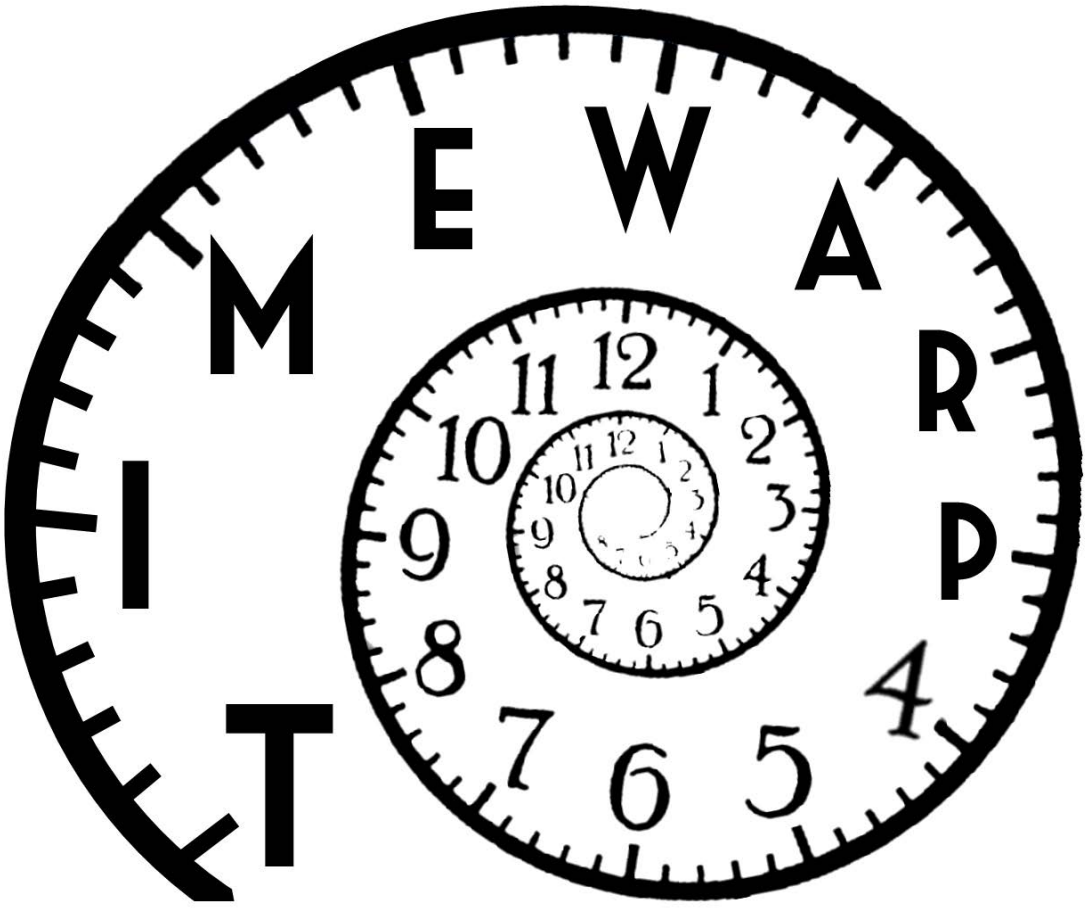


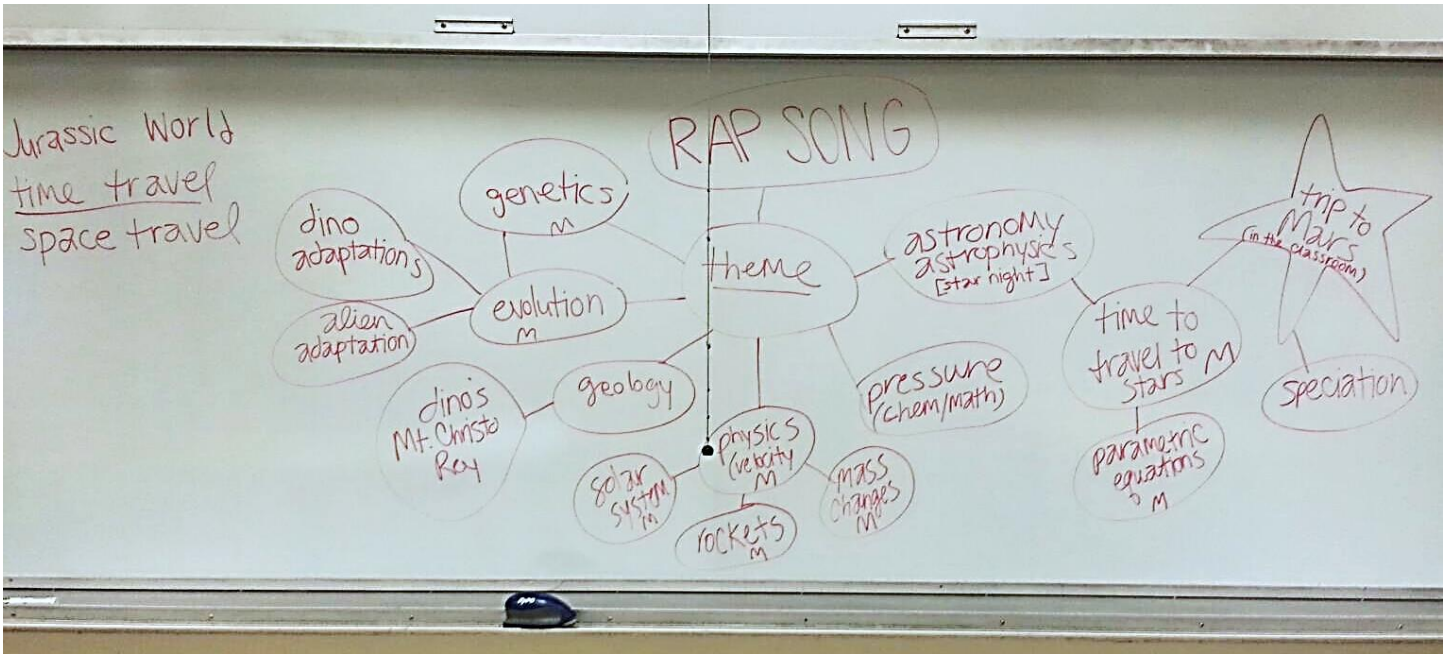
FROM JURASSIC WORLD

TO OUTER WORLDS

Navigate through lesson plans by selecting the name of the lesson plan on the Table of Contents

Table of Contents

Concept Map


Jurassic World
time travel
space travel
RAP SONG
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[star night]
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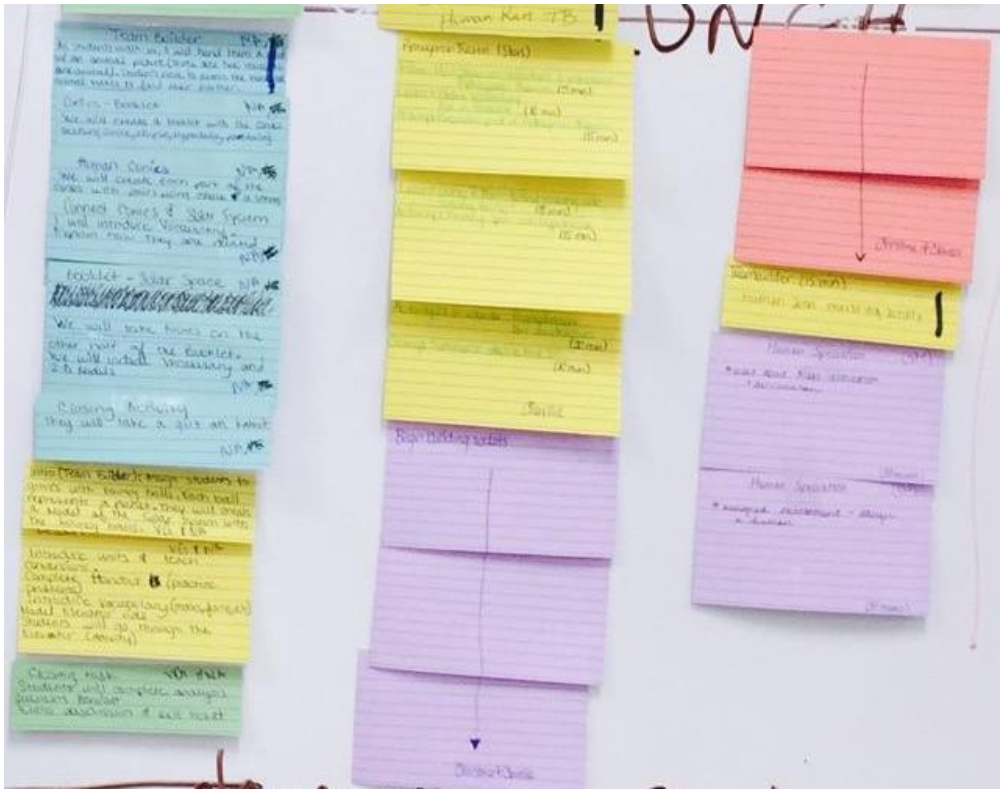
(in the classroom)
speciation

Planning out the Schedule



Schedule

	Week 1					Week 2				
	Mon	Tues	Wed	Thurs	Fri	Mon	Tues	Wed	Thurs	Fri
8:30-9:00	Rules	Teambuilder (RPS Stretch)	Teambuilder (Stephanie)	Teambuilder (hula-hoop)	Dino Tracks	Timewarp activity -teach them the dance (1 hour)	(Christina) Paper rockets -test -debrief -retest -discussion (1.5 hours)	(Sue) Future adaptations (3 hours)	Teambuilder	White Sands
9:00-9:30	Notebook presentation	(Adriano) Could you outrun a dinosaur? (1.5 hours)	Genetics intro - Jurassic world -Hand thing (All day)	(Wesley) Survival of the fittest (2.5 hours?)					(Clarissa) Flying rockets and collecting data (1 hour)	
9:30-10:00	Teambuilders: (Name game, toilet paper					(Daisy)Intro to solar system and galaxies (1 hour)				
10:00-10:30	Making Fossils!								Calculating height and Law of Sines (1.5 hours)	
10:30-11:00	Brown Bags!	Writing (30 mins)				(Valerie/Nohemy) Mass on earth vs Mass on planets (1 hour)	(Valerie) Galaxy slime lab (1 hour)	(Clarissa/Christina) Continue building rockets (2 hours)		
11:00-11:30	Teambuilder (Dino-Dino, Nesty-Nesty,									
11:30-	Lunch					Lunch				
12:00-12:30	(Adriano) Tracks activity (1 hour)	(Sue) Past Adaptations (3 hours)		(Daisy) Intro to comets & asteroids (30 min) Mass extinction theory	UTEP	(Nohemy) Solar system and model of solar system (1 hour)	(Clarissa) Pythagorean Theorem and SOH CAH TOA (1.5 hours)		Wrap It Up	Space History
12:30-1:00										
1:00-1:30	Writing Activity (30 min)					(Nohemy) Introducing conics (30 mins)		(Sue) Human speciation (2 hours)		
1:30-2:00	Teambuilder (Toilet Paper)					(Valerie) Parametric Equations -Time travel to stars (2 hours)	(Clarissa/Christina) Begin building model rocket (1.5 hours)			
2:00-2:30	Intro foldable (1 hour)	Teambuilder (cottonball race)		Build an asteroid sundae (1 hour)						
2:30-3:00										
3:00-3:30	Cleanup / Journal					Cleanup / Journal				

Daily Agenda Example

WEEK ONE
Thursday Agenda

Time	Activity	Scholar
8:30	Team builder: hula hoop	Wes
9:00	Evolution: power point, cladogram	Wes
9:30	Bird activity	Wes
10:00	Matching	Wes
10:30	Making Dinosaur teeth	Sue
11:00	Making Dinosaur teeth	Sue

11:30-12:00 LUNCH

12:00	Asteroids and comets	Daisy
12:15-1:00	Ice Cream	Daisy
1:00	Ice Cream	Daisy
1:30-2:00	Daisy	Daisy
2:00	Take out Dino Teeth molds	Sue
2:15	Filed trip prep Anthony video	
3:00		

How Fossils are Made (The Fossil Dance)

Teacher: MaST Academy (Adriano Pérez)

Subject / grade level: 9th grade Biology

Materials: Small fossils (petrified and molds or casts) for students to observe;
Imprint Fossils: 1 cup wet coffee grounds, ½ cup cold coffee, ½ cup salt, 1 cup flour, parchment paper;
Cast Fossils: 1 cup moist sand, dinosaur "claw", plastic cup, Plaster of Paris molding material

Standards: Biology: 7(A), 7(B) Chemistry: 11(C)

Lesson objective(s): Student will understand what fossils are, the four main types of fossils as well as how fossils are made

ENGAGEMENT Provide students with small fossils to inspect and pass around. Have a discussion with students concerning what a fossil is and how they're made.

EXPLANATION Student fill out a foldable (images provided in the folder) from a PowerPoint about the definition of fossils and the four main types (petrified, molds & casts, preserved remains, and traces), with examples.

EXPLORATION Students will explore the creation of two molds and a cast by creating them. Students will use the Coffee ground mix to create a mold of their own hand: mix all of the materials together until a dry/muddy consistency is achieved; each student takes a handful and places onto their parchment paper; press the ball into a round shape then imprint their hand into it.
Then they will explore casts by creating a depression in a cup filled with *slightly* moist sand; then filling the "hole" with Plaster of Paris mix (follow directions and safety on the bag). After ~2 hours the material will have hardened and students can pour the sand out, leaving just the "fossil".

ELABORATION Students will learn the steps to creating a fossil; associating each step with a "dance movement". The four steps are:

1. Death, then sediment laid down (hands are moved up in a movement representing a volcanic eruption);
2. Sediment is accumulated in layers (hands are placed one on top of another);
3. Fossils are moved up because of tectonic plates (students "shimmy" up);
4. Erosion from rain, wind, and river currents (students move arms from side to side).

EVALUATION Students are evaluated during the exploration phase; when creating the fossils they are asked whether they are making a cast or a mold. Clarification to the whole group can be made after asking each group of students.

FOSSILS

What is a fossil?

- A fossil is the preserved remains of a once-living organism.

What do fossils tell us?

