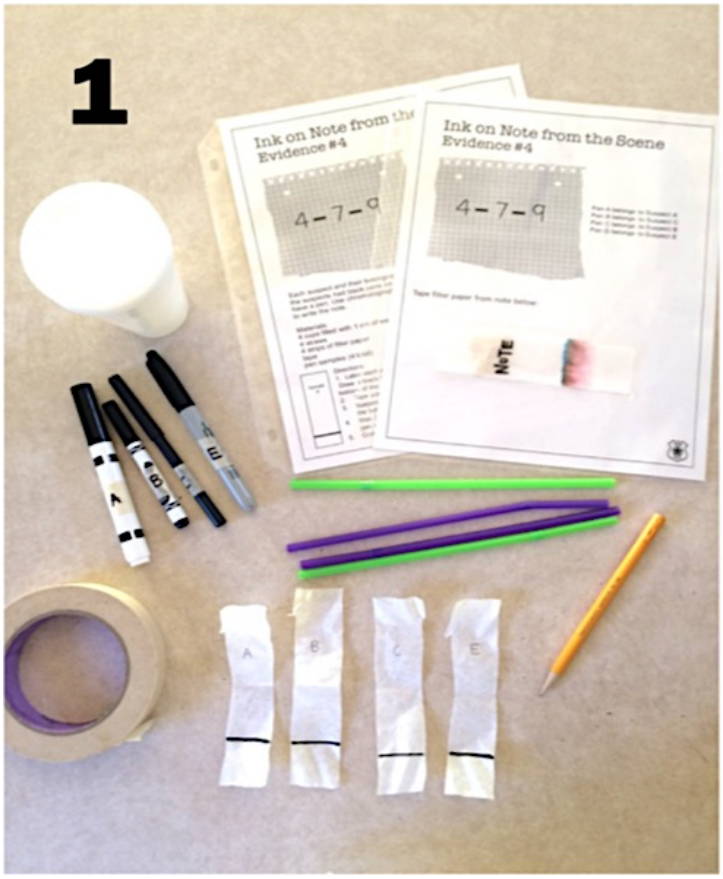
Materials:
4 cups filled with 1 cm of water
4 straws
4 strips of chromatography paper
Tape
4 pen samples

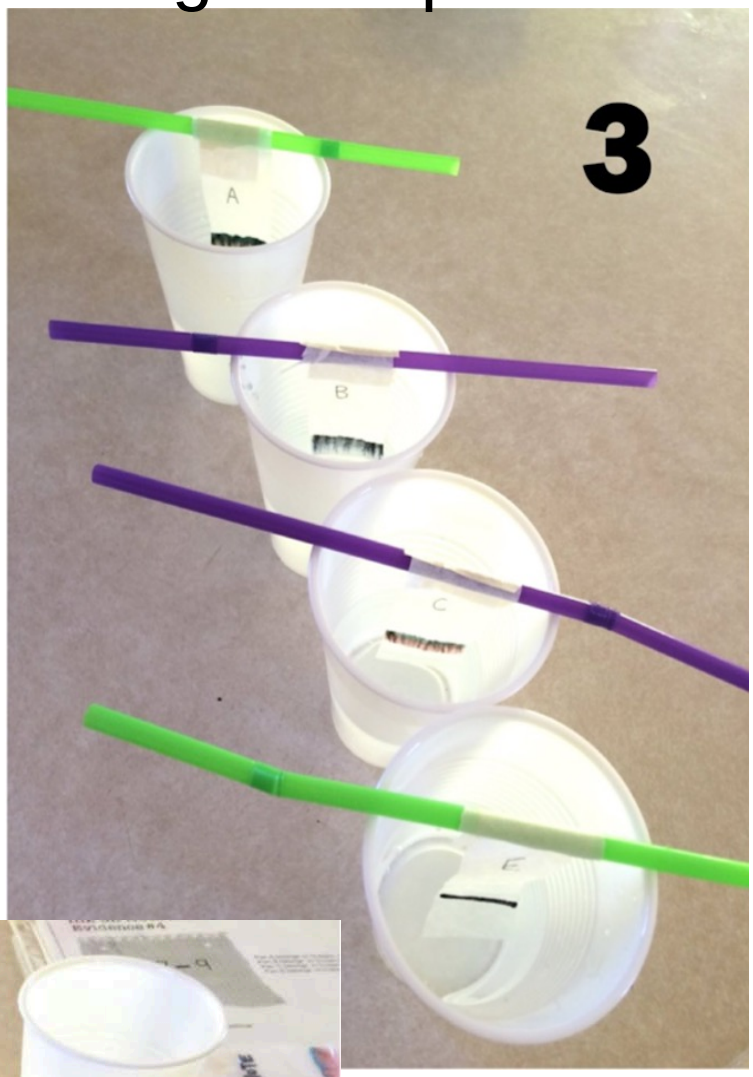
Pen A belongs to Suspect A
Pen B belongs to Suspect B
Pen C belongs to Suspect C
Suspect D- No Pen
Pen E belongs to Suspect E

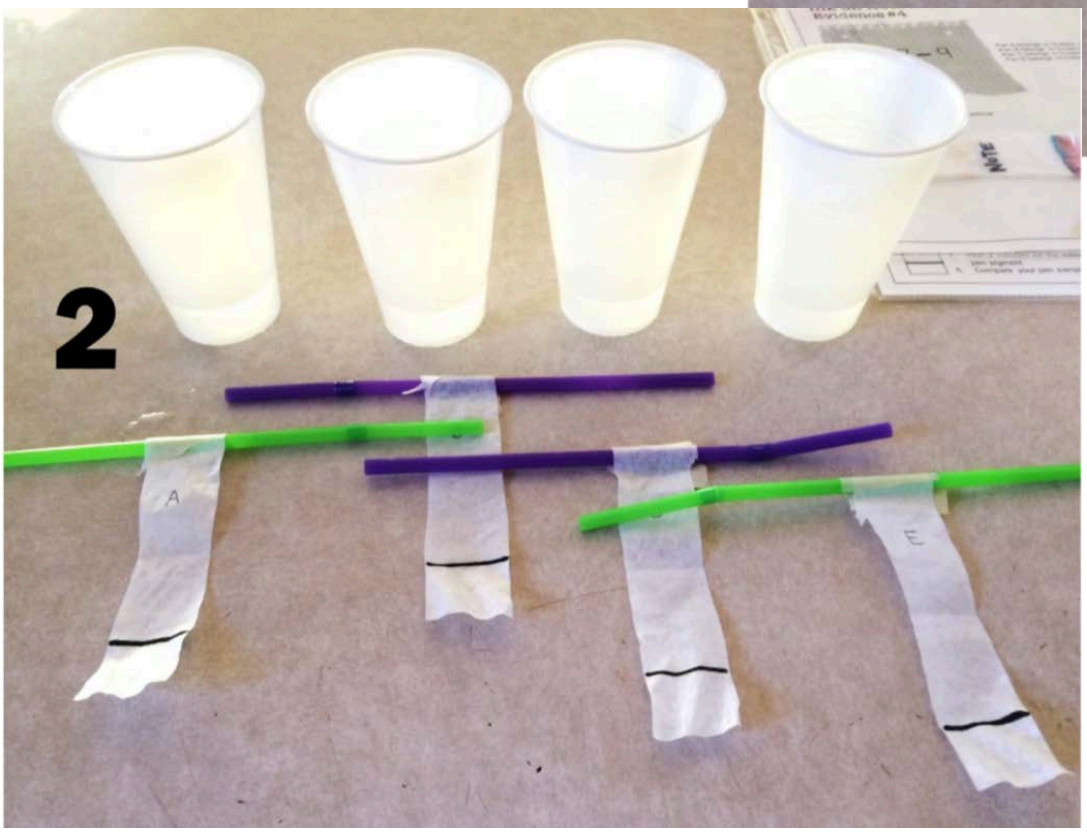
Sample A

Directions:
1. Label each paper with the pen being tested (in pencil)
- Draw a black line across one end of the filter paper 2 cm from the bottom of the strip.
2. Tape your strip to the straw so the line is on the bottom
3. Suspend each sample in a cup of water – The water should cover the bottom of the strip, but the line should be above the water.
4. Wait 1 minute for the water to travel up the paper and spread the pen pigment.
5. Compare your pen sample to one that was used to write the note.
6. Unlock the 4th lock with the pen sample used. Example- PenF

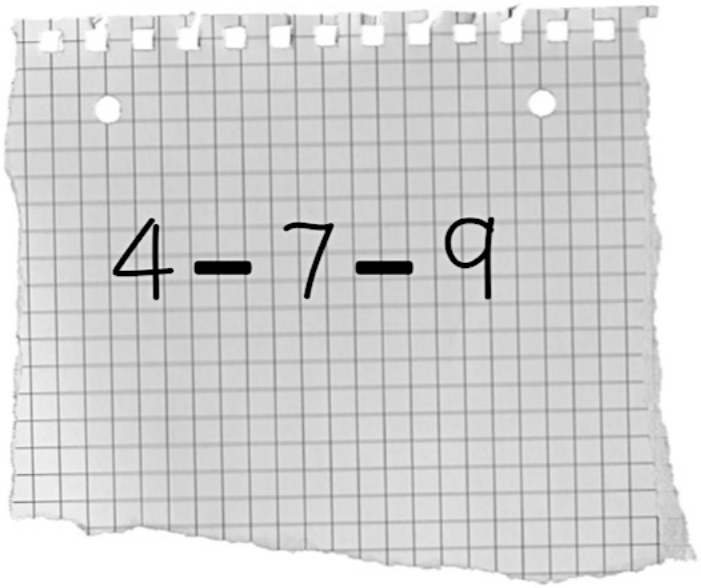
Ink on Note from the Scene
Evidence #4- Testing Set Up







Ink on Note from the Scene
Evidence #4



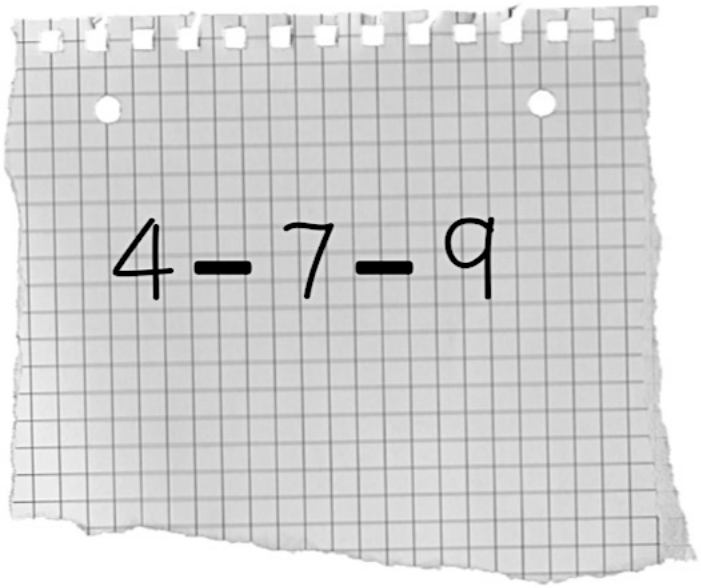
Pen A belongs to Suspect A
Pen B belongs to Suspect B
Pen C belongs to Suspect C
Suspect D- No Pen
Pen E belongs to Suspect E

Tape filter paper from pens below and compare it to the ink from the note:

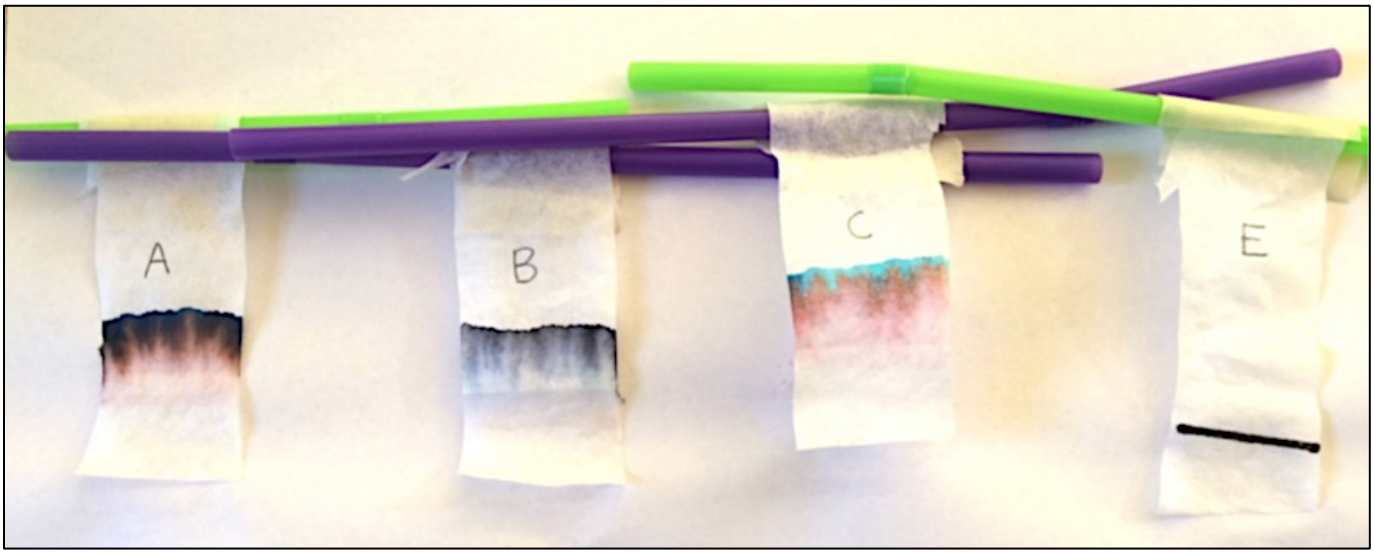
Who owns the pen that matches the ink found on the note?