- Give us clues about organisms that lived a long time ago
- Provide evidence about how the earth's surface has changed over time

4 MAIN TYPES OF FOSSILS

Petrified Fossils

Molds and Casts

Trace Fossils

Preserved Remains

PETRIFIED FOSSILS

PETRIFIED FOSSIL
Tyrannosaurus rex fossil.
Appropriately named Sue

- **Petrified =** "turning into stone."
- **Form when minerals replace all or part of an organism.**
- **Water is full of minerals. It seeps through the layers of sediment to reach the dead organism. When the water evaporates, it leaves behind the minerals.**

TRACE FOSSILS

Dinosaur footprint

- Show the activities of organisms.
- Ex: footprints, burrows, resting spots, feces
- Everything except the organism itself

MOLDS AND CASTS

MOLD FOSSIL
Ammonite mold

- A mold forms when hard parts of an organism leave behind an impression

CAST FOSSIL
Ammonite cast

- A cast forms as the result of a mold.
- Minerals fill the mold and those minerals become the cast
- A cast is the opposite of its mold.

PRESERVED REMAINS

When organisms get preserved in or close to their original states

Amber

An organism, such as an insect, is trapped in a tree's sticky resin and dies. More resin covers it, sealing the insect inside. It hardens into amber.

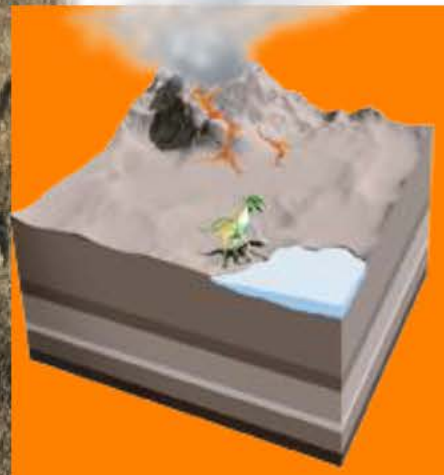
Tar

An organism, such as a mammoth, is trapped in a tar pit and dies. The tar soaks into its bones and stops the bones from decaying.

Ice

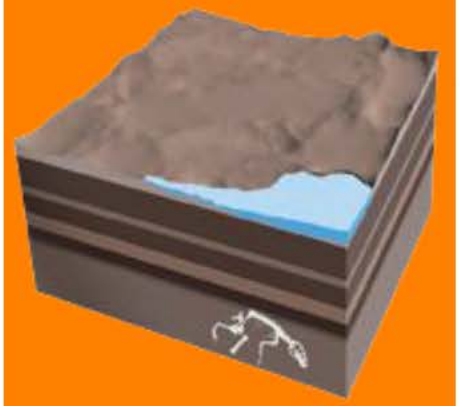
An organism, such as a woolly mammoth, dies in a very cold region. Its body is frozen in ice, which preserves the organism.

HOW IS A FOSSIL FORMED?



1. Volcano/ Death

An animal dies and is buried quickly. Sometimes by volcanic ash or silt.



2. Layers

Sediment layers accumulate above the animal's remains, and minerals slowly replace the the bones.

3. Movement

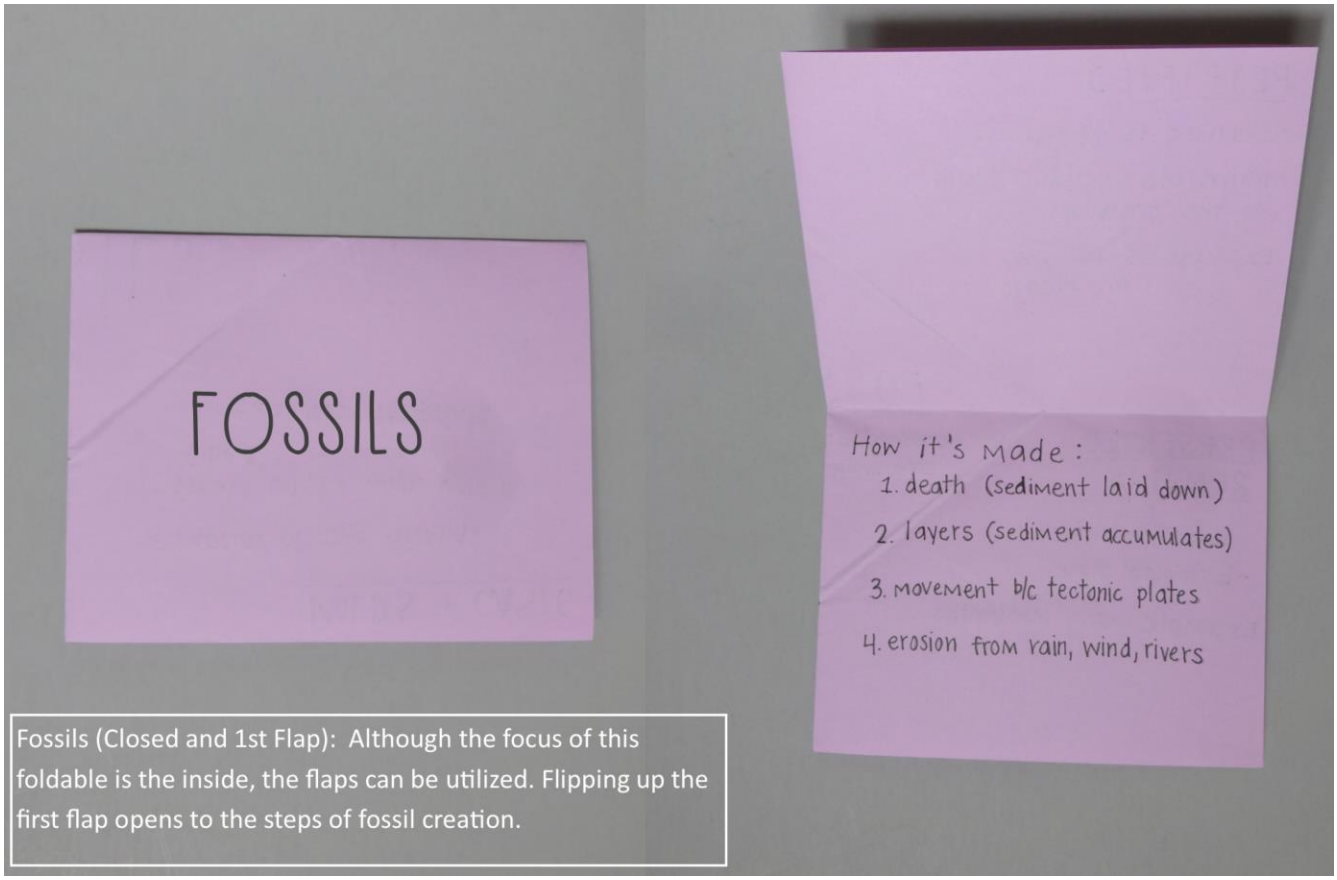
Movement of tectonic plates, or giant rock slabs that make up Earth's surface, lifts up the sediments and pushes the fossil closer to the surface.

4. Erosion

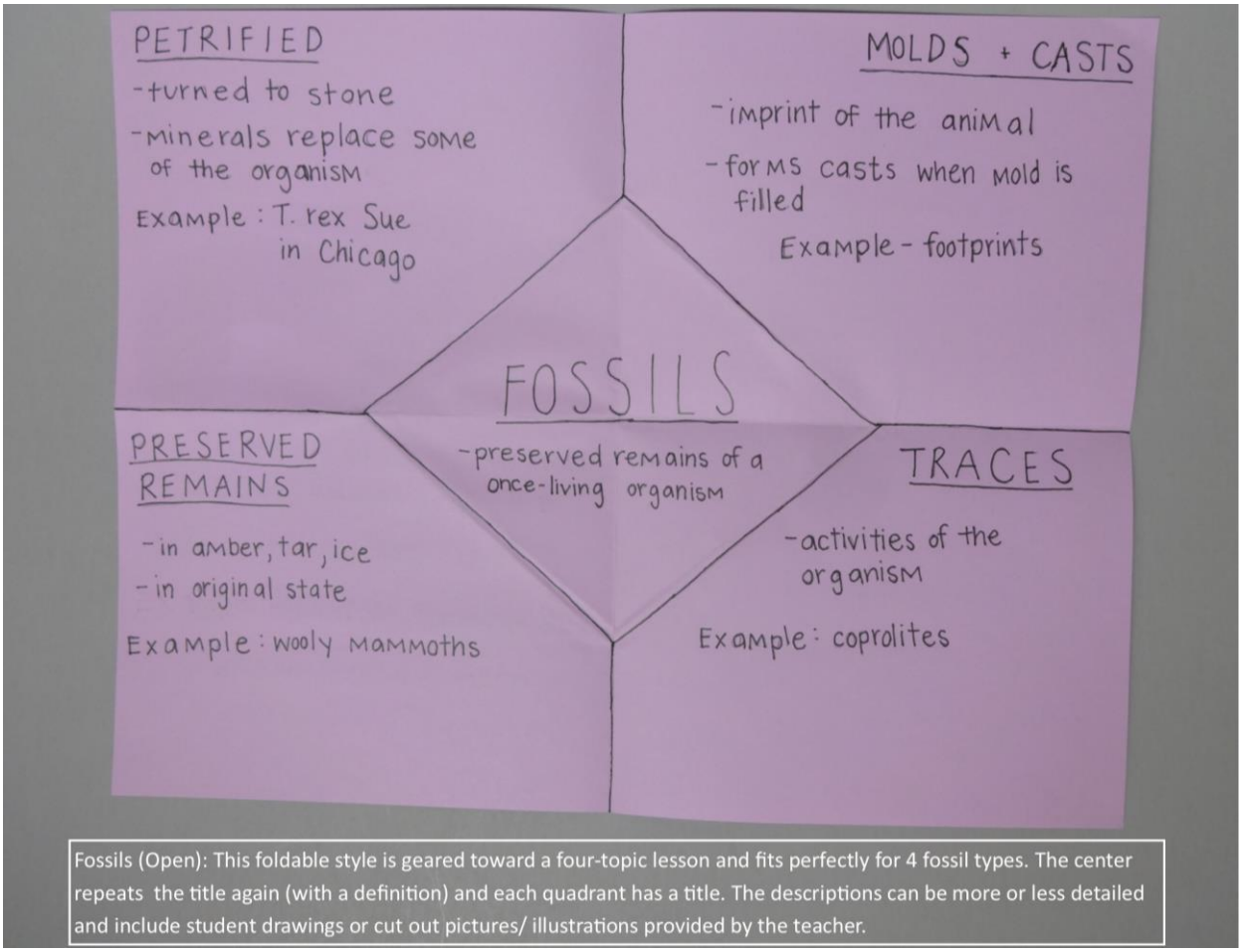
Erosion from rain, rivers, and wind wears away the remaining rock layers. Eventually, erosion or people digging for fossils will expose the preserved remains.

MAKING FOSSILS

- Slowly mix in the liquid with your hands until it feels like play doh
- Divide the dough between your group members
- Place the dough on your wax paper and make your fossils!



Fossils (Closed and 1st Flap): Although the focus of this foldable is the inside, the flaps can be utilized. Flipping up the first flap opens to the steps of fossil creation.



Fossils (Open): This foldable style is geared toward a four-topic lesson and fits perfectly for 4 fossil types. The center repeats the title again (with a definition) and each quadrant has a title. The descriptions can be more or less detailed and include student drawings or cut out pictures/ illustrations provided by the teacher.

Footprint Inferences

Teacher: MaST Academy (Adriano Pérez)

Subject / grade level: 9th grade Biology

Materials: 4 sets of dinosaur footprints cut out for every student (provided in the folder- each set has its own page so that they can be printed in different colors). Each set should be cut out before the lesson.

Standards: Biology: 2(B), 2(G)

Lesson objective(s): Student will learn how to draw inferences from an observation and to adapt or defend their ideas as new evidence is discovered.

ENGAGEMENT Introduce the topic with a captivating story: molded fossils of dinosaur footprints are found near a river path in a frozen ecosystem in northern Canada (within the arctic circle). Engage the students in a discussion concerning how they think the dinosaurs were able to make those footprints.

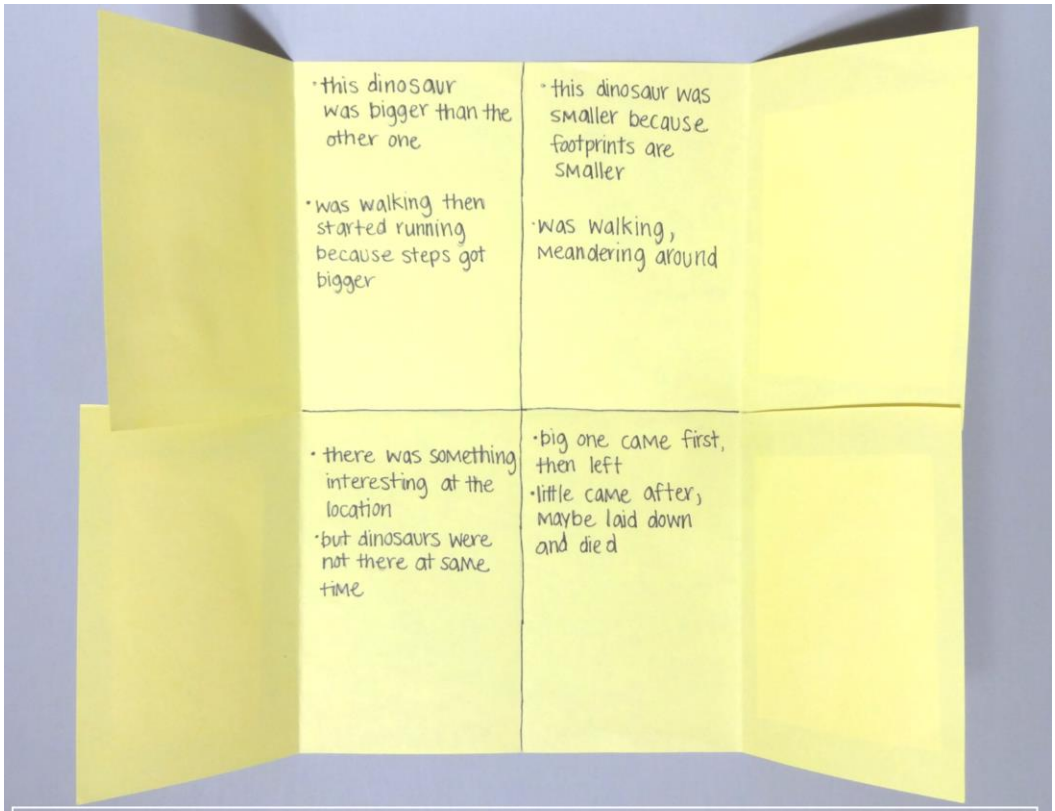
EXPLORATION Guide students through creating the foldable (images are provided in the folder). Provide students with Footprints sets #1 and #2; ask them to observe the sets, discuss them in small groups and write down their individual inferences into their foldable. Have students volunteer to share their ideas and reasoning then reach a consensus as a whole class (students can add this "class inference" to their foldable, having already recorded their original thoughts).
Add another aspect to the story: these footprint end at the wall of a cliff as if the dinosaurs walk straight into the rock, ask students how they think that that could have occurred.