Enter the first name of the person you think committed the crime to open the “Final Clue” inside the box.

Ink on Note from the Scene
Evidence #4- Answer Key



Pen A belongs to Suspect A
Pen B belongs to Suspect B
Pen C belongs to Suspect C
Suspect D- No Pen
Pen E belongs to Suspect E



Zoology

Lesson 7- Dinosaur Dig

Ages 6-11

(Adapted from Mystery Science)

Overview

In this activity, students help Edison and Doris investigate how we can infer what the outside of an animal looked like, by using clues about their skeleton. They will first examine skulls of both familiar animals and dinosaurs; specifically their teeth to figure out what that animal ate. After students will then perform a dinosaur dig and excavate dinosaur bones to see if they can apply their skills learned in the lesson to identify what the dinosaurs excavated ate.

Paleontology is a branch of biology that studies the life of plants and animals that existed in the past by examining fossils. Fossils are clues to the past! They can tell us what an organism looked like on the outside, the habitat it lived in, and even the food it ate. Dinosaur skeletons helped us learn that dinosaurs looked a lot like lizards do today. Fossils of their teeth helped us determine if they were meat or plant-eaters.

Learning Objectives

1. Students will analyze and interpret data from fossil records to determine what type of food an organism ate.
2. Students will use the fossil evidence to engage in an argument for why they chose each food source.
3. Students will be able to consider that fossilized evidence of organism's teeth and body (structure) can determine which type of food they ate (function) and the type of environment they inhabited.

Suggested Timeframe

45 minutes

Materials Required

- 1 Dinosaur Dig Sand Kit (with Tools, Inflatable Tray, and Dinosaur Skeletons)
- 1 Pair of Goggles per student
- 1 Copy of "What Do These Animals Eat?" Handout (4 Pages)
- 1 Paper Dry Erase Protective Sleeve
- 1 Thin Expo Marker for each student
- 1 Dry Eraser
  Students can place their worksheet one at a time inside the protective sleeve and use the dry erase marker to do their work.

Assessment

- Pre-Activity Assessment – Discussion Question
- Activity Embedded Assessment - Worksheet
- Post-Activity Assessment – Paleontologist Poster

Introduction/Initiation
Show students the following video from BrainStuff on YouTube called, "How do we know what dinosaurs looked like?" video 3 min. 18 seconds https://www.youtube.com/watch?v=2TNlmZmuDM4

Procedure
Before the Activity

1. Gather all supplies.
2. Get 1 "What Do These Animals Eat?" Handout (4 pages), 1 Protective Sleeve, 1 Expo Marker, and 1 Eraser for each student
3. Set up inflatable tray with the sand and bury the dinosaur skeletons (without students observing)

With the Students

1. After watching the video, "How do we know what dinosaurs looked like?" Have students examine the pictures of different animal skulls by looking at the 4 pages of the "What do these animals eat?" handout.
2. Page 1- Examine the skulls of a horse and an alligator. Determine what type of food each of these animals ate based on looking at the skull's teeth.
3. Page 2- Examine the skulls of two dinosaurs the Tyrannosaurus Rex and the Triceratops. Determine if Dinosaur A and B ate plants or meat/fish.
4. Page 3- Examine 4 Dinosaur skulls and circle if you think they ate plants or meat/fish.
5. Page 4- Examine the final two skills, the Heterodontosaurus and the Raccoon. Draw a circle around the sharp teeth used for grabbing prey, draw an arrow pointing to the front teeth that can cut through grass or leaves, and draw a box around the flat teeth for chewing.
6. Have students work with Dinosaur Dig Sand Kit – Students will wear goggles and then use the tools provided to excavate dinosaur skeletons from the inflatable table covered in sand.

Assessment
Pre-Activity Assessment
Discussion Questions: Solicit, integrate and summarize student responses.

- When scientists look at the bones of a dinosaur, why do you think they decided the outside of a dinosaur looks like a lizard rather than a furry animal or a feathered animal?

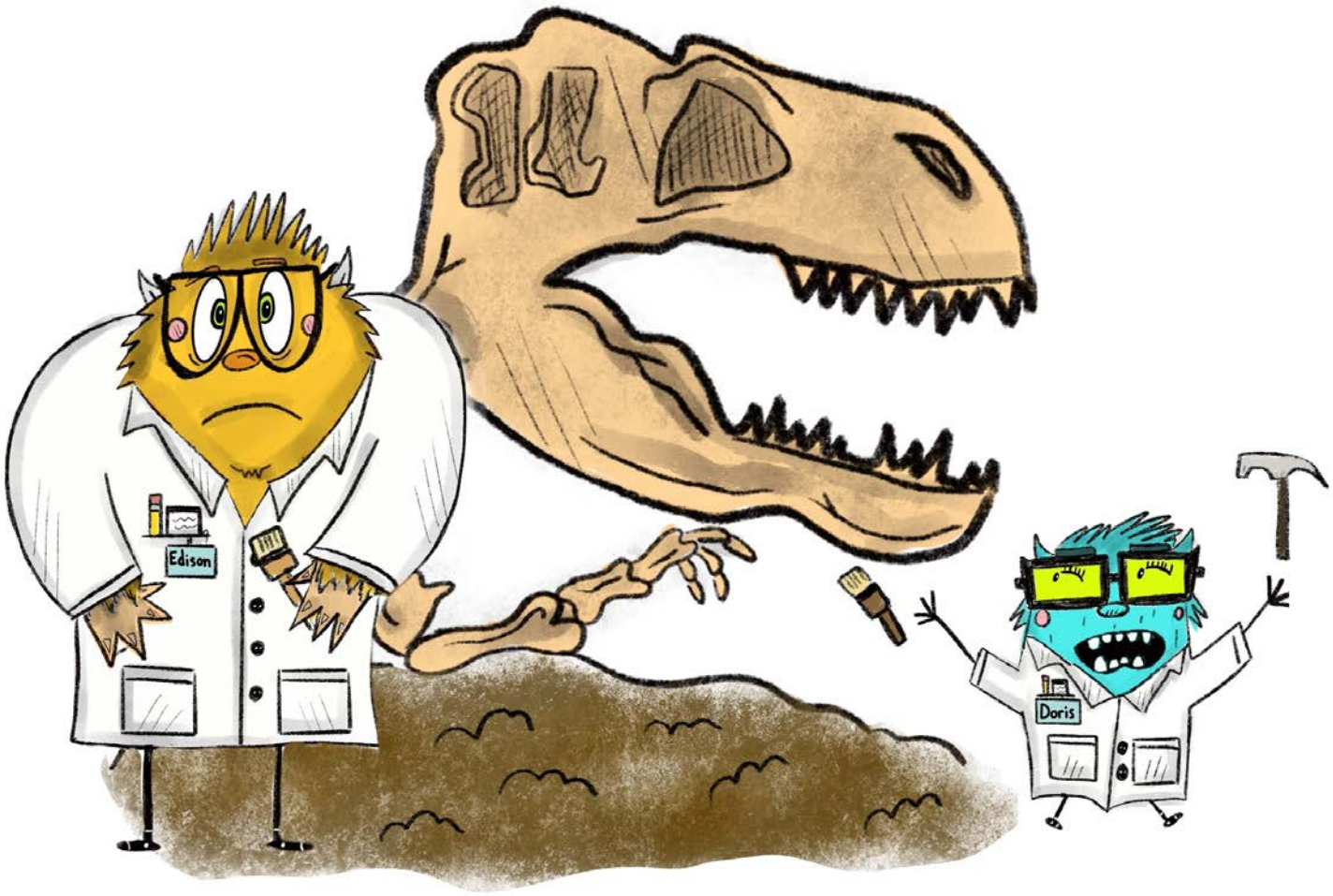
Activity Embedded Assessment
Worksheet: Students will examine pictures of skulls to determine what type of food an organism ate/eats based on the teeth.

Post-Activity Assessment
Paleontologist Poster: After students determine which type of food the dinosaurs or animals ate based on fossil records they will then participate in a dinosaur dig. During the dinosaur dig, the students will excavate dinosaur skeletons of different dinosaurs. Using those skeletons, have students identify what type of consumer they are by looking at the teeth of the skeletons. Are Dinosaurs carnivores (meat eaters), herbivores (plant eaters), or omnivores (eats plants and meat)? Have

students create a poster showing the skulls of the skeletons they found in their dig by drawing them and their teeth and labeling what type of consumer they are.

Activity Extensions

- Have students design their own dinosaur. Think about the features you would like your dinosaur to have such as (armor, horns, color, etc.) First, list its traits, then draw a sketch on paper. Explain, why does your dinosaur look that way?



WHAT DO THESE DINOSAURS EAT?

To find out, compare the teeth.

Which skull has pointy teeth for grabbing an animal?	☐ A	☐ B
Look at the back teeth. Which skull has flat teeth for chewing?	☐ A	☐ B
Which skull has a beak that could cut through grass or leaves?	☐ A	☐ B

CLOSEUP OF BACK TEETH

SKULL A

What does this dinosaur eat?

❑ Plants ❑ Meat/Fish

SKULL B

What does this dinosaur eat?

❑ Plants ❑ Meat/Fish

WHAT DO THESE DINOSAURS EAT?

To figure out the answer, look at the teeth.

Circle your answer for each dinosaur.

CLOSEUP OF BACK TEETH

PLANTS OR **MEAT/FISH**

PLANTS OR **MEAT/FISH**

PLANTS OR **MEAT/FISH**

CLOSEUP OF BACK TEETH

PLANTS OR **MEAT/FISH**

WHAT DO THESE ANIMALS EAT?

Draw a circle around the sharp teeth that can grab prey.

Draw an arrow pointing to the front teeth that can cut through grass or leaves.

Draw a box around the flat teeth for chewing.

Heterodontosaurus

I think this animal eats

_____

because

_____.

Raccoon

I think this animal eats

_____

because

_____.

ANSWER KEY

WHAT DO THESE FAMILIAR ANIMALS EAT?

To find out, compare the teeth.

Which skull has pointy teeth for grabbing an animal? ☐ A ☒ B

Look at the back teeth. Which skull has flat teeth for chewing? ☒ A ☐ B

Which skull has front teeth that could cut through grass or leaves? ☒ A ☐ B

CLOSEUP OF FRONT TEETH

CLOSEUP OF BACK TEETH

SKULL A

What does this animal eat?

☒ Plants ☐ Meat/Fish

This animal lives on ranches today.

What is it? a horse

SKULL B

What does this animal eat?

☐ Plants ☒ Meat/Fish

This animal lives in swamps.

What is it? an alligator

ANSWER KEY

WHAT DO THESE DINOSAURS EAT?

To find out, compare the teeth.

Which skull has pointy teeth for grabbing an animal? ☒ A ☐ B

Look at the back teeth. Which skull has flat teeth for chewing? ☐ A ☒ B

Which skull has a beak that could cut through grass or leaves? ☐ A ☒ B

CLOSEUP OF BACK TEETH

SKULL A

What does this dinosaur eat?

☐ Plants ☒ Meat/Fish

SKULL B

What does this dinosaur eat?

☒ Plants ☐ Meat/Fish

ANSWER KEY

WHAT DO THESE DINOSAURS EAT?

To figure out the answer, look at the teeth.

Circle your answer for each dinosaur.

CLOSEUP OF BACK TEETH

PLANTS OR MEAT/FISH

PLANTS OR MEAT/FISH

PLANTS OR MEAT/FISH

CLOSEUP OF BACK TEETH

PLANTS OR MEAT/FISH

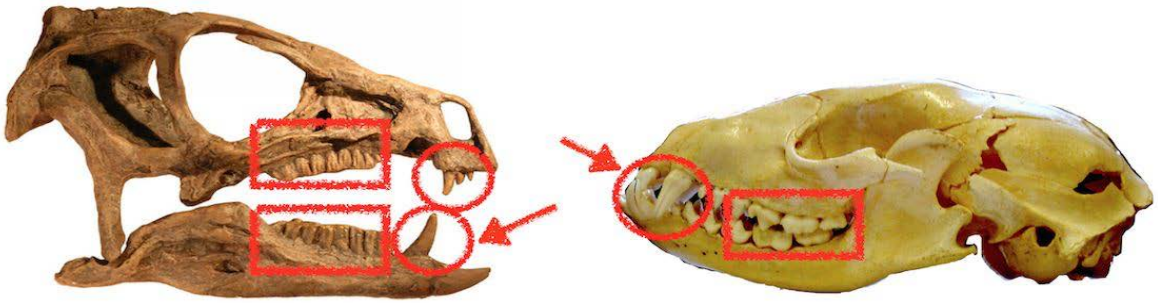
ANSWER KEY

WHAT DO THESE ANIMALS EAT?

Draw a circle around the sharp teeth that can grab prey.

Draw an arrow pointing to the front teeth that can cut through grass or leaves.

Draw a box around the flat teeth for chewing.



Heterodontosaurus

I think this animal eats

meat and plants

because

it has pointy teeth and flat teeth

Raccoon

I think this animal eats

meat and plants

because

it has pointy teeth and flat teeth

Zoology

Lesson 8- Animal Adventures:
How Many Different Kinds of Animals Are There?

Ages 12-14

(Adapted from Mystery Science)

Overview

In this activity, students help Edison and Doris investigate how scientists organize animals into groups based on their unique characteristics. In the activity, students sort animals and animal cards into groups and then classify any 'challenge' animals based on their classification system.

There are so many different kinds of animals- even today, we haven't discovered all of them! Before it was easy to travel and visit each other's continents, people only knew about the types of animals from where they grew up. Early scientists eventually started exploring different places and learning about new animals. They discovered the wide variety of living things in habitats, biodiversity. Scientists such as biologists organized the animals they discovered into groups based on their shared characteristics.

Learning Objectives

1. Students will evaluate and communicate information by sorting animals based on their traits and explaining their choices.
2. Students will sort the animals based on the traits scientists use to classify the animals as mammals, birds, reptiles, and invertebrates.
3. Students will determine which group 'challenge animals' belong to, based on their characteristics.

Suggested Timeframe

45 minutes

Materials Required

- 1 Safari Jungle Animal Bucket (60 animals in the bucket) per class
- 1 Set of Animal Cards (36 cards) per student/pair
- 1 Set of Sorting Mats (4 mats) per student/pair
- 1 Copy of "Challenge Card Sheet" Handout per student/pair
- 1 Paper Dry Erase Protective Sleeve
- 1 Thin Expo Marker for each student
- 1 Dry Eraser

Students can place their worksheet inside the protective sleeve and use the dry erase marker to do their work.

Assessment

- Activity Embedded Assessment – Animal Sort Game
- Post-Activity Assessment – Animal Adventure Post Assessment

Introduction/Initiation
Tell students,

"Imagine that you go on a trip far away from home. You go outside one day, exploring, and you happen to see a really strange animal. It's unlike any animal you've ever seen before. You don't know what kind of animal it even is. But you observe it closely. Now you don't have a camera with you, so you take notes, and draw pictures, and try to describe in words all the things you notice about it.

When you get back home, you describe to your friends what the animal looked like. 'You see it had spots like a leopard, but it was tall like a camel, actually taller with long legs and a long neck." But your friends just say, "Sure, I bet you were just imagining it. There's no animal that exists like that." You really had seen it, though. "No, really" you say. "It was the most amazing animal." Your friends don't believe you. How could you convince them that the animal was real?

How would you convince your friends?

Now, you might be thinking, it should be easy to convince your friends that you really saw this strange animal. You could look for pictures of the animal on the Internet and just show those to your friends.

Today, the idea of knowing what kinds of animals there are in the world seems silly. We have cameras and the Internet, and you can even hop on a plane to travel to places in just a few hours. But there was a time when people hadn't traveled to different places around the world. For example, a few hundred years ago, most people from the continent of Europe had never been to the continent of Africa. When some Europeans eventually traveled from Europe to Africa, they saw animals they weren't familiar with. They really did see a tall animal with spots that they've never seen before. They called it a camelopard because it had long legs and a long neck like a camel, but spots like a leopard. They came back to Europe and describe the animal to other people at home. It turns out that this camelopard is an animal that I think you're familiar with.

What do you think it is?

That's right. It's a giraffe. Camelopard is what some people actually used to call giraffes. For people who hadn't seen them before, they thought they looked like a camel with leopard spots.

Today, we live in a world where we can see animals anytime we want like in zoos, books, or on TV shows. So even if you never travel or leave your town, you know about all kinds of different animals that live all over the world. But a long time ago, before people had explored and visited each other's continents, people only knew about the animals they grew up with. They never got to see animals far away.

Early scientists learned that they could learn a lot by traveling, so they started sailing on ships, exploring places far away from where they grew up. They found all kinds of new and interesting animals. They didn't have cameras to take

pictures of them. Instead, they had to describe things by drawing them as best they could and writing about them.

Scientists started to notice that some animals are similar but had only a few differences. They wondered how should we group these animals? Should we group them based on what kinds of animals they are? How should we group them?

Early scientist decided to group animals based on what kinds of animals they are."

Today you will investigate how scientists organize animals into groups based on their unique characteristics

Procedure

Before the Activity

1. Gather all supplies.
2. Get 1 set of animals cards, 1 set of sorting mats, 1 handful of animals from the animal bucket, and 1 Challenge Card Sheet for each pair of students.

With the Students

In this activity, students are going to imagine they're explorers. Their task is to group animals by their traits by figuring out how they're different from one another and how they're the same.

1. After reading the introduction/initiation, show students the Grouping Animals Picture of 6 different animals (frog, horse, zebra, etc.) and ask the students "How would they group these animals?" After students have grouped the animals in the picture, discuss ways in which they grouped the animals such as: color, stripes, etc. Tell the students that scientists wanted to group animals based on their 'characteristics'- how the animal looks and its different parts.
2. After, students are going to sort the animals from the animal bucket by classifying them into groups. Tell students, "In today's activity you're going to act like a scientist and figure out where each one of these animals belong." Give pairs of students a handful of animals from the animal bucket. Have them sort their animals into different groups. After two minutes, have students pick a group and share why they put those animals together. Then have students pick an animal that was hard to put into a group and have them share what animal it is and why it was hard to group.
3. Explain to students that scientists don't just look at the outside of the animal when grouping them. They look at the inside and ask, do they have bones? Or no bones? They also ask where did the animals young come from. Do they hatch from an egg? Or are they born? Using the animals from the bucket, have students sort the animals into groups of animals that have bones and another group that has no bones. After have the students sort their animals into a group that lays eggs and a group that doesn't lay eggs. Give students the animal sorting mats.

Students will place the rest of their animals on one of the four sorting mats: mammals, birds, reptiles, and invertebrates.

4. Next, students will play the “Animal Sort Game” using the animal cards with a partner. *The cards have information about that animal that the students are going to use to sort the cards into four piles. The piles should be grouped by the traits scientists use to identify mammals, birds, reptiles, and invertebrates.*
   **If students are having trouble, they can use the sorting mat.*

Assessment

Activity Embedded Assessment

Animal Sort Game will be used to show students understanding of classifying animals into groups (without using the sorting mats) unless needed.

Post-Activity Assessment

Animal Adventures End of Activity Assessment

Activity Extensions

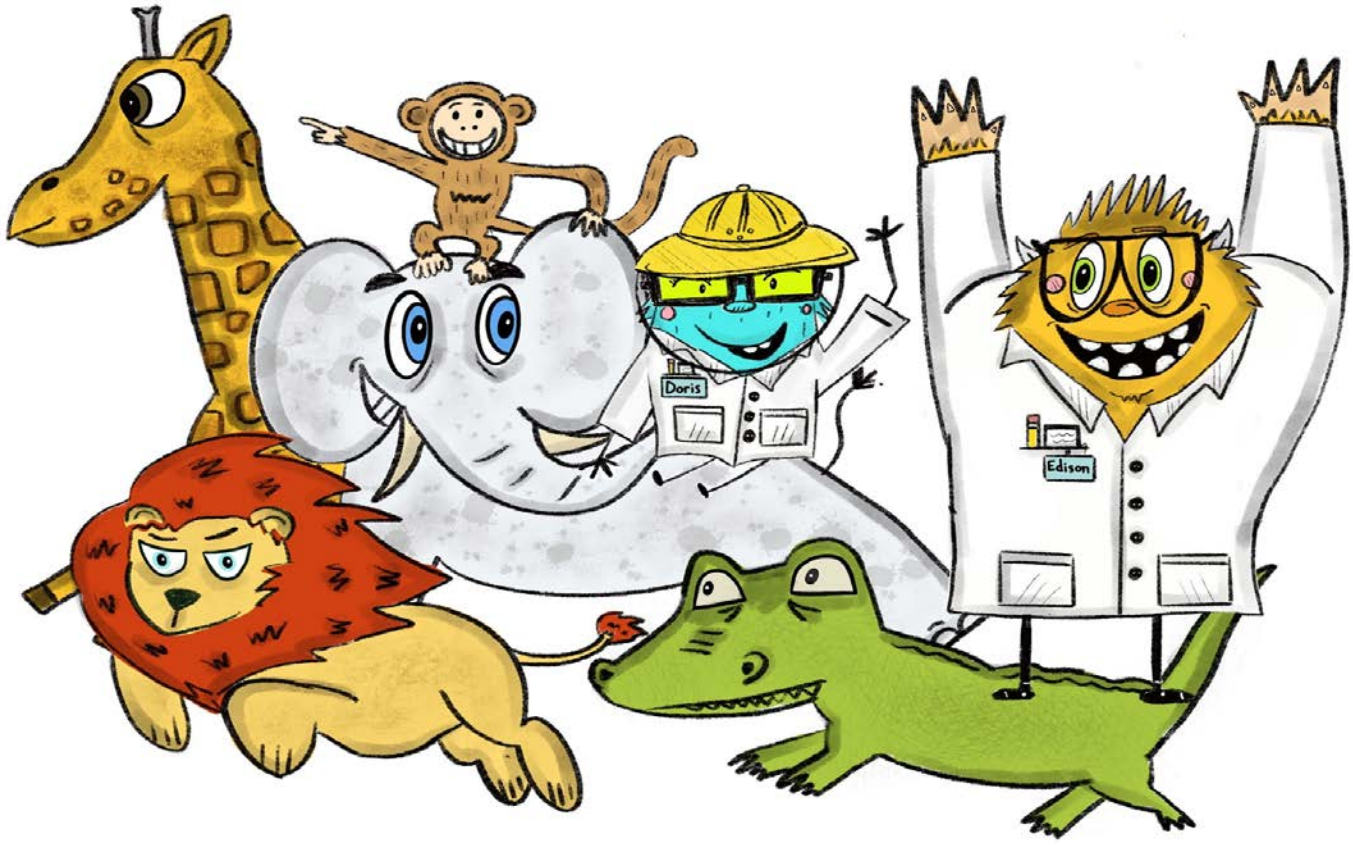
- Have students create their own animal and write a paragraph describing its features. Think about all of the traits in each group. Will your newly discovered animal have traits from more than one category? What will your new animal be called? What features and adaptations does it have?

Grouping Animals Picture

Look at these 6 animals. How many different ways can you group them? Why would you put certain animals together?