ELABORATION Inform students that after climbing the cliff and *a lot* of digging through snow, another set of footprints have been revealed. Provide Set #3 to students, have them observe and make a hypothesis as to what they think is occurring in the scene, discuss their inferences in small groups, and attempt to reach a consensus as a class. Make sure to ask students to back up their ideas with evidence or logic. Ask students how the dinosaurs could have climbed a cliff.

EXPLANATION Provide Set #4 to students- this is the entire set of footprints the scientists could find in the area. Ask them to decide if this new set supports their hypothesis or if they will have to adapt their ideas to fit the new information. If they need to change their hypothesis, have them do so and record this into their foldable.

EVALUATION Assessment is ongoing throughout the activity- make sure the students are providing evidence and following logical thought as well as being open-minded to the ideas of others. Ask students in their small groups to draw a poster illustrating the event they think occurred. Posters can be hung up and then have a gallery walk so that they may share their illustration and thought process.

Front (closed foldable): Students receive the top two pictures first and glue to shutters. The bottom left picture second, the bottom right picture last. (Alternatively these pictures can be shown on a projector and the students can draw their own version or the pictures can be numbered).



Front (open foldable): students have the option of drawing lines to divide up the back page (might be preferable because it separates the space better). They should write their hypothesis down for each picture as well as their thought process or reasoning.

Can You Outrun a Dinosaur?

Teacher: MaST Academy (Adriano Pérez)

Subject / grade level: 9th grade Biology

Materials: Prepared calculation tables, outlines of each set of dinosaur footprints (can be chalk outlines or paper cut; drawn to size!), calculators, meter sticks

Standards: Biology: 7(A) Physics: 4(B)

Lesson objective(s): Students will use measurements and various calculations to extrapolate the speed of a dinosaur based off of its footprints. Then, students will calculate their own running speed as a function of a distance over time. Students will compare the two speeds to determine if they could have outrun each dinosaur.

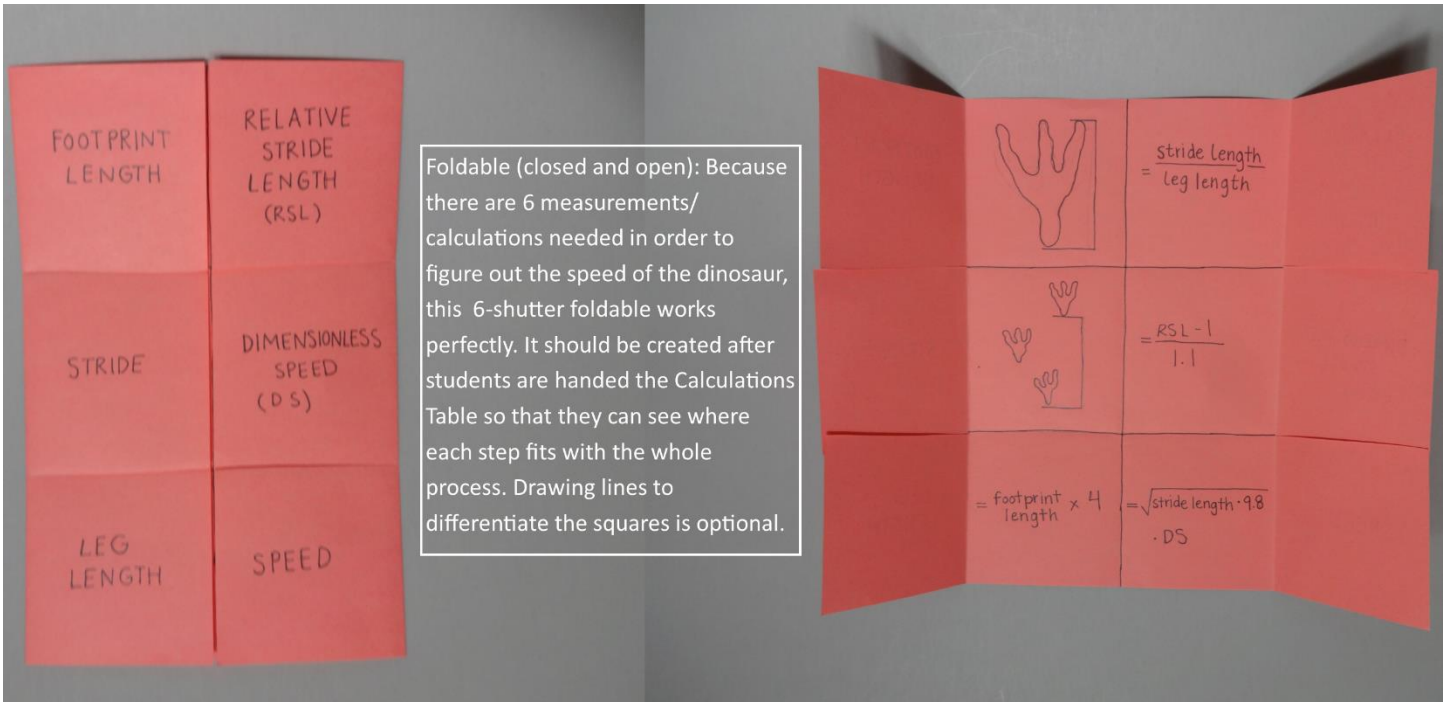
ENGAGEMENT Have a discussion with students if they think that they could outrun a dinosaur or what their technique to outrun a dinosaur would be. Ask students how they would determine how fast a dinosaur could run if they're all extinct already.

EXPLANATION Students will use a foldable to take notes on the steps of calculating a dinosaur's speed, using only its footprints (pictures and equations will be used to describe the measurements and calculations). This can be done by utilizing the white board and drawing/writing each section of the foldable (images are provided in the folder). The Ankylosaur will be used as an example to guide students through the steps once more, as well as to practice entering information into the table.

EXPLORATION Students will be divided into 5 groups and assigned a dinosaur to calculate its speed. They will go to the location of the dinosaur footprints, and use meter sticks to measure footprint length/ stride length and then follow the calculations to determine speed. Students will also determine their own speed by timing how long it takes them to run 20 meters- these measurements will be recorded into the other table.

ELABORATION Students will regroup and share their measurements and calculations with the class by filling out a table drawn onto the whiteboard. Students will also share their speed by writing it into a table on another whiteboard. As a whole class, students will fill in their tables and discuss whether they would be successful at outrunning each dinosaur.

EVALUATION Students are evaluated as they are filling in the whiteboard tables; corrections could be made by asking students to double check their calculations and asking guiding questions to put them on the right track.



Foldable (closed and open): Because there are 6 measurements/ calculations needed in order to figure out the speed of the dinosaur, this 6-shutter foldable works perfectly. It should be created after students are handed the Calculations Table so that they can see where each step fits with the whole process. Drawing lines to differentiate the squares is optional.

Dinosaur	Footprint length	Stride Length	Leg Length $Footprint \times 4$	Relative Stride Length $\frac{(Stride\ length)}{Leg\ Length}$	Dimensionless speed $\frac{(RSL-1)}{1.1}$	Speed $\sqrt{Stride\ Length \times 9.8} \times Dimensionless\ Speed$
Apatosaurus		5 meters*				
Triceratops		5.6 m*				
Stegosaurus		4 m*				
Ankylosaur	0.3 m*	1.6 m*				
Indominus Rex		12 m*				
Tyrannosaurus Rex		9.6 m*				

Dinosaur	Footprint length	Stride Length	Leg Length $Footprint \times 4$	Relative Stride Length $\frac{(Stride\ length)}{Leg\ Length}$	Dimensionless speed $\frac{(RSL-1)}{1.1}$	Speed $\sqrt{Stride\ Length \times 9.8} \times Dimensionless\ Speed$
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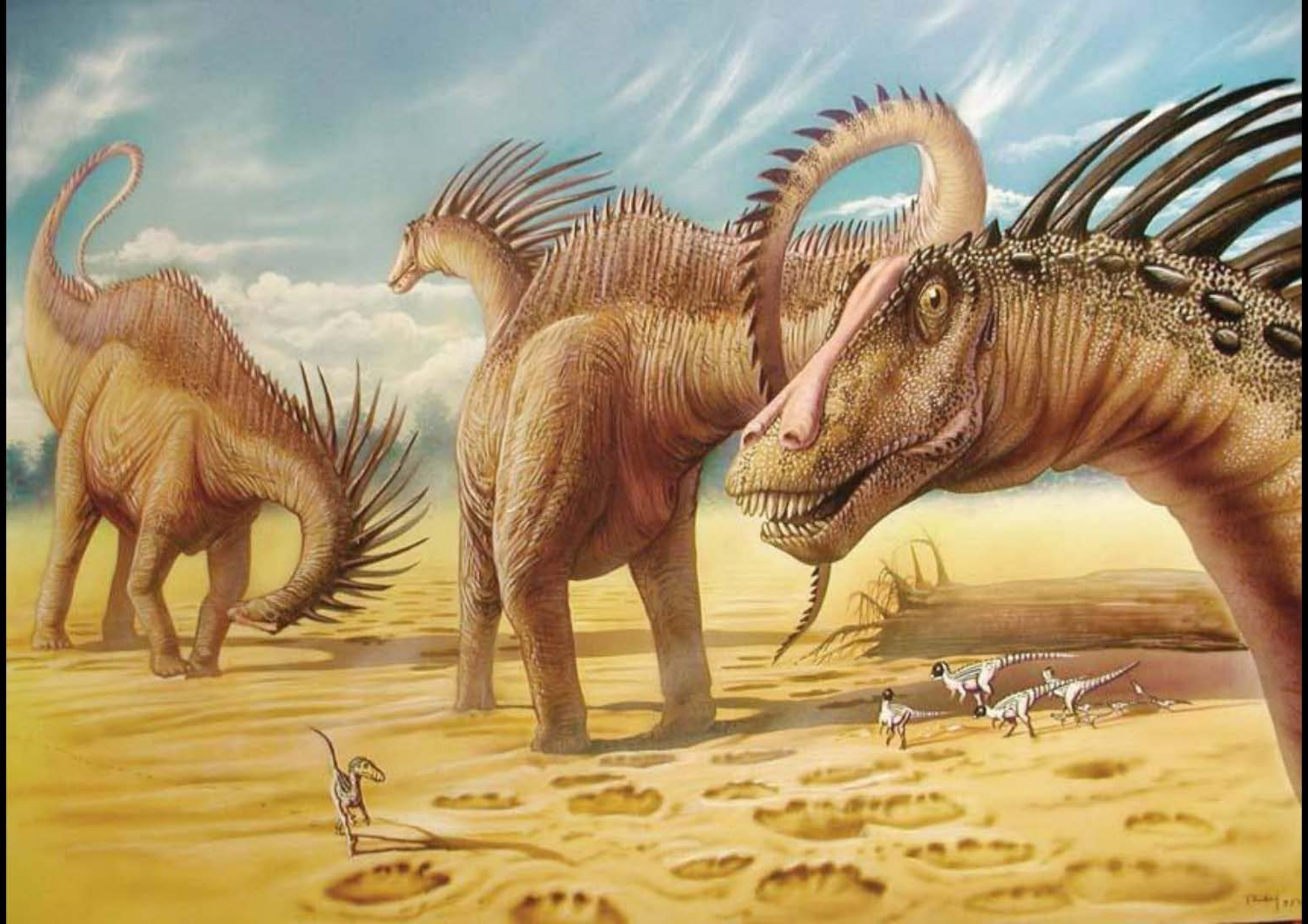
Tyrannosaurus Rex		9.6 m*				