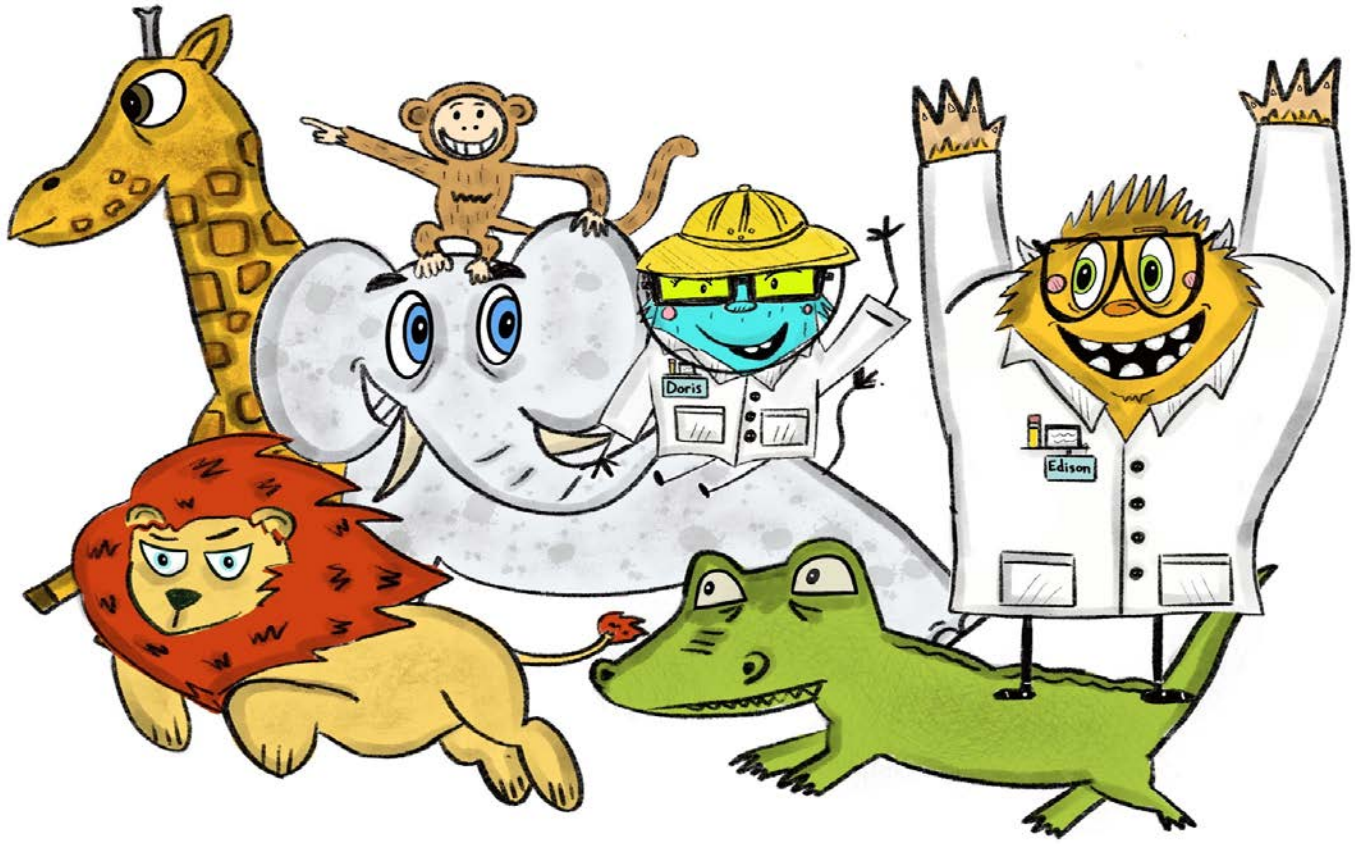
Mammal Sorting Mat

- Does the animal have bones?
- Does the animal have hair or fur?
- Does the animal not lay eggs?



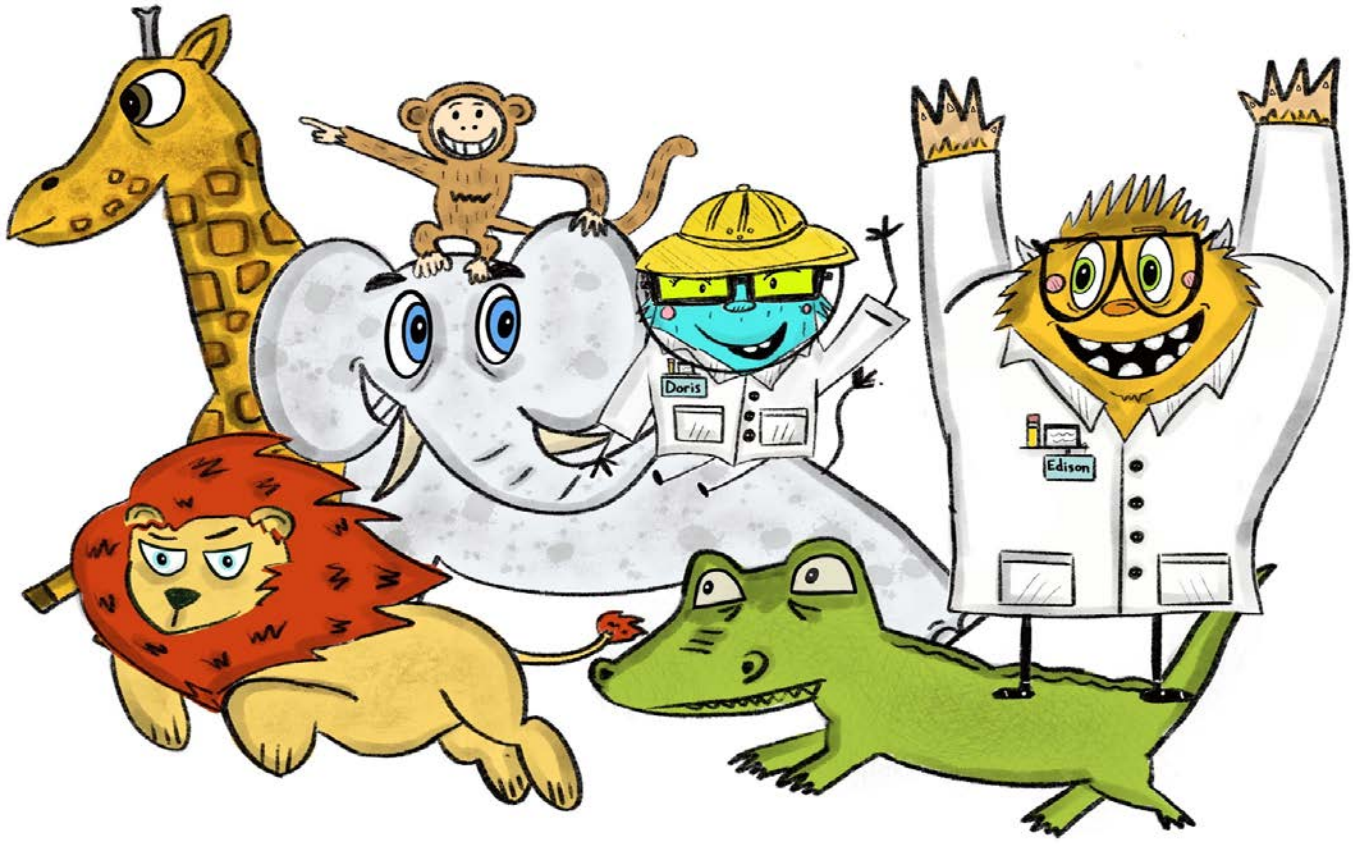
Bird Sorting Mat

- Does the animal have bones?
- Does the animal have feathers?
- Does the animal lay eggs?



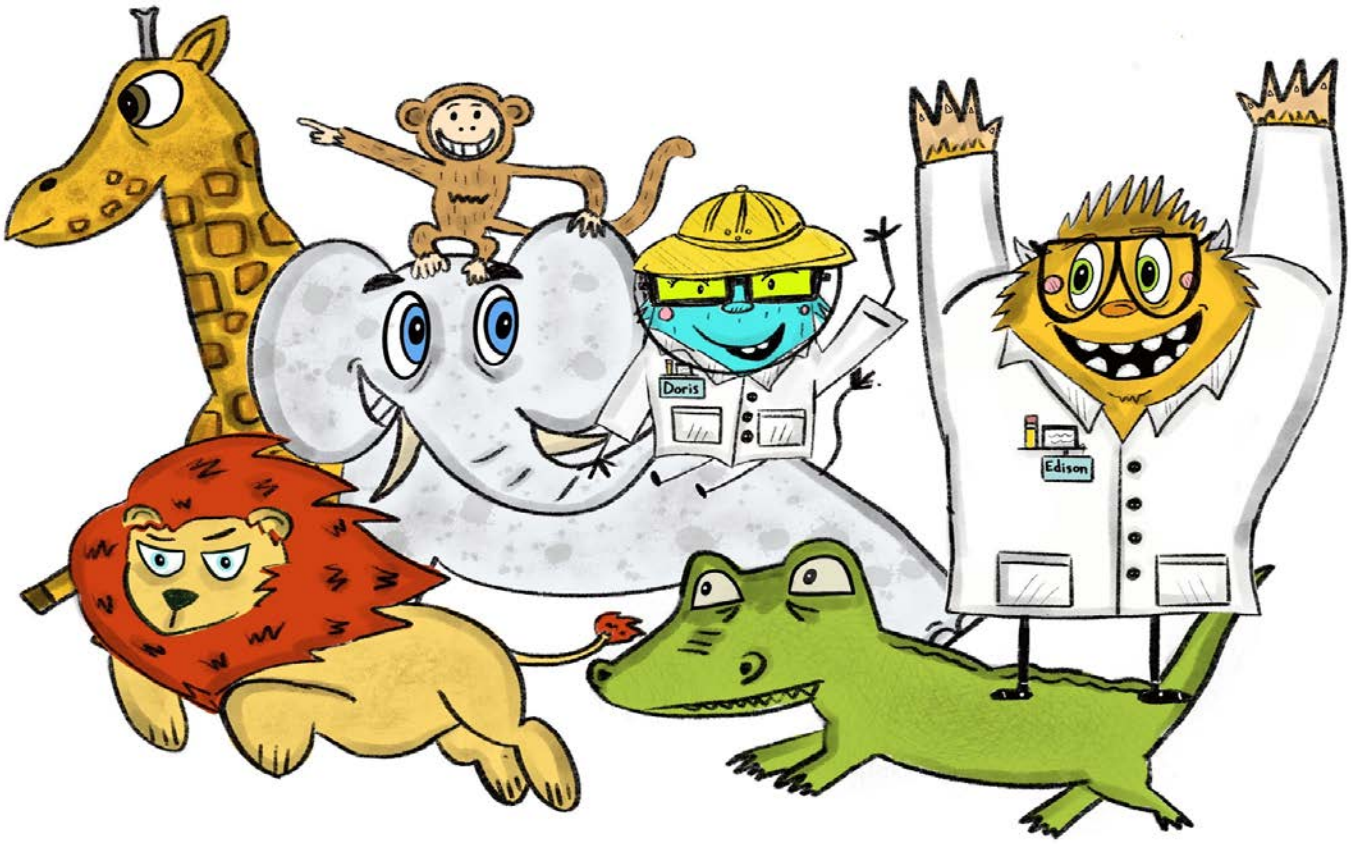
Reptile Sorting Mat

- Does the animal have bones?
- Does the animal have scales?
- Does the animal lay eggs?



Invertebrates Sorting Mat

Does the animal not have any bones?



STAGE 2

Bald Eagle

HP 110

Evolves from Chick

- Has bones inside its body
- Lays eggs
- Has feathers

Characteristics

Eagles are dominant predators and are known as birds of prey. An eagle's eyesight is so good that it can apparently see a mouse on the ground when the eagle is still high in the sky.