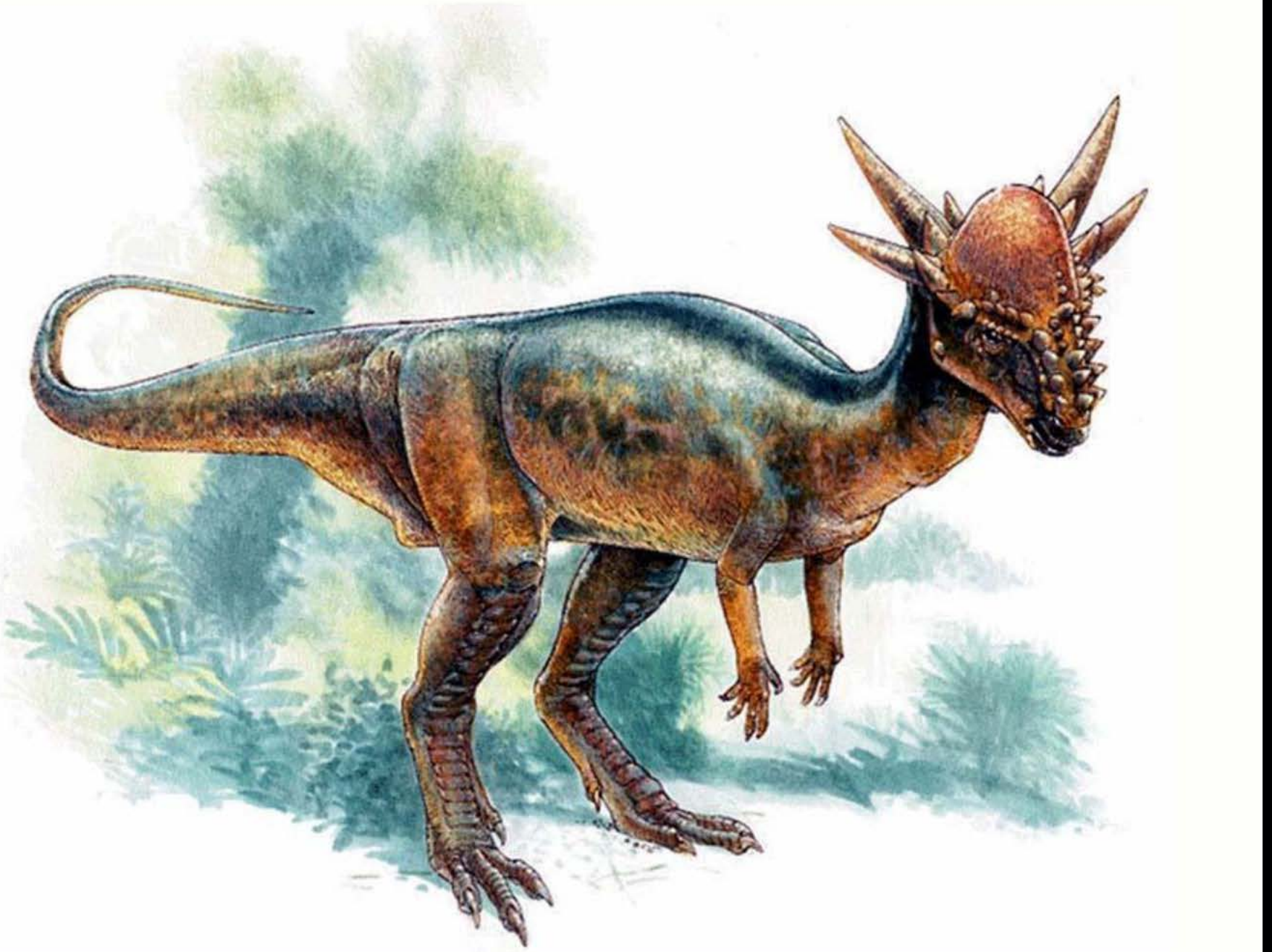
Name	Distance	Time	Speed

Name	Distance	Time	Speed

Design-a-Dinosaur

Teacher: MaST Academy (Sue Huffman)
Subject / grade level: 9th grade Biology
Materials: iPads with EarthViewer application, poster boards, art supplies (markers, colored pencils, glue, colored paper, scissors, tape), Adaptations Powerpoint (provided in the file folder)
Standards: Biology: 7(C), 7(E), 12(B)
Lesson objective(s): Student will be able to define natural selection and identify selection pressures; they will be able to draw connections between a species' environment and its traits by creating a dinosaur that is adapted to live in a specific environment from the Mesozoic Era.
ENGAGEMENT Show students a slide show of dinosaurs and other animals (extinct and extant) with interesting or odd adaptations. Ask students why each animal has those features and let them share their thoughts, use this as an opportunity to introduce ideas like environmental pressures, natural selection, and selective breeding.
EXPLORATION Utilizing the iPads and the application EarthViewer, students will select a location on Earth, then "go back in time" to observe how the location has changed. They can also use the internet to find reliable sources that describe the old habitat. The students will be asked to create a poster illustrating the environment. Students can be asked: what features of the habitat are important to include on the poster?
ELABORATION Groups will switch posters. Then, students will be provided a simple drawing of a dinosaur and are asked to adapt it to be best suited to the new environment. Students will use what they've learned about adaptations to make sure their evolutions are logical. Students can be asked: what aspects of the poster are you looking at to design your dinosaur?
EXPLANATION Students will then do a gallery walk in which the groups explain their habitat and their dinosaur, and what adaptations the dinosaur has and why. Each group can be asked: what pressured the dinosaur to look that way? How did it get there? How long would the evolution take?
EVALUATION General evaluation conducted during the lesson includes questions asked while students are designing their posters/ dinosaurs (such as why is your dinosaur that color? etc.) Each student will write a description of their environment, dinosaur and its adaptations; from the viewpoint of a time traveler recording into their field notebook.





Kosmoceratops by James Gurney, Finalist in the ARC Salon and winner of the Silver Medal at Spectrum Fantastic Art. © BDSP, Inc. 2013


Cephalotes
atratus L.

Adaptations PowerPoint Cheat Sheet

1. *Shuvuuia*- long snout adapt to tunneling for insects and spade-like front limbs for digging
2. *Carnotaurus*- front arms are completely vestigial (essentially useless), horns used for combatting other males
3. *Amargasaurus*- Spines along neck, back, and tail. Could have a membrane in between (like a sail)
4. *Stygimoloch*- spikes along back of skull as well as a central horn and hornlets on face
5. *Therizinosaurus*- extremely long claws, purpose unknown because most likely herbivorous
6. *Kosmoceratops:* skull is decorated with numerous horns on skull and frill
7. *Concavenator*: tall and narrow crest on back and large quilled feathers on arms
8. *Cyphonia clavata*: bug with an ant-like attachment growing on its back
9. *Elaphodus cephalophus*: males have fang-like canine teeth
10. Maned wolf (*Chrysocyon brachyurus*): canid with extremely long legs
11. Pink Fairy Armadillo (*Chlamyphorus truncatus*): silky fur and a flexible shell on its back
12. Cassowary- Large three-toed feet and a crest on the head (multiple purposes)
13. Narwhal- Whale w/ large straight tusk from modified canine tooth
14. Sarcastic fringehead, *Neoclinus blanchardi*, ferocious fish which opens mouth to battle other males

THE MESOZOIC ERA IS A WILD PLACE, FULL OF ALL KINDS OF WONDROUS ENVIRONMENTS!

HOWEVER, IN ORDER TO SURVIVE THESE LANDS, A DINOSAUR MUST BECOME ADAPATED AND READY TO BLEND IN, SCARE OFF, OR BATTLE OTHER ANIMALS; FIND FOOD TO EAT; AND LAST BUT NOT LEAST, FIND A MATE!

GLUE THIS SIDE TO NOTEBOOK

ADAPTING A DINOSAUR

YOUR GUIDE TO COMPETING IN THE SURVIVAL OF THE FITTEST!

INTERACTING WITH OTHER DINOSAURS

When facing another dinosaur what does your dinosaur do?

1. Does it try to blend into the surroundings?

-If your dinosaur uses this technique then perhaps its skin has colors that match the trees or grass. Maybe it grown a bumpy or stony texture to its skin.

2. Does it attempt to scare off the other dinosaur?

-There are many ways to look scary: a large frill behind its head; spikes growing out of its neck or back; make a tremendous noise like a honk or roar; or perhaps its just extremely large!

3. Does it fight the opponent?

-In order to win a fight, the dinosaur must be equipped: long claws, armor along its back and head, a spiky tail, or razor-sharp teeth.

FINDING SOMETHING TO EAT

Like any other animal, a dinosaur has got to eat!

1. Hunter

-In order to be a good hunter, your dinosaur has to either outrun or outsmart its prey. Does it have long, strong legs or travels in packs. Does it have wide snout or narrow with lots of teeth or just a beak?

2. Scavenger

-If your dinosaur is an opportunist, is it small and fast or big and intimidating?

3. Herbivore

-Flat teeth are a sign of a plant-eater but how does it get its food? Does it need to have a long neck to reach high branches or a pointy snout to dig through the dirt?

FINDING A MATE

In order to truly be adapted, your dinosaur has to pass on its genes!

1. The most beautiful one of all

-Do your male and female dinosaurs look the same? How does the male attract the female: a busy feather display, attractive colors, or is it a specific dance.

2. Love is a battlefield

-Or does your dinosaur have to fight for the right to mate? How does it do this? Do they bump heads, poke each other with spikes and horns, or swing large tails around.

THESE IDEAS ARE JUST SUGGESTIONS TO GET YOUR MIND FLOWING, I ENCOURAGE YOU TO BE CREATIVE AND CREATE AN AWESOME DINOSAUR!

Dinosaur DNA

Teacher: MaST Academy (Stephanie Gonzalez)

Subject / grade level: 9th grade Biology

Materials: Pre-made DNA strands w/ corresponding RNA strands (slips of paper), iPads, paper, markers, colored pencils

Standards: Biology: 6(A), 6(B), 6(C), 6(H)

Lesson objective(s): Student will understand that DNA is the genetic code for proteins and, as a result, life. Students will also understand the process in which DNA is translated into RNA and then into proteins.

ENGAGEMENT Show students a video clip taken from the film "Jurassic World" that shows the scenes where the young boy names DNA nucleotides and the Park Manager discusses creating "genetically modified" dinosaurs. Ask students where our physical features come from and have a guided discussion on what they know about DNA.

EXPLANATION Have students write down the 4 DNA nucleotides and Uracil (RNA nucleotide). Together with students, copy a strand of DNA so that they can learn the pairing rules; then transform that strand into RNA and translate into proteins using a protein chart. After the initial explanation, have the students practice each step on their own and go over the process- explaining and going into more detail as needed.

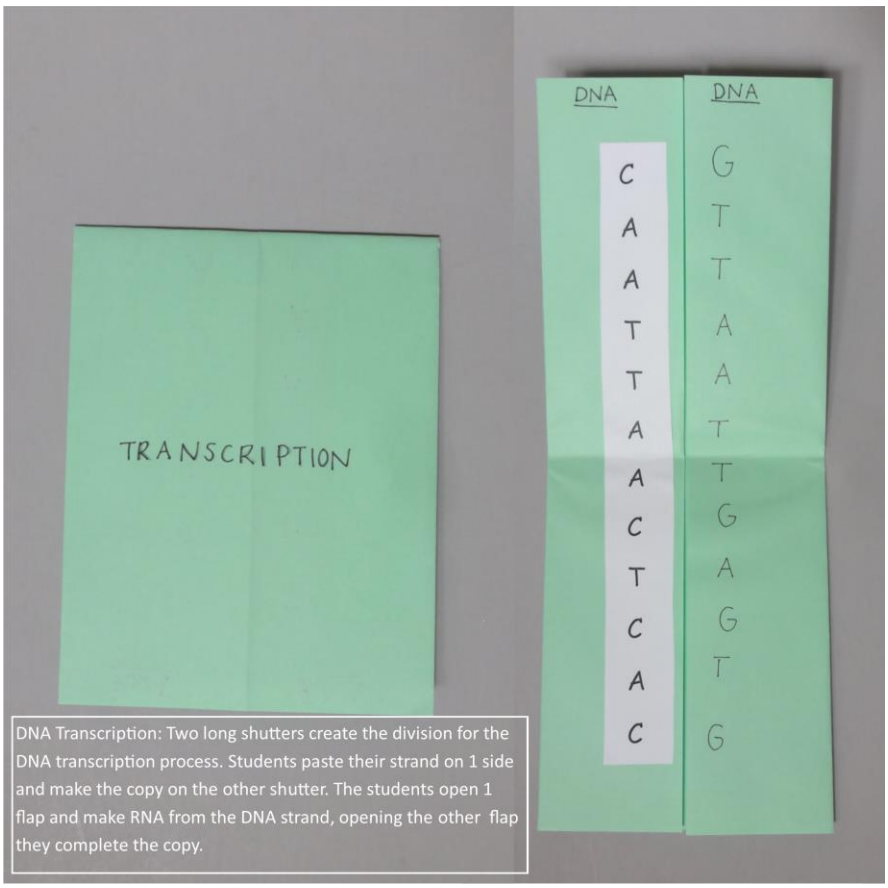
EXPLORATION Students will each receive their own, unique, "DNA Strand". Have them create the foldable to symbolize the step-by-step process in which transcription occurs. Have them copy their DNA, translate into RNA, then copy that RNA into the other strand (pictures illustrating this process are in the folder). After students have done this they can go look through the RNA strand slips of paper to find their corresponding slip. The slip has the name of a dinosaur on it- this is the dinosaur that they "created".

EXLABORATION Students will use the iPads and materials to create a poster advertising their dinosaur. It needs to list several factoids about the dinosaur and have a drawing of the dinosaur. Once everyone is done, students participate in a "Pair and Share" activity in which they present the posters on a one-on-one environment.

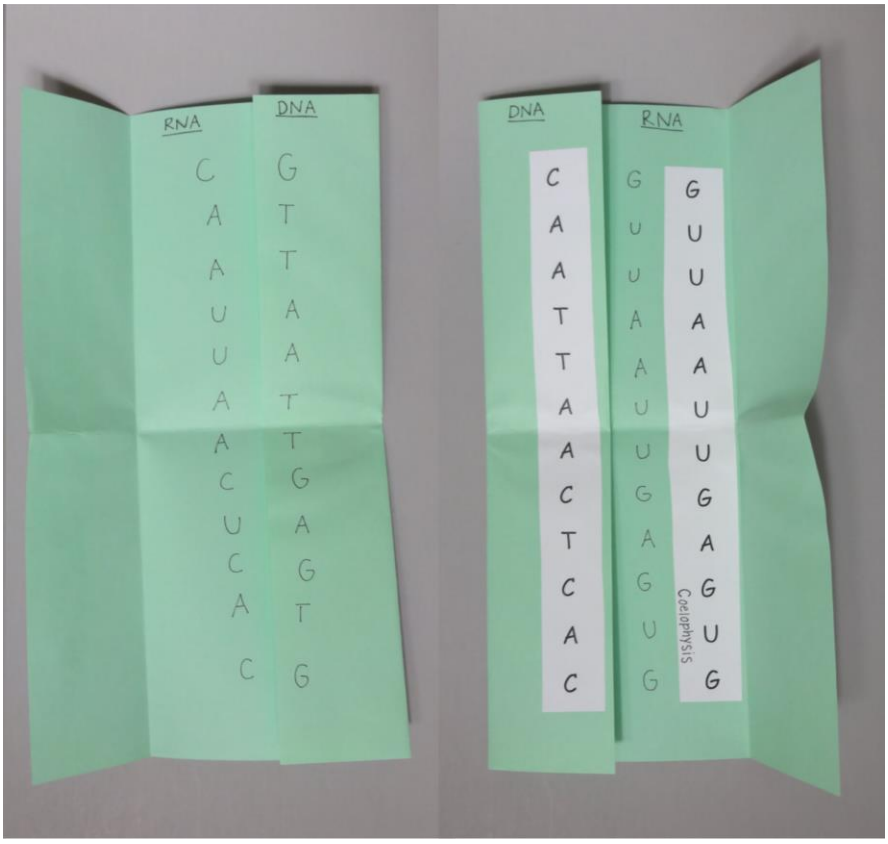
EVALUATION Formative assessment is ongoing, first during the practice and then when students are translating and transcribing the DNA on their own.