Habitat

Eagles are most commonly found in the Northern Hemisphere including Europe, Asia and North America. Eagles are also found on the African continent.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Aves

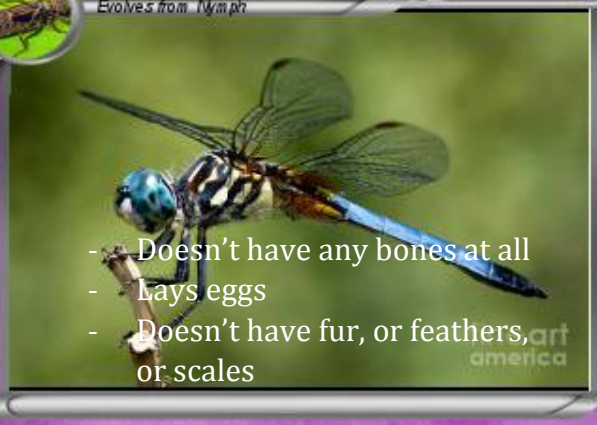
- fake card -

STAGE 2

Dragonfly

HP 30

Evolves from Nymph



- Doesn't have any bones at all
- Lays eggs
- Doesn't have fur, or feathers, or scales

Characteristics

Dragonflies have long, thin, colorful bodies, large eyes, and two pairs of transparent wings. It is unable to walk on solid ground. A dragonfly can fly in six directions: up, down, forward, back, and side to side.

Habitat

The dragonfly is generally found around watery areas in both the North and South Hemispheres. They can be found hovering near lakes and swamps because their larvae are aquatic.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Arthropoda
Class: Insecta

- fake card -

STAGE 2

Hummingbird

HP 30

Evolves from Chick

- Has bones inside its body
- Lays eggs
- Has feathers

Characteristics

Hummingbirds have long, pointed beaks and long tongues to gather nectar from deep inside flowers. They can beat their wings 15-80 times every second! They are also the only species of bird that can fly backwards.

Habitat

There are nearly 350 known species of hummingbird, found throughout the Southern Hemisphere.These small birds tend to prefer the more tropical climates.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Aves

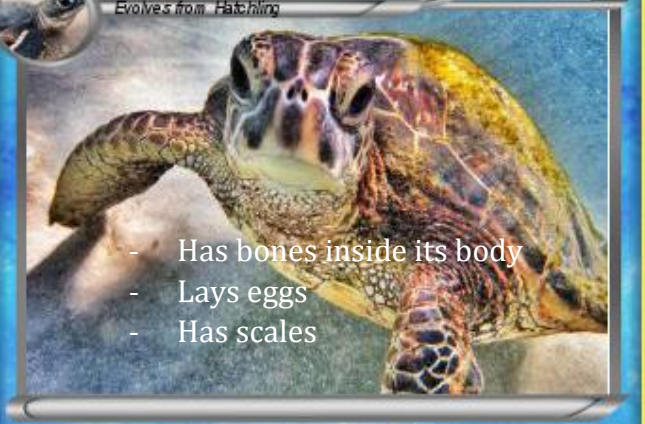
- fake card -

STAGE 1

Sea Turtle

HP 60

Evolves from Hatchling



- Has bones inside its body
- Lays eggs
- Has scales

Characteristics

Although sea turtles spend their time out at sea, they always go back to the same beach to breed and often travel huge distances to get there. The smallest sea turtles measure around 50cm and largest are nearly 2m.

Habitat

Sea turtles are found in all of the major oceans and smaller seas, except for the Arctic Circle.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Reptilia

- fake card -

STAGE 1

Red-Knee Tarantula

HP 40

Evolves from: Spiderling

- Doesn't have any bones at all
- Lays eggs
- Doesn't have fur, or feathers, or scales

Characteristics

The Red-Knee Tarantula is a type of burrowing tarantula. It is most well known for its hairy body and the red bands that are along its legs. They are quite common now to be kept as pets because they are slow growers.

Habitat

The Red-Knee Tarantula is found in Mexico, south-western United States and Panama.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Arthropoda
Class: Arachnida

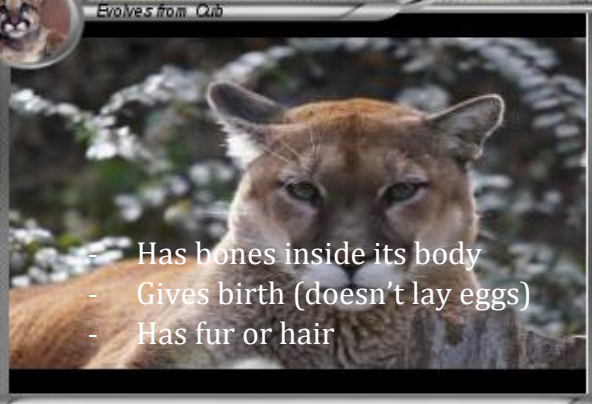
- fake card -

STAGE 1

Cougar

HP 90

Evolves from: Cub



- Has bones inside its body
- Gives birth (doesn't lay eggs)
- Has fur or hair

Characteristics

The cougar has longer back than front legs and a long heavy body. Cougars are also well known for their amazing ability to jump up to 30ft.

Habitat

Cougars can be found mainly in the mountain regions of Canada and Mexico. Cougars are also found in Asia and Africa.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

- fake card -

STAGE 1

Kangaroo

HP 130

Evolves from: Joey

- Has bones inside its body
- Gives birth (Doesn't lay eggs)
- Has fur or hair

Characteristics

The kangaroo is the largest of the marsupials, which means it has a deep pouch on its front to carry its young. Kangaroos have large, flat feet which they use in order to hop. The kangaroo is the national animal of Australia.

Habitat

The kangaroo is found in Australia and the Indonesian island of New Guinea.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

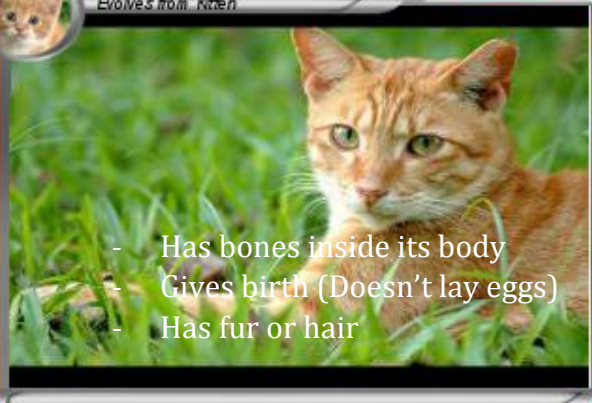
- fake card -

STAGE 1

Orange Tabby Cat

HP 40

Evolves from: Kitten



- Has bones inside its body
- Gives birth (Doesn't lay eggs)
- Has fur or hair

Characteristics

Tabby cats have fur with stripes, dots, lines or swirling patterns, usually together with a mark resembling an 'M' on its forehead. Other names for this cat are marmalade cat and ginger cat.

Habitat

Orange tabby cats are usually domestic and live in homes around the world.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

- fake card -

STAGE 1

Great White Shark

HP 190

Evolves from: Pup

- Doesn't have bones in its body
- Gives birth (Doesn't lay eggs)
- Doesn't have fur, feathers, or scales

Characteristics

The great white shark can grow to more than 8m long and weigh well over 4,000lbs! It has approximately 300 teeth which are arranged in many rows along both its top and bottom jaws.

Habitat

The great white shark is most commonly seen around Australia, South Africa, California and Mexico.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Chondrichthyes

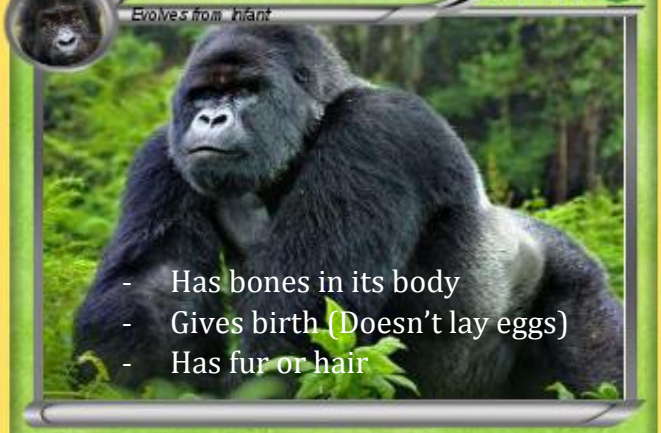
- fake card -

STAGE 1

Gorilla

HP 190

Evolves from: Infant



- Has bones in its body
- Gives birth (Doesn't lay eggs)
- Has fur or hair

Characteristics

Gorillas are the biggest of the world's primates. They spend most of their time eating, sleeping and grooming the other gorillas. The gorilla will not usually fight, but will make lots of noise when it feels threatened.

Habitat

Gorillas live in the forests in select parts of Africa. The gorilla population is sadly much lower than it used to be meaning that gorillas are an endangered species.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

- fake card -

STAGE 1

Alligator

HP 110

Evolves from: Hatchling

- Has bones inside its body
- Lays eggs
- Has scales

Characteristics

Alligators can be yellow, green, brown, and finally turning almost completely black in old age. Alligators have been known to move at speeds of up to 15mph on land, making them one of the fastest reptiles in the world.

Habitat

Alligators can be found in the southern United States and in China. They live in freshwater environments, such as ponds, marshes, wetlands, rivers, lakes, and swamps.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Reptilia

- fake card -

STAGE 2

Poison Dart Frog

HP 180

Evolves from Tadpole

- Has bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

Most poison dart frogs are small, sometimes less than 2cm in length. They are brightly colored to warn other animals that they are poisonous.

Habitat

Poison dart frogs can be found in humid, tropical environments of Central and South America.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Amphibia

-fake card-

STAGE 2

Komodo Dragon

HP 90

Evolves from Hatchling

- Has bones inside its body
- Lays eggs
- Has scales

Characteristics

Komodo dragons prefer to live alone. Males fight all other males. They are the biggest lizard that exists. Komodo dragons eat meat, and are nearly as long as a small car.

Habitat

Komodo dragons only live on the island of Komodo. Their habitat is very hot most of the year.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Reptilia

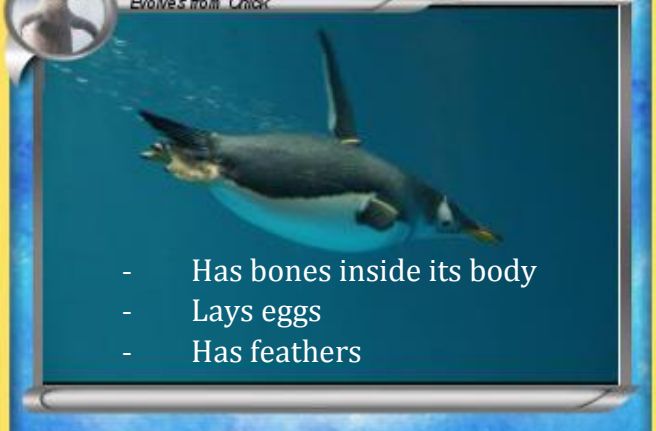
-fake card-

STAGE 2

Penguin

HP 40

Evolves from Chick



- Has bones inside its body
- Lays eggs
- Has feathers

Characteristics

There are 16 species of penguins. Most penguins are black and white. Penguins cannot fly, but all penguins can swim. Penguins lay eggs that hatch into chicks.

Habitat

Most penguins live in Antarctica. The African penguin lives in South Africa. The Chilean penguin lives at the very southern tip of South America.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Aves

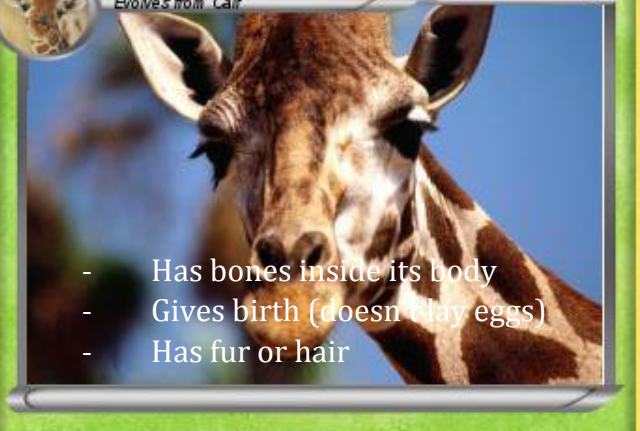
-fake card-

STAGE 1

Giraffe

HP 130

Evolves from Calf



- Has bones inside its body
- Gives birth (doesn't lay eggs)
- Has fur or hair

Characteristics

Giraffes are the tallest animal on land. Its long neck allows it to eat leaves that are too high for other animals to find. Giraffes have large eyes and a purple tongue!