NOTES The creator of this lesson took many steps to relate this lesson to the Dinosaur theme: the students found their DNA strands in plastic baggies in amber-colored Jell-O. Also in the bag was a picture of a mosquito to signify where the DNA was found. The corresponding RNA strands were placed into plastic Easter eggs and hidden all around an adjoining room. As the students finished transcribing their DNA they were instructed to go look through the dinosaur eggs to find the specific one that they had created.

WRAP UP As a wrap-up to this activity students were taken through a procedure to extract the DNA of a strawberry and place in a vial to keep. The lesson plan for this activity can be found in the folder.



DNA Transcription: Two long shutters create the division for the DNA transcription process. Students paste their strand on 1 side and make the copy on the other shutter. The students open 1 flap and make RNA from the DNA strand, opening the other flap they complete the copy.



DNA Extraction Lab

Background Info:

All living things contain DNA (deoxyribonucleic acid – the genetic code material of cells). It is the DNA that determines all of the unique characteristics of species and accounts for the great biological diversity of organisms on Earth. Any research into the study of DNA requires the first step of isolating this molecule. The following labs are simple but very effective ways of isolating and extracting DNA from both plants (wheat) and animals (you)!

DNA Necklace Lab: DNA Extraction from YOU!

Question: Can DNA be extracted and isolated from living things?

Materials: sports drink, cup, disposable test tube, test tube rack, microcentrifuge tube, pipette, yarn, alcohol, clear dish soap

Procedures:

1. ***Prepare Tubes:*** Write your initials on your test tube, microcentrifuge tube, pipette, and cup.
2. Measure 2 mL of sports drink using your pipette and test tube. Pour it into the small cup.
3. Pour 2 ML of clear soap solution into the test tube.
4. ***Slough off Cheek Cells:*** Swish the sports drink VIGOROUSLY for 60 seconds. You are trying to slough off as many cheek cells as possible.
5. Spit the sports drink back into the small cup.
6. Carefully pour into the test tube.
7. ***Release the DNA from Cells:*** GENTLY mix the test tube by holding your thumb over the opening and inverting the test tube 5 times.
8. Try to avoid creating too many bubbles.
9. The soap solution breaks the cell membranes, which are made of lipids – just like soap breaks down grease on dishes.
10. ***Separate out the DNA:*** Tilt the test tube and GENTLY pour alcohol down the side of the test tube using your transfer pipette until the total volume reads 13 mL.
11. You are trying to form 2 distinct layers. DO NOT MIX THIS!!
12. Let the test tube stand for about 10 minutes.
13. You will see white clumps appearing – this is YOUR DNA precipitating!
14. While waiting, cut 2 feet of yarn for your necklace.
15. ***Extract the DNA:*** Use the transfer pipette to GENTLY remove the strands of DNA and squirt it into your microcentrifuge tube.
16. Pipette a small amount of leftover liquid into the microcentrifuge tube.
17. ***Create Your Necklace:*** Center your sting on the cap's hinge, and then snap it shut.
18. Tie your necklace around your neck.
19. Show off to all your friends!

Data:
Draw and label your test tube with the precipitated DNA.
Results: Write a few sentences describing your results.

Label test tube and results on this side.

Results/Observations:_____

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Data:
Draw and label your microcentrifuge tube
with your lab results. Be sure to draw your necklace as well!

Analysis:

1. What does DNA stand for and where is it located?_____
_____
_____
2. Why is DNA important?_____
_____
3. Briefly discuss the structure of DNA including the backbone (sides) and base pairs (rungs) of the ladder._____
_____
_____
_____

DNA Isolation from Strawberries

Developed by Diane Sweeney
http://www.caseciw.org/first_light_case/horn/strawberries/strawbdnaproc.html

Teacher Background

This is a simple, effective protocol for spooling DNA. Ripe strawberries are an excellent source for extracting DNA because they are easy to pulverize and contain enzymes called pectinases and cellulases that help to break down cell walls. And most important, strawberries have eight copies of each chromosome (they are octoploid), so there is a lot of DNA to isolate.

The purpose of each ingredient in the procedure is as follows:

Shampoo or dishwasher soap helps to dissolve the cell membrane, which is a lipid bilayer.

Sodium chloride helps to remove proteins that are bound to the DNA. It also helps to keep the proteins dissolved in the aqueous layer so they don't precipitate in the alcohol along with the DNA.

Ethanol or isopropyl alcohol causes the DNA to precipitate. When DNA comes out of solution it tends to clump together, which makes it visible. The long strands of DNA will wrap around the stirrer or transfer pipet when it is swirled at the interface between the two layers.

Notes on Materials and Recipes

- Use Ziploc ™ freezer bags rather than sandwich bags, as they are thicker.
- Fresh or frozen strawberries can be used. Be sure to thaw the frozen berries at room temperature. Bananas or kiwi fruit can also be used but yield less DNA.
- Use non-iodized table salt or laboratory-grade sodium chloride.
- 95% ethanol or 91 or 100% isopropyl alcohol can be used to precipitate the DNA. Isopropyl alcohol can be purchased from a pharmacy. Whichever you use, make sure it is ice cold by placing in an ice-water bath or in the freezer.

DNA Extraction Buffer

- 100 ml (3/8 cup) shampoo (without conditioner) or 50 ml dishwasher detergent
- 15 grams sodium chloride (2 teaspoons)
- water to 1 liter

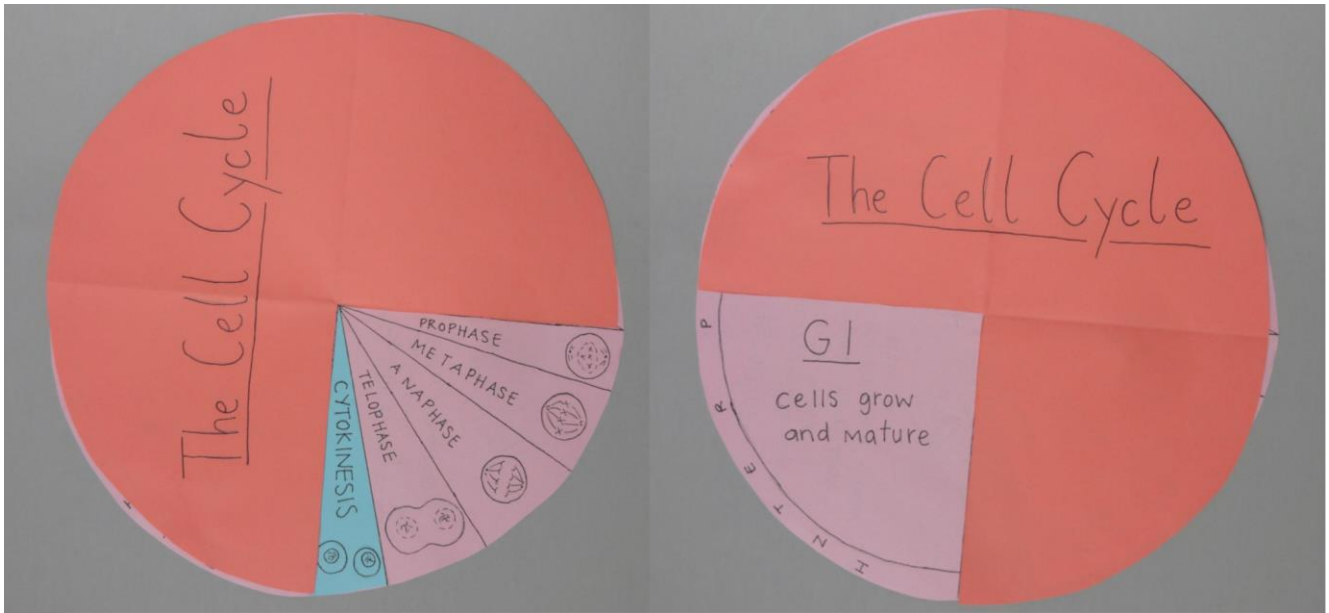
DNA Isolation from Strawberries
Student Directions

Materials per student group
- 1-3 strawberries (about the volume of a golf ball). Frozen strawberries should be thawed at room temperature.
- 10 ml DNA Extraction Buffer (soapy salty water)
- about 20 ml ice cold 91% or 100% isopropyl alcohol
- 1 Ziploc ™ bag
- 1 clear test tube
- 1 funnel lined with a moistened paper towel
- 1 coffee stirrer or transfer pipet

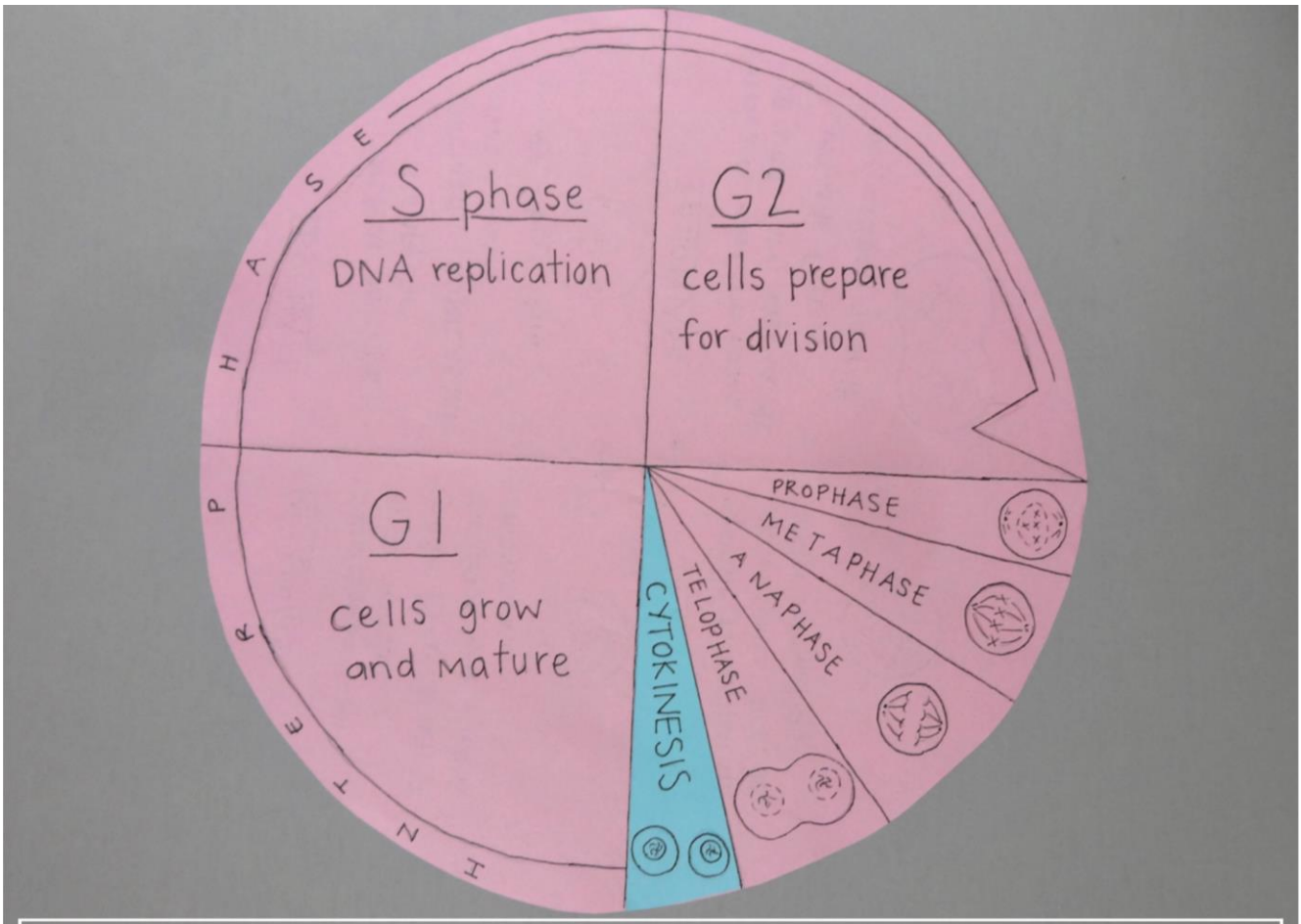
Directions
1. Remove the green sepals from the strawberries.
2. Place strawberries into a Ziploc ™ bag and seal shut.
3. Squish for a few minutes to completely squash the fruit.
4. Add 10 ml DNA Extraction Buffer (soapy salty water) and squish for a few more minutes. Try not to make a lot of soap bubbles.
5. Filter through a moistened paper towel set in a funnel, and collect the liquid in a clear tube. *Do not* squeeze the paper towel. Collect about 3 ml liquid.
6. Add 2 volumes ice cold isopropyl alcohol to the strawberry liquid in the tube. Pour the isopropyl alcohol carefully down the side of the tube so that it forms a separate layer on top of the strawberry liquid.
7. Watch for about a minute. What do you see? You should see a white fluffy cloud at the interface between the two liquids. That's DNA!
8. Spin and stir the coffee stirrer or transfer pipet in the tangle of DNA, wrapping the DNA around the stirrer.
9. Pull out the stirrer and transfer the DNA to a piece of saran wrap or clean tube. The fibers are thousands and millions of DNA strands.
10. To view in a microscope, put the glob on a clean slide and gently tease/stretch apart using 2 toothpicks or dissecting pins. The fibers will be easier to see in the teased-apart area.
11. Rinse your funnel. Put the Ziploc ™ bag and paper towel in the garbage.

Candy Cell Cycle

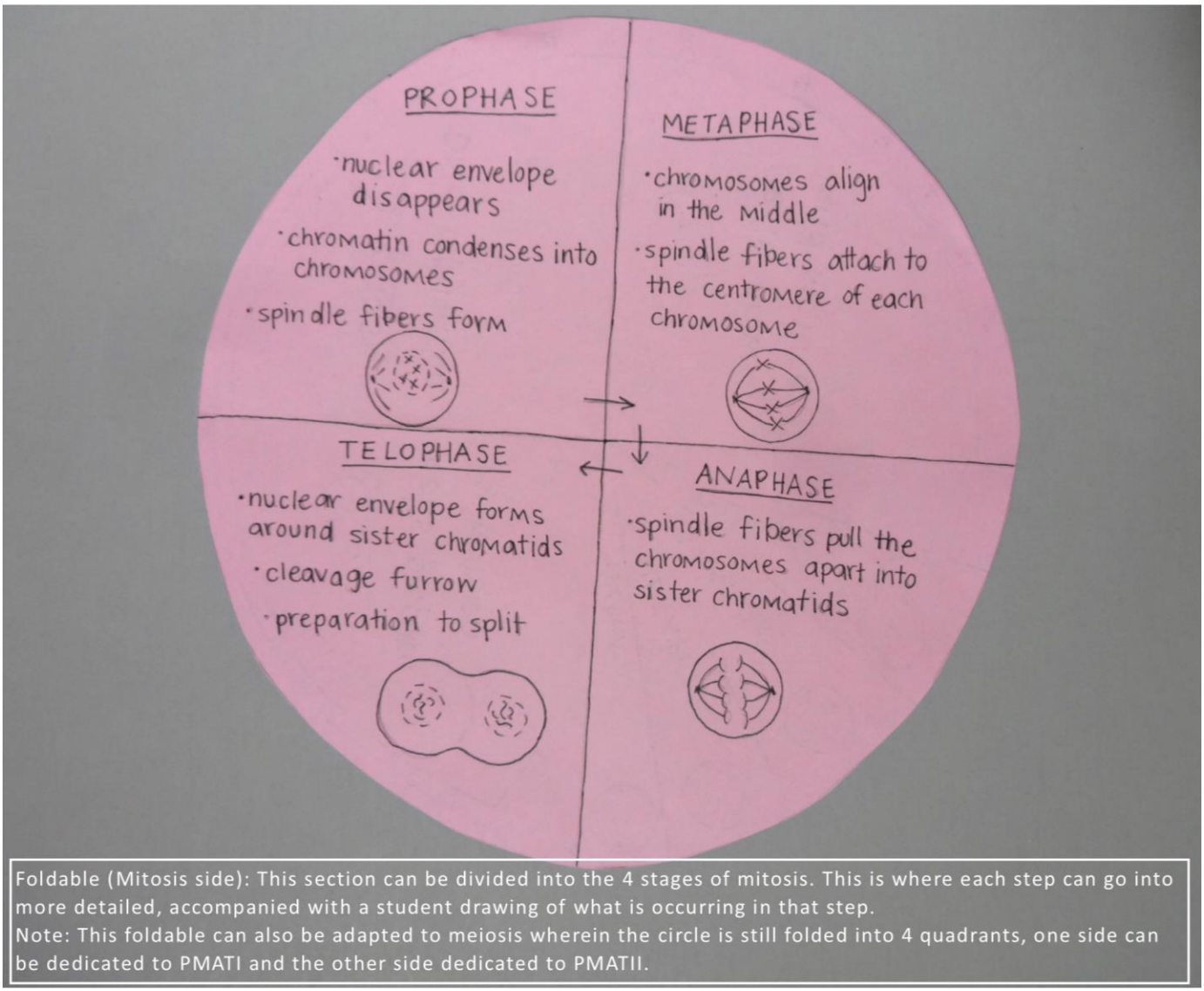
Teacher: MaST Academy (Stephanie Gonzalez)
Subject / grade level: Biology/ 9th grade
Materials: Twizzlers, poster board, markers, paper brads, video of cell undergoing mitosis
Standards: Biology: 5(A)
Lesson objective(s): Students will be able to list the steps of the cell cycle and mitosis. They will also be able to describe what is happening within the cell during each phase.
ENGAGEMENT Students will be divided into four groups and assigned a stage of mitosis. They will be asked to finish a poster describing the stage and to illustrate that stage of mitosis using the Twizzlers candy and the information provided on the poster. (The Twizzlers candy is used to represent DNA (due to the "twisty" design of the candy) and how DNA is replicated during Prophase).
EXPLANATION First, students are guided through creating the foldable. Utilizing the white board and the Twizzlers posters, students will be guided through the stages of the cell cycle on the front side of the foldable then they will copy down the details of mitosis and cytokinesis on the back of the foldable. (See pictures in the file folder for pictures of the foldable and notes).
EXPLORATION Students will use the information on their foldable and the posters to re-enact the cell cycle themselves (after relocating to an open space, like a hallway). Students are randomly assigned roles such as: nuclear envelope, centrosomes, chromosomes, and cell membrane. They will physically arrange themselves (with guidance from teacher and/or other students) into representing the different stages, as snapshots of what is occurring in the stage and the movements the organelles, etc. undergo during the process.
ELABORATION Back in the classroom, students will view a video of actual cells undergoing mitosis. At several spots during the video, it will be paused and students will be asked to volunteer to explain what is occurring in the cell- like what step that the cell is currently at, what is happening to the chromosomes, etc. If students experience difficulty, teacher can assist with guiding questions or by asking another student to contribute as well.
EVALUATION The poster creation and/or video explanations can serve as an evaluation. However, the majority will be formative assessment done throughout the lesson. Guiding questions and, if needed, corrections will be made while the students are re-enacting the cell cycle and creating their posters.



Foldable (with cover): Each side of the foldable can utilize the "The Cell Cycle" ¾ circle cover to help focus the student on what step is being covered. The paper can also be rotated to show the process in its chronological steps.

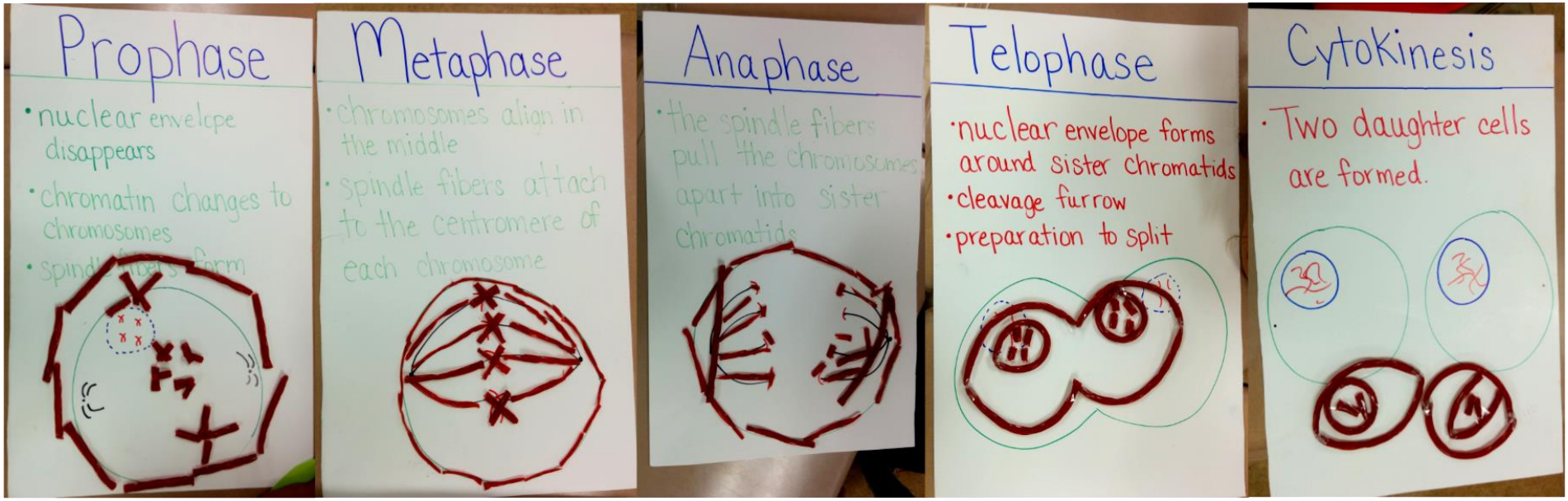


Foldable (cell cycle side): Folding the circle in half twice creates four quadrants. Students will divide into G1, S phase, G2 (interphase) and mitosis. The last quadrant is divided into 5 sections for mitosis and cytokinesis; an alternately colored paper can be glued over the cytokinesis section to indicate that it is its own process. The notes for interphase can be as detailed as wanted; mitosis should just have names and pictures as the other side will go into more detail.



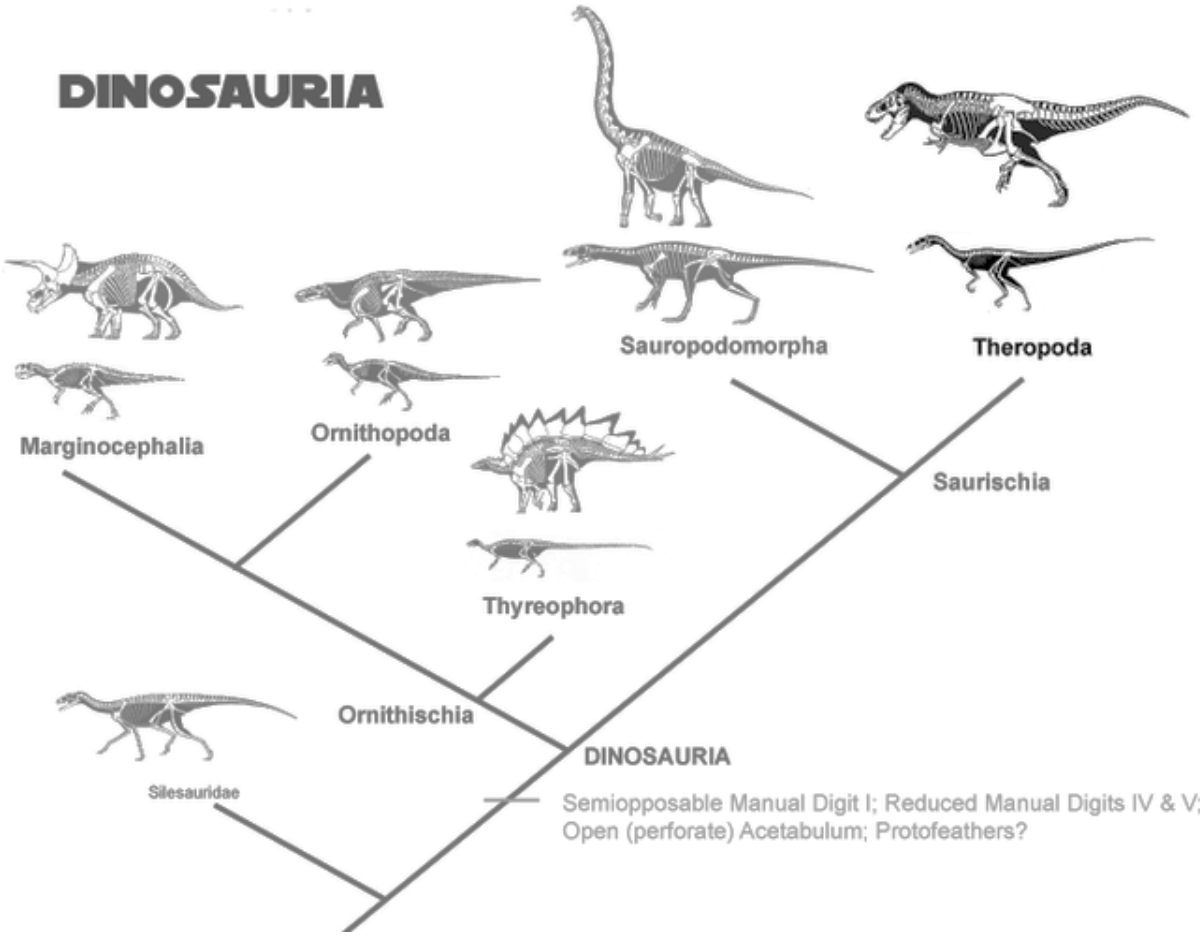
Foldable (Mitosis side): This section can be divided into the 4 stages of mitosis. This is where each step can go into more detailed, accompanied with a student drawing of what is occurring in that step.
Note: This foldable can also be adapted to meiosis wherein the circle is still folded into 4 quadrants, one side can be dedicated to PMATI and the other side dedicated to PMATII.