Habitat

Giraffes live in open woodlands and savannas in Africa.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

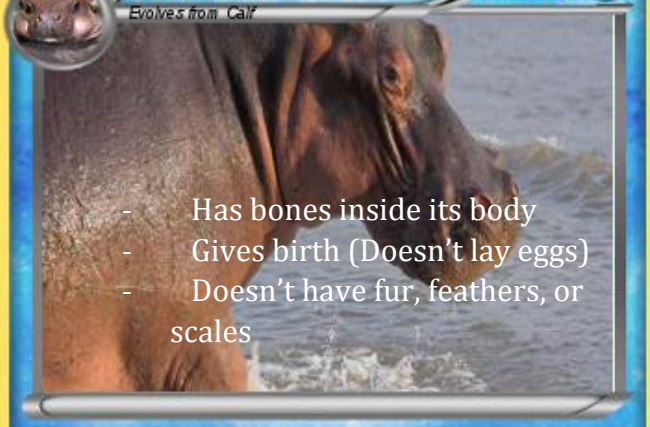
-fake card-

STAGE 1

Hippopotamus

HP 200

Evolves from: Calf



- Has bones inside its body
- Gives birth (Doesn't lay eggs)
- Doesn't have fur, feathers, or scales

Characteristics

A hippopotamus can grow up to 5 meters in length. It has large canine teeth which it uses to fight.

Habitat

Hippopotamuses can be found in the rivers and lakes of sub-Saharan Africa.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

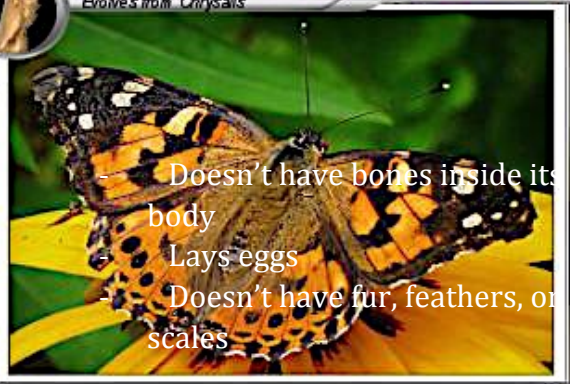
- fake card -

STAGE 2

Butterfly

HP 50

Evolves from: Chrysalis



- Doesn't have bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

The Painted Lady butterfly has a wingspan of 5-9cm. Its wings are deep orange with black spots. It can live from 2-4 weeks. Its main defense mechanisms are flight and camouflage.

Habitat

Painted Lady butterflies can be found on every continent except Antarctica and South America.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Arthropoda
Class: Insecta

- fake card -

STAGE 2

Flamingo

HP 30

Evolves from: Chick

- Has bones inside its body
- Lays eggs
- Has feathers

Characteristics

Flamingoes are white when they hatch. They turn pink from eating pink foods. They link to stand on one leg in the water to help them fish.

Habitat

Flamingoes live in wet, swampy places. They live all over the world including North America, South America, and Africa.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Aves

- fake card -

STAGE 1

Labrador Retriever

HP 120

Evolves from: Pup

- Has bones inside its body
- Gives birth (Doesn't lay eggs)
- Has fur or hair

Characteristics

One of the most popular breeds in the USA, the Labrador Retriever is loyal, loving, affectionate, and patient, making it a great family dog. It has an "otter tail" and friendly eyes.

Habitat

The Lab is native to Newfoundland, off the northeastern Atlantic coast of Canada, where it worked side by side with fishermen catching fish.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

- fake card -

STAGE 1

Giant Panda

HP 80

Evolves from Cub

- Has bones inside its body
- Gives birth (Doesn't lay eggs)
- Has fur or hair

Characteristics

Giant Pandas are creamy-white with large patches of black. They also have strong jaw muscles and flat molars, which allow them to crush bamboo stems and leaves.

Habitat

The Giant Panda can be found in the mountains and forests of central and western China. These high-altitude forests are cool, cloudy, and moist.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

-fake card-

STAGE 2

Starfish

HP 50

Evolves from Juvenile

- Doesn't have bones inside its body
- Lay eggs
- Doesn't have fur, feathers, or scales

Characteristics

The starfish (or sea star) has 5 arms and suckers on its feet. If it loses an arm, it can grow a new one! Starfish also have two stomachs: one for digestion and one to engulf their prey.

Habitat

Starfish can be found in oceans all around the world.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Echinoderm-ata
Class: Asterozoa

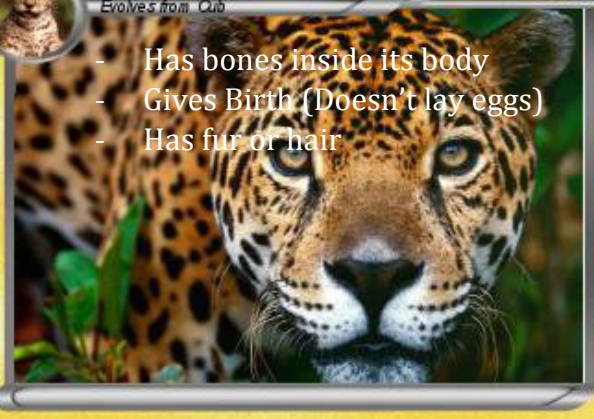
-fake card-

STAGE 1

Jaguar

HP 190

Evolves from Cub



- Has bones inside its body
- Gives Birth (Doesn't lay eggs)
- Has fur or hair

Characteristics

The jaguar is the 3rd largest Cat in the world and is well known for its immense power and speed. Jaguars have tan or dark yellow fur, which is dotted with darker patterns.

Habitat

Jaguars live in the tropical rainforests of Central and South America. They prefer thick, dense, moist jungle, where there is plenty of cover in order to hunt and ambush prey.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

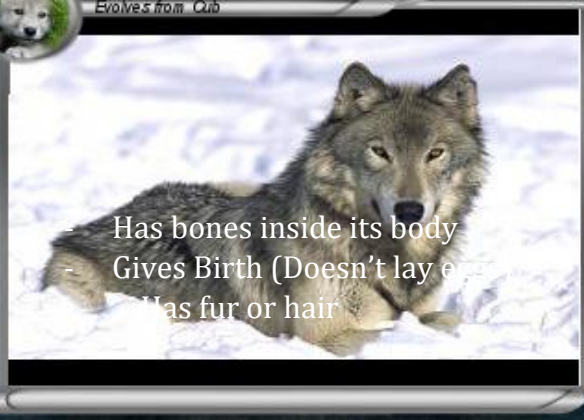
-fake card-

STAGE 1

Wolf

HP 170

Evolves from Cub



- Has bones inside its body
- Gives Birth (Doesn't lay eggs)
- Has fur or hair

Characteristics

Wolves have a thick layer of fur to help keep them warm. They hunt together in packs and work together as a team to kill their prey. Their fur can be white, gray, brown, or black.

Habitat

Wolves inhabit forests, deserts, mountains, tundras, grasslands, and even urban areas. The largest wolves can be found in Alaska.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

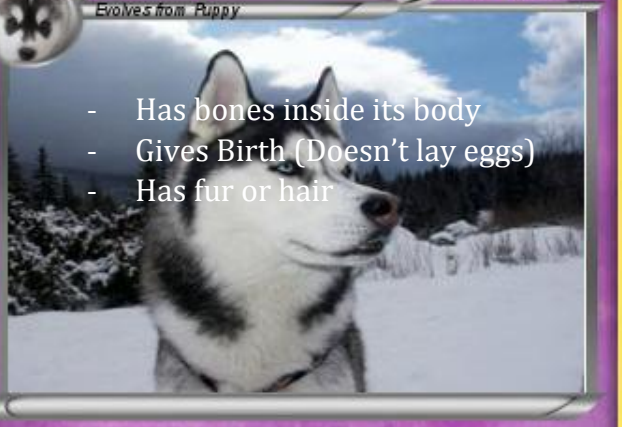
-fake card-

STAGE 1

Husky

HP 100

Evolves from Puppy



- Has bones inside its body
- Gives Birth (Doesn't lay eggs)
- Has fur or hair

Characteristics

Husky type dogs are energetic and athletic. They usually have a thick double coat that can be gray, black, copper red, or white. Husky-type dogs were originally used to pull sleds and hunt.

Habitat

Huskies can be found in the United States, especially in Alaska. They are also found in Canada, Russia, and Greenland.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

- fake card -

STAGE 1

Beaver

HP 50

Evolves from Kit

- Has bones inside its body
- Gives Birth (Doesn't lay eggs)
- Has fur or hair

Characteristics

Beavers have webbed hind feet and a broad, scaly tail. A beaver's teeth will grow continuously so that they will not be worn down by chewing on wood. Beavers are known for building dams, canals, and lodges.

Habitat

Beavers live in the "riparian zone", the place between land and a river or stream. They create wetlands that are used by many other species.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Mammalia

- fake card -

STAGE 2

Ladybug

HP 30

Evolves from Larva

- Doesn't have bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

Ladybugs are yellow, orange, or scarlet with small black spots on their wing covers. They are useful insects because they eat aphids or scale insects, which are pests in gardens.

Habitat

Both adults and larvae live on plants like roses, oleander, milkweed and broccoli. In the winter, the adults hibernate in large groups, often in high mountains.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Arthropoda
Class: Insecta

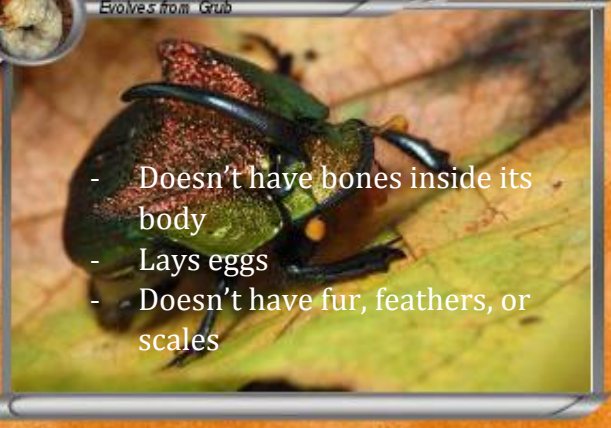
- fake card -

STAGE 2

Scarab Beetle

HP 30

Evolves from Grub



- Doesn't have bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

The scarab beetle, or dung beetle, can be around 1 inch long. The front of the head is flat and golden bronze. The male has a long, curved horn extending from the front of the head. The front legs are used for digging.

Habitat

The rainbow scarab is native to the eastern United States, from Massachusetts to South Dakota in the north and Texas to Florida in the south. They are commonly found in animal excrement.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Arthropoda
Class: Insecta

- fake card -

STAGE 2

Honey Bee

HP 40

Evolves from Larva

- Doesn't have bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

Honey bees produce and store honey. Worker bees clean the hive and feed the larvae. They also communicate to other bees where pollen can be found by flying in a special pattern that looks like a dance.

Habitat

Honey bees live in hives that they create out of wax. They prefer to live in gardens, woodlands, orchards, meadows and other areas where flowering plants are abundant.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Arthropoda
Class: Insecta

- fake card -

STAGE 2

Praying Mantis

HP 120

Evolves from Nymph

- Doesn't have bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

Mantises have two grasping, spiked forelegs to catch and hold their prey tightly. When threatened, mantises will stand tall and spread their legs and wings wide, to make themselves seem larger.

Habitat

Praying Mantises are usually found in the warmer regions. Most species live in the tropical rainforest, although others can be found in deserts, grasslands and meadows.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Arthropoda
Class: Insecta

- fake card -

STAGE 2

Snowy Owl

HP 100

Evolves from Owlet

- Has bones inside its body
- Lays eggs
- Has feathers

Characteristics

The snowy owl has bright white feathers that are often flecked with black and grey. It also has large eyes, a sharp, curved beak and large head, along with feathers on its feet. The snowy owl is one of the largest species of owl in the world.

Habitat

The snowy owl is primarily found within the Arctic Circle with the range of the snowy owl ranging across Canada, Greenland, Europe and Asia.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Aves

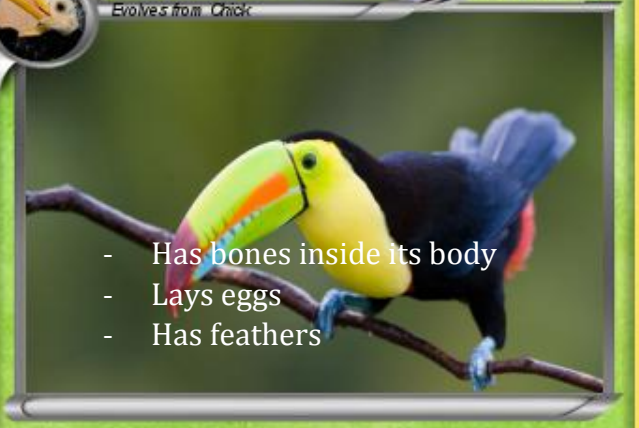
- fake card -

STAGE 2

Keel-Billed Toucan

HP 70

Evolves from Chick



- Has bones inside its body
- Lays eggs
- Has feathers

Characteristics

The keel-billed toucan's bill can reach lengths of nearly 20cm long and is around one third of the length of the keel billed toucan's body. Its bill is made out of a substance called keratin, which is extremely light but still very strong.