Sample of Student Work

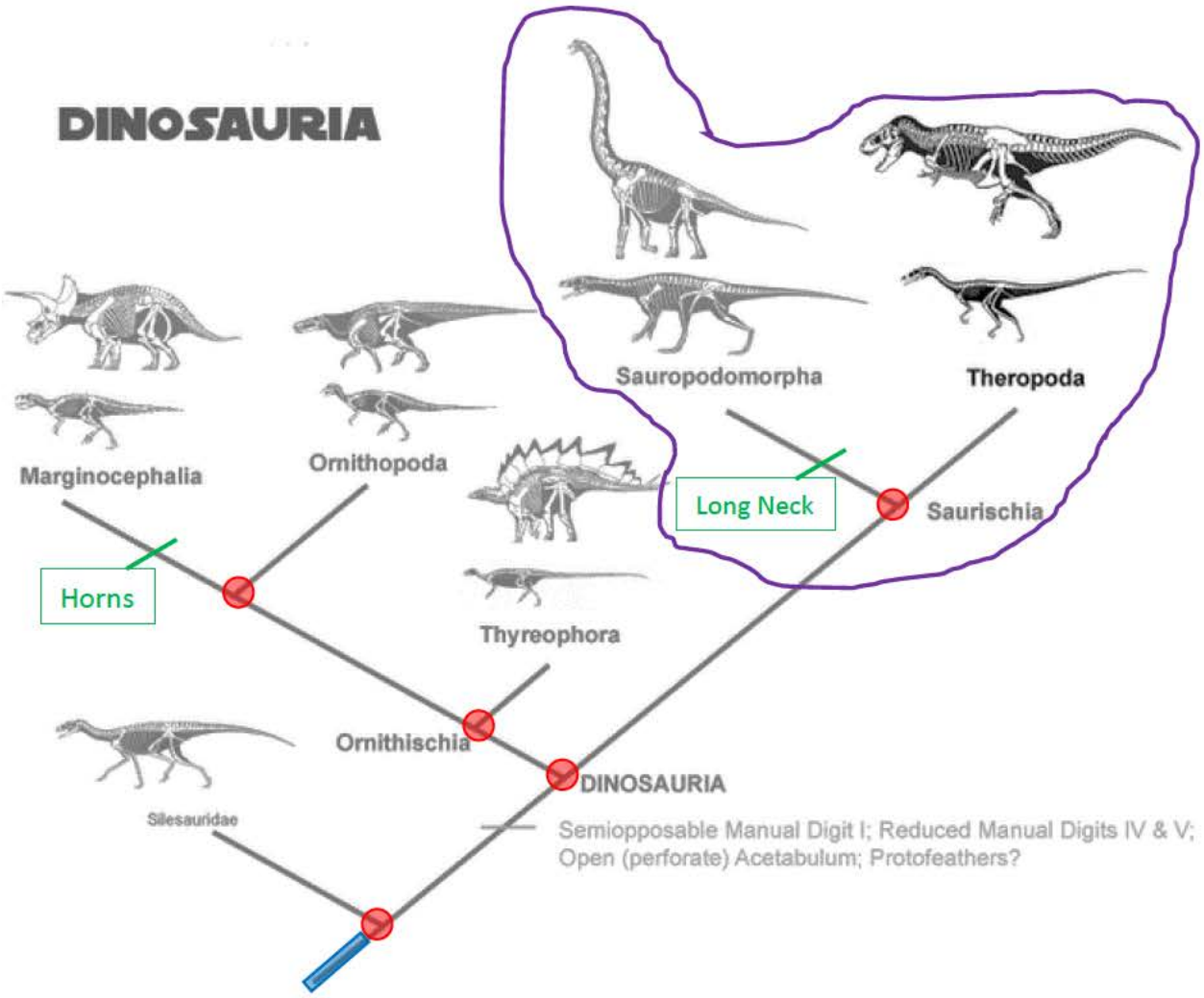


Dinosaur, Birds Beaks, and Evolution

Teacher: MaST Academy (Wesley Simental)
Subject / grade level: Biology/ 9th grade
Materials: markers, plastic cups, string, bubblegum, mini Tootsie rolls, spoons, masking tape, duct tape, yarn, scissors, Styrofoam bowls/plates, hole puncher
Standards: Biology: 7(A), 7(D), 8(A), 8(B)
Lesson objective(s): Students will be able to describe, identify, and define the parts of a cladogram as well as be able to analyze a cladogram and create one of their own. Students will also understand how environment (particularly food options) can be a major force in the evolution of certain characters.
ENGAGEMENT Students will be divided into two groups of birds: The "Bubblegum Eaters" and the "Tootsie Roll Eaters" and given plastic cups as their beaks. Divided into groups of four, each group will have a pile of bubblegum and tootsie rolls; the students are given 1 minute to "eat" as many of their designated candies as they can, using only their cup and not their hands. They are given the stipulation that eating anything other than their food results in death. Then, as a group reflect on how they did- who ate the most? Give each group 1 minute at the "adaptation table" in which they are allowed to modify their beak using whatever supplies are provided. They are given 1 minute to try and eat the most food. Again, reflect on what they learned and then students are given one more chance to adapt their beak to be the best "hunter".
EXPLANATION Ask students to reflect on their adaptations; guide them to see that they started with the exact same beak but, due to adaptations to different foods, they all ended up looking quite different. Go over cladogram characteristics by defining and color-coding the Dinosauria cladogram (provided in the folder).
EXPLORATION Have students complete the Evolution Handout in their groups (also provided). Model the thought-process they should go through by answering the first few questions as a class.
ELABORATION Explain how dichotomous keys (based off of cladograms and shared/unshared characters) are used to identify species. Students are tasked with using a Dichotomous Key to identify the given aliens; model the process by identifying the first alien together as a class. (this file is also in the folder)
EVALUATION is ongoing throughout the activity. An assessment can be based off of whether they got the answers on evolution sheet correct or correctly identified what alien was what. Wrong answers should be used as opportunities to clarify concepts for the students.



DINOSAURIA
Sauropodomorpha
Theropoda
Marginocephalia
Ornithopoda
Saurischia
Thyreophora
Ornithischia
Silesauridae
DINOSAURIA
Semiopposable Manual Digit I; Reduced Manual Digits IV & V;
Open (perforate) Acetabulum; Protofeathers?



NODE: special event that took place to cause the evolution of a new clade

COMMON ANCESTOR: how all groups on a cladogram are connected

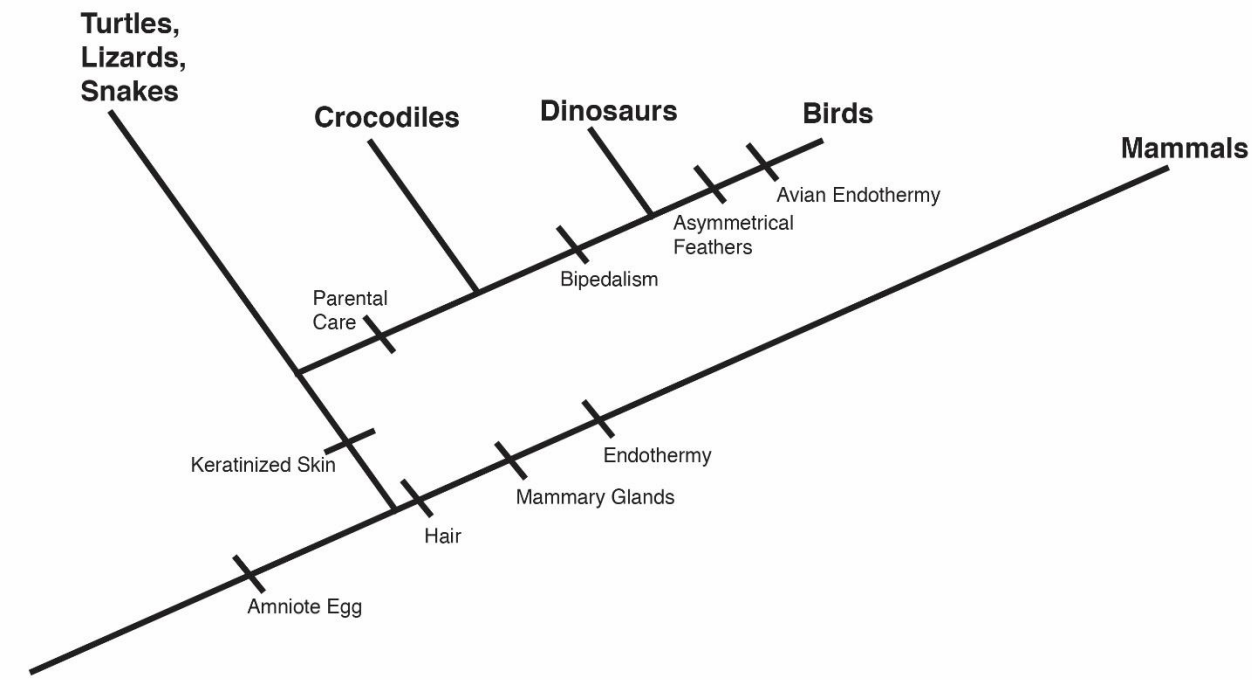
CHARACTERISTIC (ADAPTATIONS): an alteration in the structure or function of an organism

CLADE: a group of species related by a common ancestor

Name: _____

Evolution

Cladogram #1

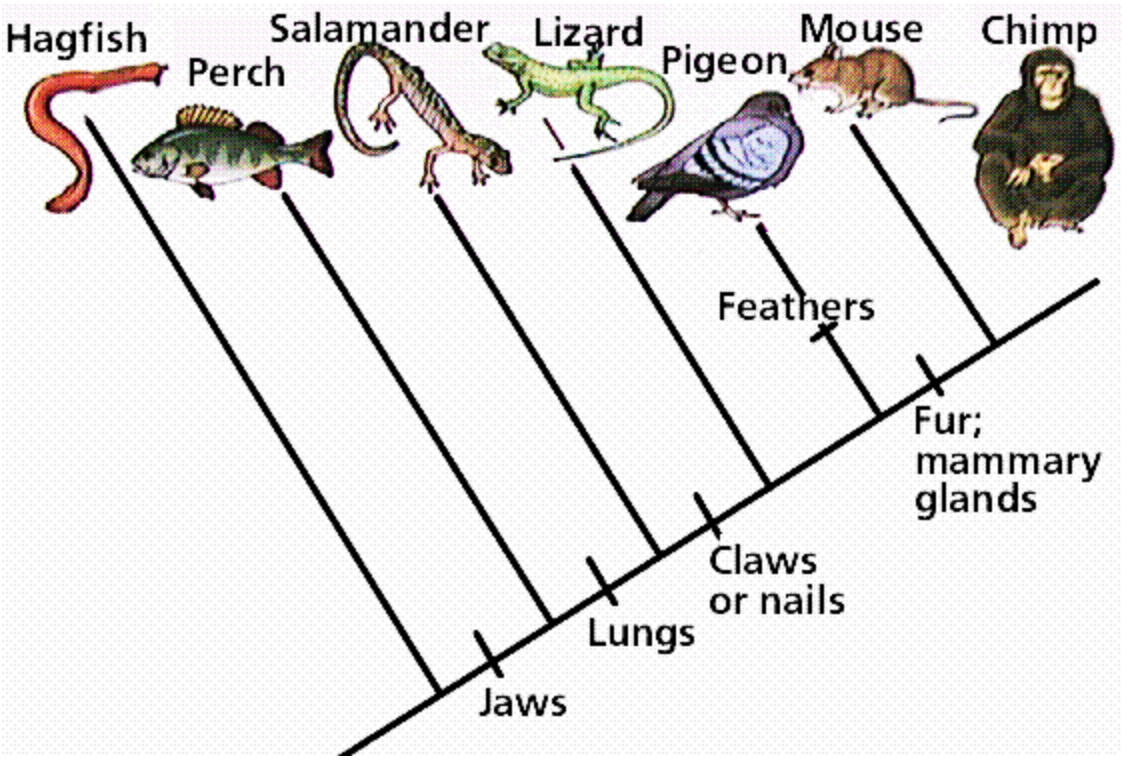


1. Name five characters possessed by birds: _____
   _____
   _____
2. Name two characters possessed by reptiles/birds (the group made of turtles, lizards, snakes, crocodiles, dinosaurs, birds; including common ancestors):
   _____
   _____
3. Name four characters possessed by mammals (Note: one of the four has been lost by almost all mammal species): _____
   _____
   _____
4. True or False: On their own, turtles, lizards, snakes, crocodiles, and dinosaurs form a clade. _____
5. True or False: On their own, crocodiles, dinosaurs, and birds form a clade.
   _____
6. According to the cladogram, which character evolved first: the amniote egg or hair? (Please circle one).

Name: _____

7. According to the cladogram, which character evolved first: keratinized skin or bipedalism? (Please circle one).
8. On the cladogram, circle the point (node) that represents the most recent common ancestor of crocodiles, dinosaurs, and birds.

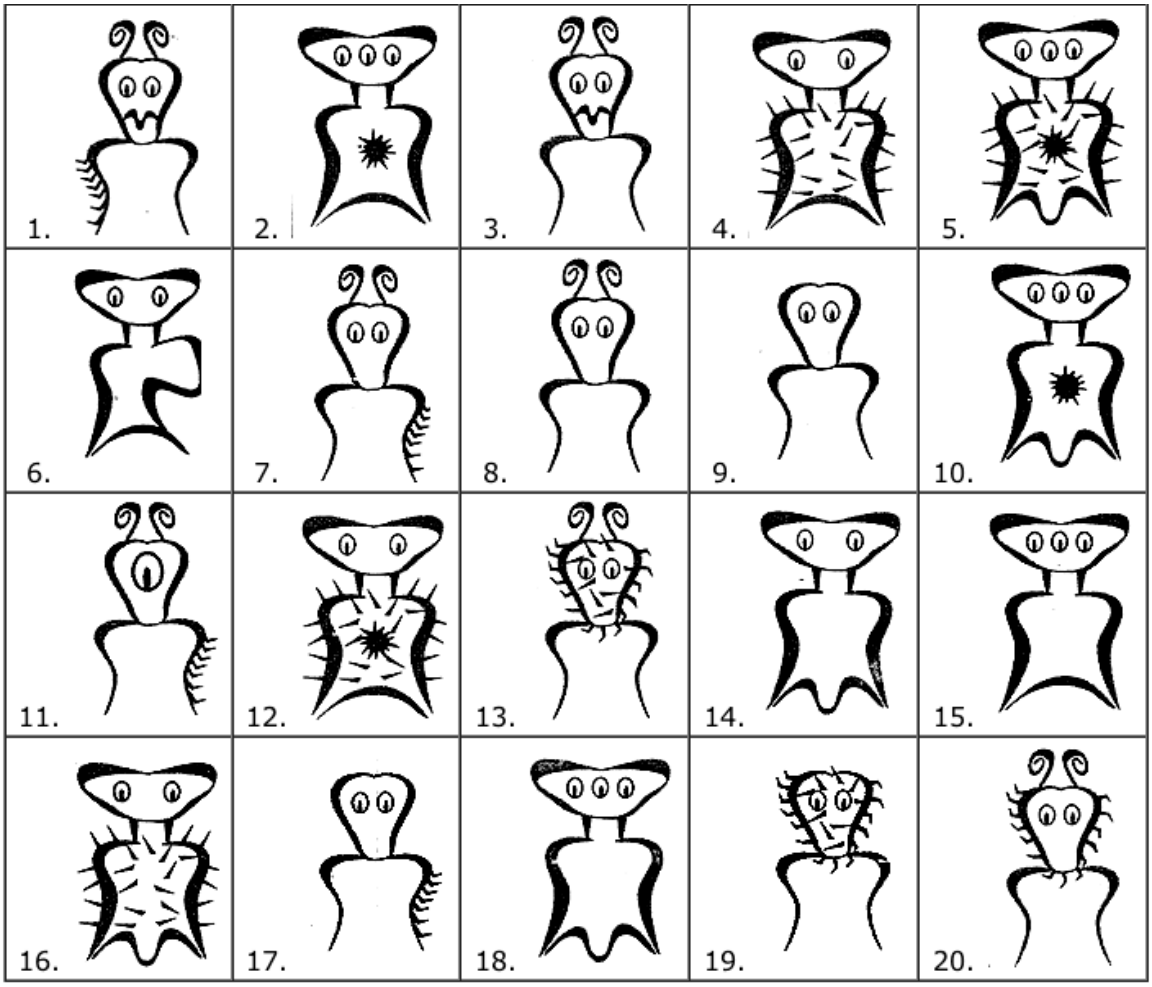
Cladogram #2



1. What animal does not have jaws? _____
2. Which animals have lungs? _____
   _____
3. Which of the following groups, taken by themselves, do NOT form a clade? ____
   a. Pigeon, Mouse, and Chimp
   b. Lizard, Pigeon, and Mouse
   c. Salamander, Lizard, Pigeon, Mouse, and Chimp
   d. Hagfish, Perch, Salamander, Lizard, Pigeon, Mouse, and Chimp

Name _____ **Class** _____ **Date**_____

Alien Classification – Using a Dichotomous Key



Directions: Help! Scientists have discovered quite a few new creatures on planet Pamishan. They need your help to identify and classify them.