Habitat

The keel-billed toucan is native to the jungles of South America where it lives in holes in the trees, often with several other keel-billed toucan individuals.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Aves

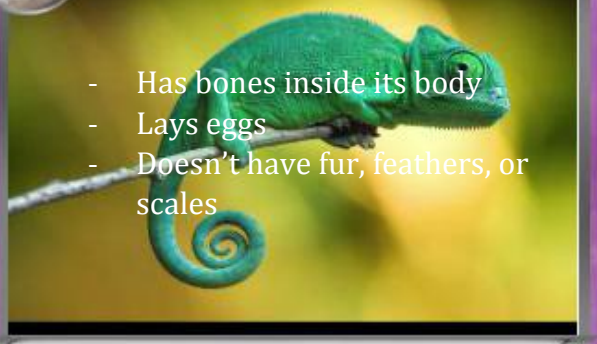
- fake card -

STAGE 1

Chameleon

HP 60

Evolves from Baby Chameleon



- Has bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

Most people believe that chameleons change their color to blend in with environment, but the real reason is mood change. Their tongue can be 1.5 to 2 times longer than their body and they use it to catch insects.

Habitat

Chameleons can be found in forests mostly on the island of Madagascar in Africa, southern Europe, south Asia and Sri Lanka.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Reptile

- fake card -

STAGE 2

Red-Eyed Tree Frog

HP 60

Evolves from Tadpole

- Has bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

Red-Eyed Tree Frogs sleep by day, stuck to leaf-bottoms with their eyes closed and body markings covered. When disturbed, they flash their bulging red eyes and reveal their huge, webbed orange feet and bright blue-and-yellow legs.

Habitat

They are found in tropical lowlands from southern Mexico, throughout Central America, and in northern South America.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Amphibia

- fake card -

STAGE 1

Fire Salamander

HP 110

Evolves from Nymph

- Has bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

The bright markings on the fire salamander's back warn predators that it is poisonous. The fire salamander is the only amphibian that does not hatch from an egg. Instead, the babies develop inside the mother's body.

Habitat

The fire salamander can be found in the forests of Europe, Africa, and Asia.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Amphibia

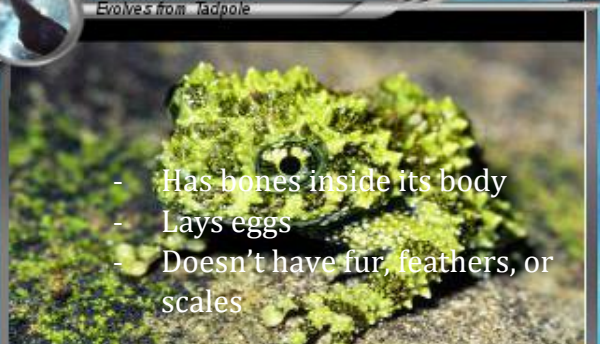
- fake card -

STAGE 2

Mossy Frog

HP 50

Evolves from Tadpole



- Has bones inside its body
- Lays eggs
- Doesn't have fur, feathers, or scales

Characteristics

The combination of the green body coloration with black spots, tubercles and spines makes the Vietnamese Mossy Frog look like a clump of moss. As a result, they're almost impossible to spot when sitting still.

Habitat

The Vietnamese Mossy Frog lives in the limestone regions of northern Vietnam, where they occupy cavities in the banks of mountain streams and flooded caves.

weakness resistance

retreat

Kingdom : Animalia
Phylum : Chordata
Class: Amphibia

- fake card -

Name _____ Date _____

Animal Adventures:
How many different kinds of animals are there?

(End of Activity Assessment)

1. Match the group of animals with its characteristics.

__ Invertebrates a. Bones, scales, lays eggs
__ Reptiles b. Bones, hair or fur, gives birth to live young
__ Birds c. Bones, feathers, lays eggs
__ Mammals d. Bones, moist skin, lays eggs

2. Place an **X** next to any characteristics that scientists use to group animals.

__ Whether it has bones or no bones inside
__ What color it is
__ Whether it lays eggs or gives birth to live young
__ What it eats
__ Where it lives
__ Whether it has scales, fur, hair or feathers

3. True or False? (circle one)

Scientists only look at the <u>outside</u> of animals' bodies to figure out what group they belong to.

4. Bats have wings and can fly, but scientists did not group them with birds. Why is that?

_____
_____
_____

5. Tarantulas (spiders) are covered in hair but scientists did not group them with mammals. Why is that?

_____
_____
_____
_____

Animal Adventures:
How many different kinds of animals are there?

ANSWER KEY

(End of Activity Assessment)

1. Match the group of animals with its characteristics.

D Invertebrates	a. Bones, scales, lays eggs
A Reptiles	b. Bones, hair or fur, gives birth to live young
C Birds	c. Bones, feathers, lays eggs
B Mammals	d. No bones

2. Place an **X** next to any characteristics that scientists use to group animals.

X Whether it has bones or no bones
__ What color it is
X Whether it lays eggs or gives birth to live young
__ What it eats
__ Where it lives
X Whether it has scales, fur, hair or feathers

3. True or False? (circle one)

Scientists only look at the outside of animals' bodies to figure out what group they belong to.

4. Bats have wings and can fly, but scientists did not group them with birds. Why is that?
- Bats don't have feathers or lay eggs, so they can't be birds.
- Bats give birth to live young and have fur, so they are mammals.

5. Tarantulas (spiders) are covered in hair but scientists did not group them with mammals. Why is that?
- Tarantulas don't have bones, so they can't be mammals.

Zoology

Lesson 9- Frog Dissection Simulation

Ages 15-19

Overview

In this activity, students will investigate the internal and external features of a frog. They will perform a frog dissection simulation while analyzing the structure and function of specific organs.

Frogs are excellent model organisms for scientific studies of development, behavior, anatomy, and physiology. They are commonly used in biology classes as representative vertebrates with specialized amphibian characteristics and behaviors.

The dissection of simulated frogs is an engaging introduction to vertebrate anatomy. Exploring the anatomy of the frog allows discussions about adaptations and how anatomical structures are related to their functions.

Learning Objectives

1. The students will be able to describe the external structures of the frog.
2. The students will be able to describe the internal structure of the frog.

Suggested Timeframe

45 minutes

Materials Required

- 1 Frog Dissection Simulator (per pair of students)
- ! Set of Frog Dissection Tools
- 1 Thin Dry Erase Marker for each student
- 1 Dry Eraser for each student
- 1 Dry Erase Protective Sleeve
- 1 Frog Dissection Worksheet for each student (26 Master Sheets provide)

Students can place their worksheet inside the protective sleeve and use the dry erase marker to do their work.

Assessment

- Pre-Frog Dissection Activity Assessment
- Embedded Frog Dissection Activity Assessment
- Post-Heart Activity Assessment

Introduction/Initiation

Have students examine the x-ray of the frog. Have students discuss observations and write down things that they notice about the x-ray and things that they wonder (questions) that they have.

Procedure

Before the Activity

1. Gather all supplies.
   Per Student- Get 1 Frog Dissection Worksheet, 1 Protective Sleeve, 1 Expo Marker, and 1 Eraser
   Per Pair/Group- 1 Frog Dissection Simulation and 1 Set of Tools

With the Students

External Features – Before Dissecting the Frog

1. Examine the hind and front legs. The hind legs (back legs) are strong and muscular and are used for jumping and swimming. The forelegs (front legs) provide balance and cushion the frog when it lands after jumping. Note the difference between the toes of the hind legs and those of the front legs.
2. Locate the large, bulging eyes. The frog has three eyelids. The two outer ones are the color of the frog's body. The upper and lower lids do not move. The third eyelid is a transparent membrane that protects the eye while allowing the frog to see underwater. It also keeps the eye moist when the frog is on land.
3. Behind each eye, find the circular eardrum, tympanum. Then locate the two openings into the nasal cavity. These nasal openings, or external nares, found towards the tip of the snout (nose) will close when the frog is underwater.
4. Feel the frog's skin. It is smooth, would normally be moist, and thin. Because the skin is thin and moist, the frog can breathe directly through its skin as well as with his lungs. Look at the frog's belly. Notice the difference in coloring between the belly and the rest of the frog's body.
5. Look at the thumb pads and try to determine if your frog is male or female.

Internal Structures – Dissecting the Frog

1. The frog is placed on its back (dorsal side) during dissection. Find its mouth and open it.
2. Locate the tongue. Is it attached to the front or back of the mouth? In a live frog, the tongue is sticky and is used to catch insects.
3. Gently run your finger along the inside of the upper jaw. The ridges that you feel are maxillary teeth. Two vomerine teeth can also be found in the upper jaw. They are located towards the front of the upper j aw, between and slightly behind the internal openings of the nostrils.
4. Find the gullet (throat), the wide opening that leads to the esophagus. On both sides of the gullet, near the jaw hinges are other openings. These are the openings to the Eustachian tube opening. Using your tools, find out where the Eustachian tubes lead.

Dissecting the Frog

1. Now you are ready to open the abdominal cavity. First, your incision will be made along the middle of the belly – from the pelvis to the throat. Begin by lifting the belly away from the frog.

Digestive System

1. The largest organ in the abdominal cavity is the reddish brown liver. Find it and count the number of lobes (sections).

2. Locate the greenish sac attached to the liver. This is the gall bladder. It stores bile, which breaks down fat during digestion.
3. Beneath the liver, find the large, white stomach. It will be on the ride side as you look at the frog. The straight part of the small intestine (near the stomach) is called the duodenum; the remaining, coiled section of the small intestine is the ileum.
4. The small intestine eventually widens to form the large intestine. The large intestine is a straight tube leading to the anus. The lower portion of the large intestine is called the cloaca.
5. Two smaller organs are somewhat more difficult to find. In the area along the inner curve of the stomach, locate the pinkish pancreas. In the fold of the coiled part of the small intestine, see if you can find a small, reddish, spherical structure. This is the spleen.
6. Using your tools, carefully remove the liver, the upper end of the stomach, and the lower end of the large intestines.
7. How long do you think the intestine is? Record your guess.

Respiratory System

1. Locate the lungs, two reddish brown saclike structures. Remove the lungs with your tools.

Circulatory System

1. Locate the heart that lies between the lungs. The frog's heart has three chambers. Remove the heart with your tools.

Excretory System

1. Find the two dark red kidneys attached to the back wall of the abdominal cavity.
2. Find the urinary bladder, which empties into the cloaca. Thee tubes leading from each kidney to the bladder are called ureters.

Assessment

Pre-Activity Assessment

Discussion Questions: Solicit, integrate and summarize student responses.

- What do you notice about the frog x-ray? (Student Observations)
- What do you wonder about the frog x-ray? (Student Questions)

Activity Embedded Assessment

Worksheet: Have the students record their observations and complete the Dissection worksheet.

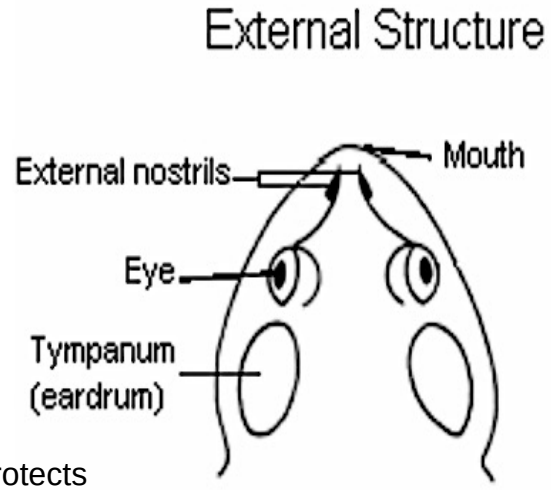
Activity Extensions

- Have students' research and identify the function of each organ of the frog's internal anatomy and create a presentation to share with the class.

Name _____ Date _____

Frog Dissection Procedure - Student Sheet

External Features – Before Dissecting the Frog



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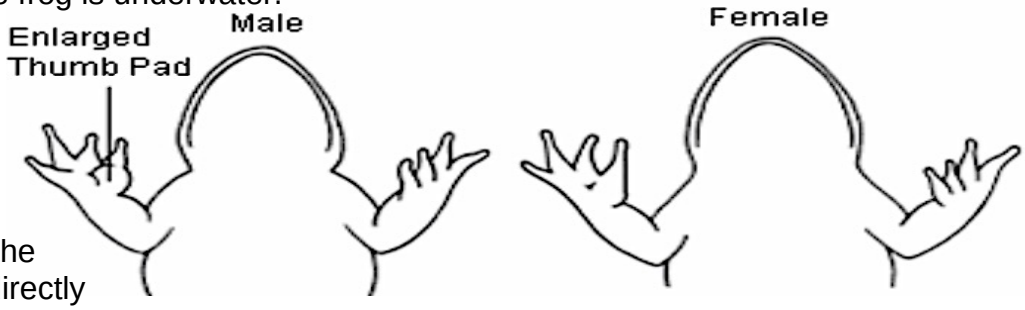

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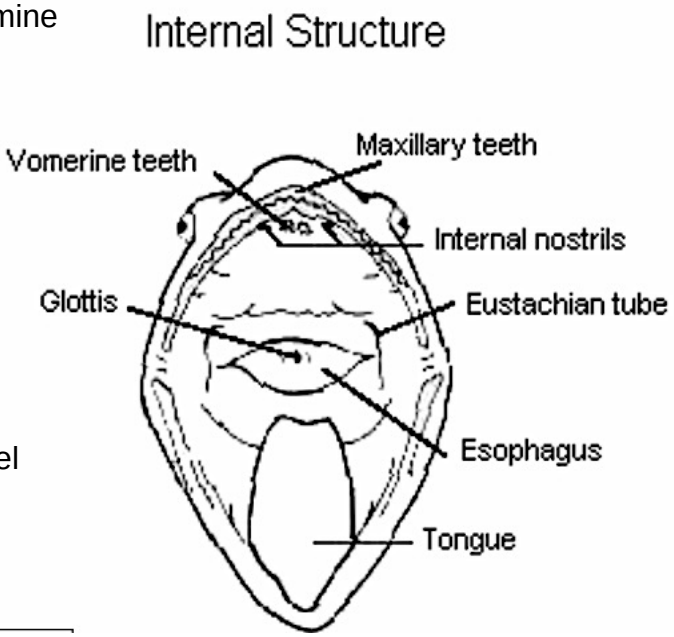

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<u>Dissecting the Frog</u>

1. Now you are ready to open the abdominal cavity. First, your incision will be made along the middle of the belly to the throat. Begin by lifting the belly away from the frog.

Record your observations:

_____
_____
_____
_____
_____
_____
_____

<u>Digestive System</u>

1. The largest organ in the abdominal cavity is the reddish brown liver. Find it and count the number of lobes (sections).
2. Locate the greenish sac attached to the liver. This is the gall bladder. It stores bile, which breaks down fat during digestion.
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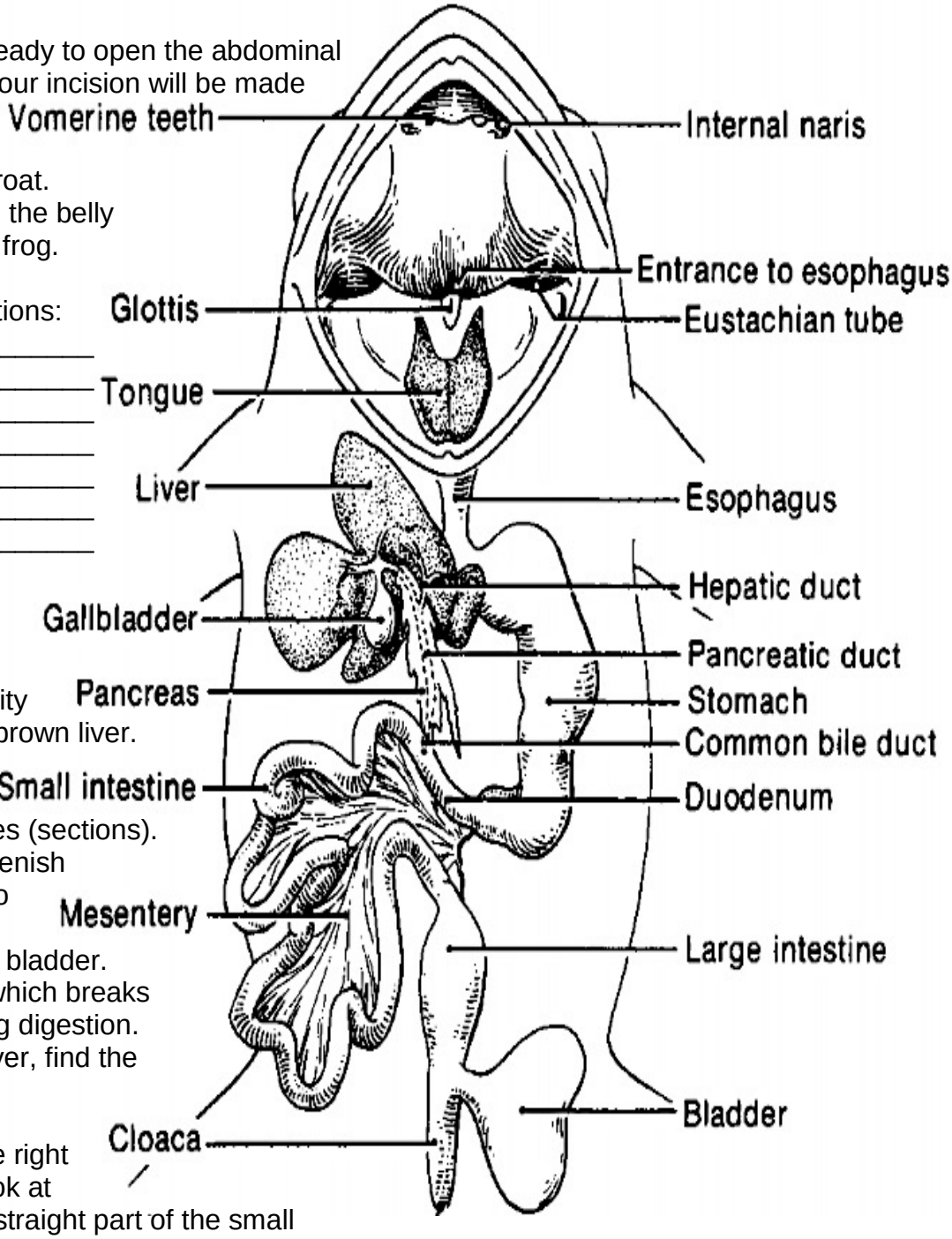

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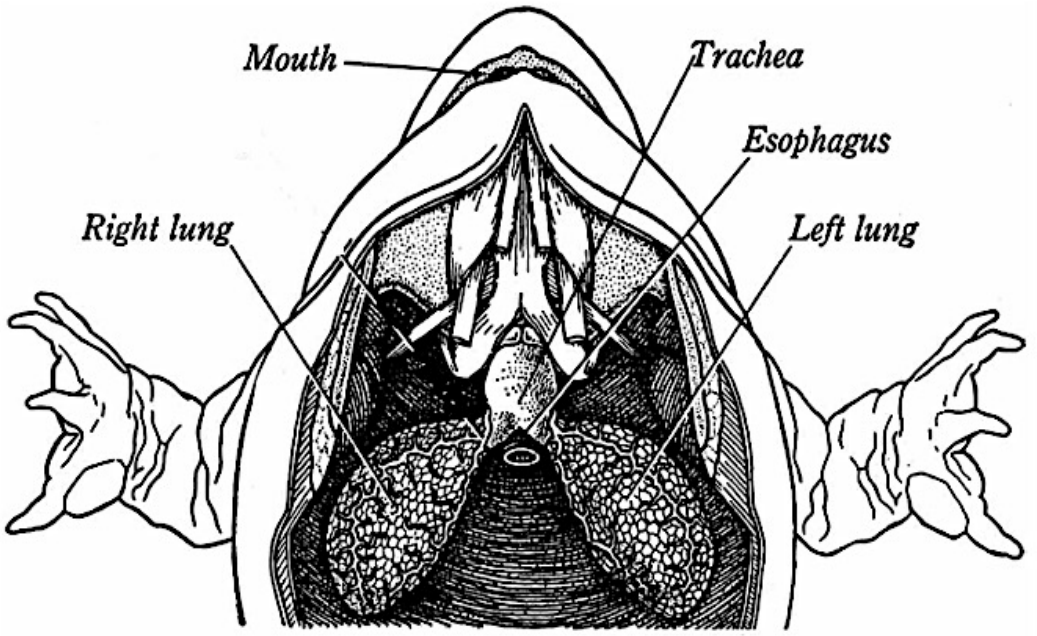

Circulatory System

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Excretory System

1. Find the two dark red kidneys attached to the back wall of the Abdominal cavity.
2. Find the urinary bladder, which empties into the cloaca. Thee tubes leading from each kidney to the bladder are called ureters.

Clean-Up

1. Clean up all materials but replacing all the pieces of the frog and it's organs.
2. Return dissection tools.
3. After clean up, research the function of each of the internal organs in the frog and color the diagram.

A. Esophagus (yellow)_____

_____

C. Stomach (purple)_____

_____

D. Pancreas (orange)_____

_____

F. Cloaca (black)_____

_____

H. Lung (dark blue)_____

_____

I. Heart (red)_____

_____

J. Liver (brown)_____

_____

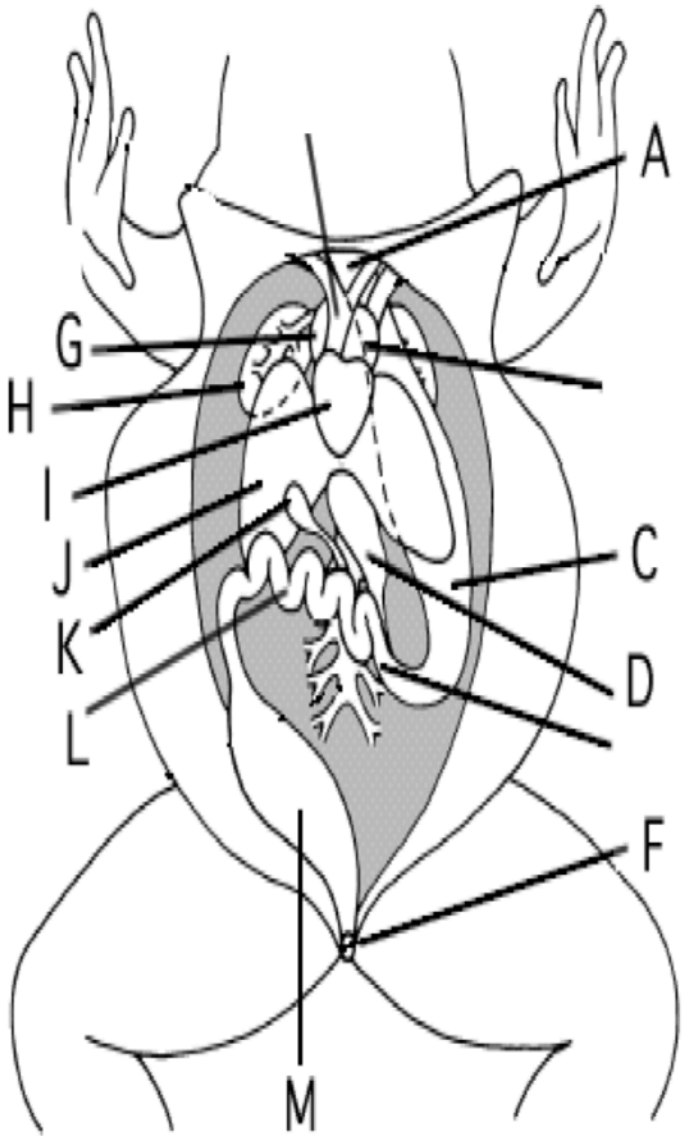
K. Gallbladder (lt. green)_____

_____

L. Small Intestine (Dark green)_____

_____

M. Large Intestine (lt. blue)_____



Research the function of each organ and color the diagram.