1. Use the dichotomous key below to identify these creatures.
2. Write the ***number*** of the alien next to its ***scientific name***

1. a. The creature has a large wide head.....go to 2
   b. The creature has a small narrow head.....go to 11

2. a. It has 3 eyes .....go to 3
   b. It has 2 eyes .....go to 7

3. a. There is a star in the middle of its chest.....go to 4
   b. There is no star in the middle of its chest .....go to 6

4. a. The creature has hair spikes .....Broadus hairus
   b. The creature has no hair spikes.....go to 5

Name _____ Class _____ Date_____

Alien Classification – Using a Dichotomous Key

5. a. The bottom of the creature is arch-shaped .....Broadus archus
   b. The bottom of the creature is M-shaped .....Broadus emmus

6. a. The creature has an arch-shaped bottom .....Broadus plainus
   b. The creature has an M-shaped bottom.....Broadus tritops

7. a. The creature has hairy spikes .....go to 8
   b. The creature has no spikes.....go to 10

8. a. There is a star in the middle of its body .....Broadus hairystarus
   b. The is no star in the middle of its body .....go to 9

9. a. The creature has an arch shaped bottom .....Broadus hairyemmus
   b. The creature has an M shaped bottum .....Broadus kiferus

10. a. The body is symmetrical .....Broadus walter
    b. The body is not symmetrical.....Broadus anderson

11. a. The creatrue has no antennae .....go to 12
    b. The creature has antennae .....go to 14

12. a. There are spikes on the face .....Narrowus wolfus
    b. There are no spikes on the face .....go to 13

13. a. The creature has no spike anywhere .....Narrowus blankus
    b. There are spikes on the right leg .....Narrowus starboardus

14. a. The creature has 2 eyes.....go to 15
    b. The creature has 1 eye.....Narrowus cyclops

15. a. The creature has a mouth.....go to 16
    b. The creature has no mouth.....go to 17

16. a. There are spikes on the left leg .....Narrowus portus
    b. There are no spikes at all .....Narrowus plainus

17. a. The creature has spikes .....go to 18
    b. The creature has no spikes .....Narrowus georginia

18. a. There are spikes on the head .....go to 19
    b. There are spikes on the right leg.....Narrowus montanian

19. a. There are spikes covering the face .....Narrowus beardus
    b. There are spikes only on the outside edge of head .....Narrowus fuzzus

Graham Cracker Plate Tectonics

Teacher: MaST Academy (Sue Huffman)

Subject / grade level: 9th grade

Materials: Per student: 1 fruit roll-up, 2 graham crackers, 1 large tablespoon of cake frosting (the whipped kind is preferable), 1 sheet of parchment paper, 1 plastic spoon. Shared between ~4 students: 1 cup of water

Standards: Earth and Space Science: 10(B), 10(C), 10(E)

Lesson objective(s): Student will understand the 3 types of plate boundaries (divergent, convergent, and transform) as well as characteristics associated with each of those boundaries (like mountain building or sea floor spreading).

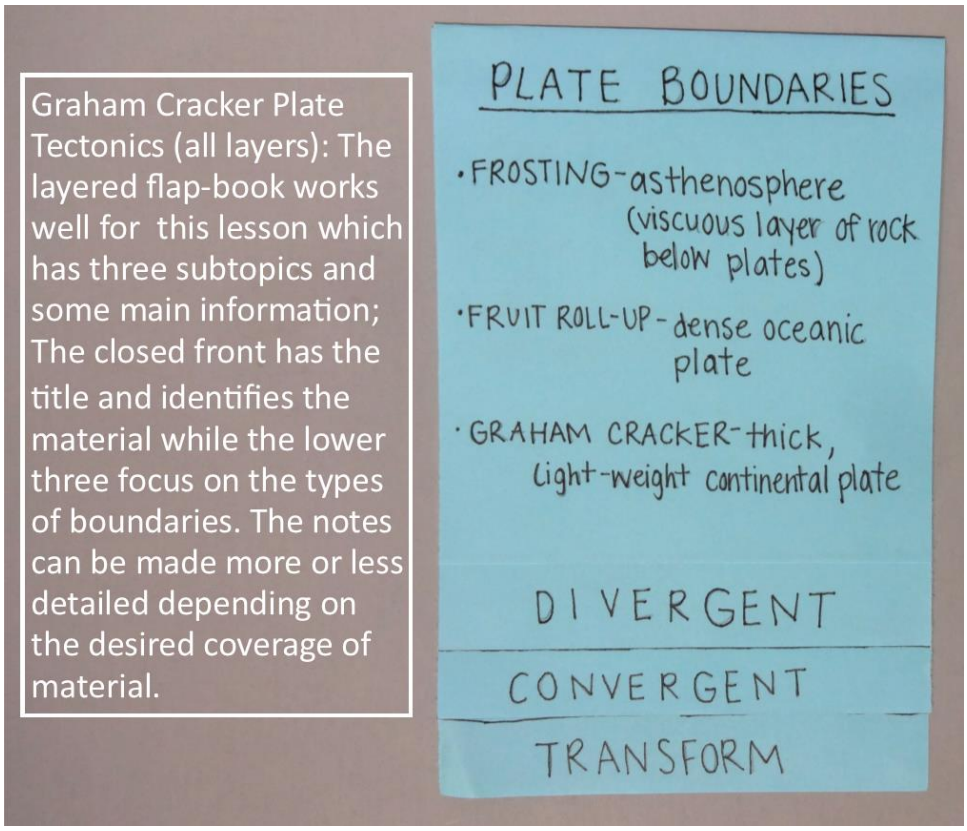
ENGAGEMENT Show students a video showing the transformation of Earth's surface "From Pangea to Modern Continents" (video is attached in the file folder) and ask them what they think the mechanism is for the changes. Build on their contribution. Guide students through creating the foldable and labeling what each material represents (images of the foldable are also in the folder)

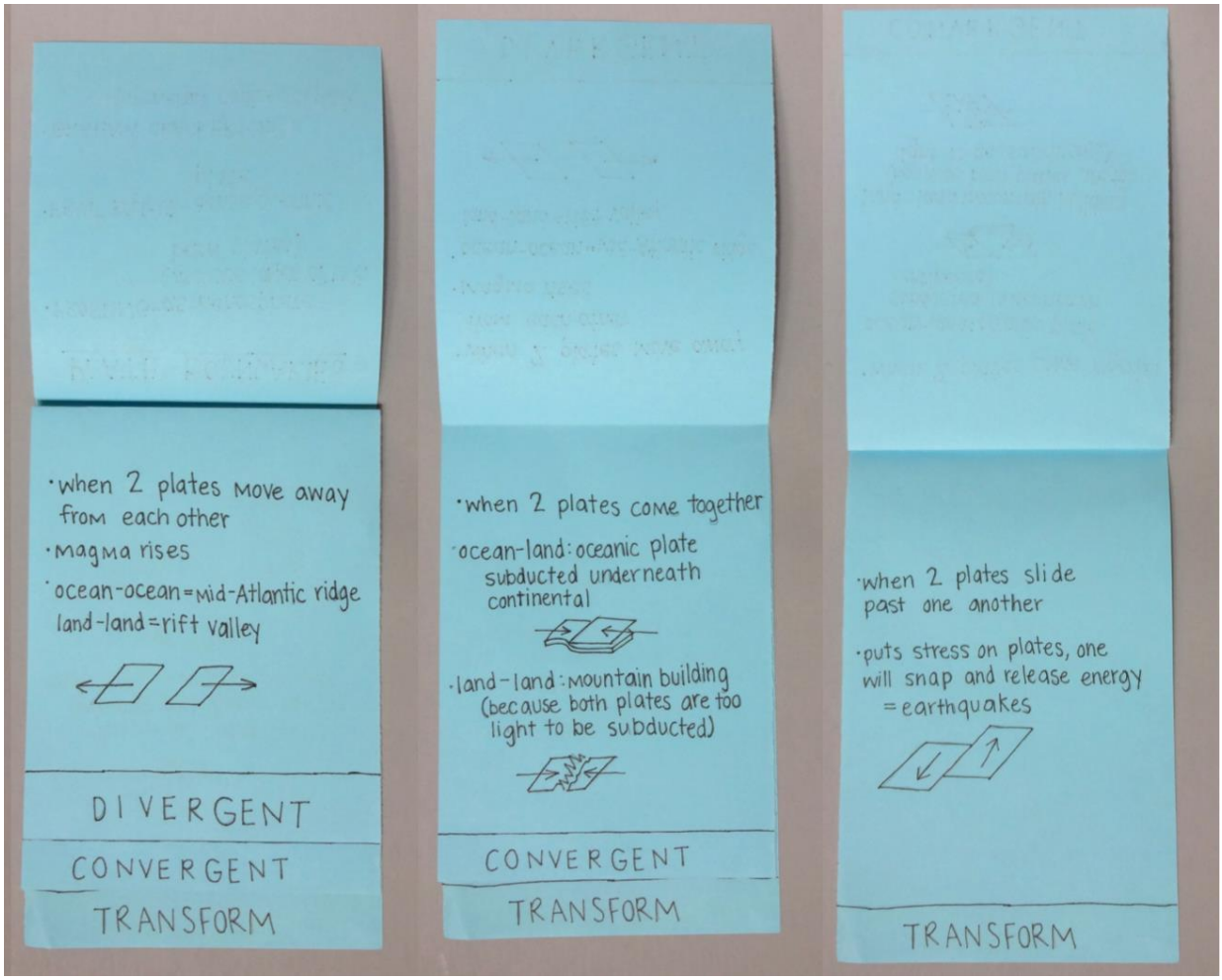
EXPLANATION & **EXPLORATION** First, have students label the flap and define what the boundary is. Then, tell and model what they are to do to demonstrate the boundary with their materials. Have the students perform the boundary on their own and talk about what they observed happened. Elaborate on the boundary by returning to the foldable and writing the characteristics of the boundary. Repeat this process for the other two boundaries.

MODELING FOR BOUNDARIES: First, students spread a thick layer of frosting on their parchment paper.
Divergent (Ocean-Ocean): tear fruit roll-up in half, places hard edges together on top of the frosting and press down slightly; then, push the fruit roll-ups away from each while still pressing down. The frosting should rise in between the two "oceanic plates".
Convergent (Ocean-Land): students remove one fruit roll-up and replace it with half of a graham cracker lightly placed on the frosting. Students push the two together (keeping pressure on the fruit roll-up), the graham cracker should move on top of the fruit roll up.
Convergent (Land-Land): students now remove the fruit roll-up from the frosting. They take turns dipping the other graham cracker into the water for 2 seconds (no longer!) and place this one next to the other "continental plate" on the parchment paper (wet side facing the inside). Students now push the two together, the wet part of the graham cracker should crumble upward, creating a "mountain".
Transform (Land-Land): students flip the graham crackers so that the two dry sides are touching each other. They push one cracker away from their body and the other towards them while still pushed together, the sides of the crackers should scrape and crumble slightly.

EVALUATION Quick check of understanding while students eat their materials; formatted as: what type of boundary would it be if mountains were created? Also: valleys formed in the middle of a continent; volcanoes occurring along the shoreline of a country.

Graham Cracker Plate Tectonics (all layers): The layered flap-book works well for this lesson which has three subtopics and some main information; The closed front has the title and identifies the material while the lower three focus on the types of boundaries. The notes can be made more or less detailed depending on the desired coverage of material.





Space Rock Sundae

Teacher: MaST Academy (Daisy Wilson)

Subject / grade level: Astronomy

Materials: Per pair of students: 1 cup Half & Half, ½ teaspoon vanilla extract, 2 tablespoons sugar, 4 cups crushed ice, ½ cup rock salt, 2 quart-size zip-top plastic bags, 1 cup rock salt.
Various toppings: chocolate rock candy, sour gummy worms, crushed Andy's mints, coconut flakes, metallic sugar beads
Also: measuring cups, spoons, Dixie cups, paper towels

Standards: Astronomy: 9 (D); Earth and Space: 5 (D); Chemistry: 4 (A), 4 (C)

Lesson objective(s): Students will be able to compare and contrast the characteristics of comets, asteroids and meteoroids. Students will also be able to understand the phase changes of matter and have introductory insight into chemical reactions.

ENGAGEMENT Students will be asked the following questions: How is ice cream made? What are asteroids? What are comets? How did the dinosaurs go extinct? As the conversation wraps up, ask them: what do all of these have in common?

EXPLANATION Students will be introduced to comets, asteroids, and meteors and their identifying features such as orbit and composition. They will complete a Venn Diagram comparing and contrasting asteroids and comets (labels for the Venn Diagram are provided in the file folder). They will also be provided an image of the anatomy of the solar system to put into reference the location of the bodies (also provided). Finally, students will review the states of matter.

EXPLORATION Students will be divided into groups of 4 and given the materials to make ice cream. The class will be guided step-by-step through making the ice cream (there are many resources online that can provide greater detail in making ice cream in the classroom). Each group will be assigned a space rock (comet or asteroid) and asked to add toppings that correlate to the type of rock, for example- coconut flakes as frozen carbon dioxide.

EVALUATION Students will be asked to trade samples of their ice cream. They will use their senses to see and taste the ice cream while writing down their observations. Then they will be asked to categorize their ice cream sample as an asteroid or comet and why, based on the evidence they drew from the composition of their "space rock".

Most orbit between Mars and Jupiter	Elliptical orbit is more circular	Made of mostly rock and/or metal	Elliptical orbit
Some have crashed into the Earth	Can contain organic matter	Orbit the sun	Long tails when close to the sun
Surrounded by hydrogen cloud called coma	Elliptical orbit is more oval	Most can be found either in the Kuiper belt or in the Oort cloud	Made of frozen ice, gas, and dusty rock

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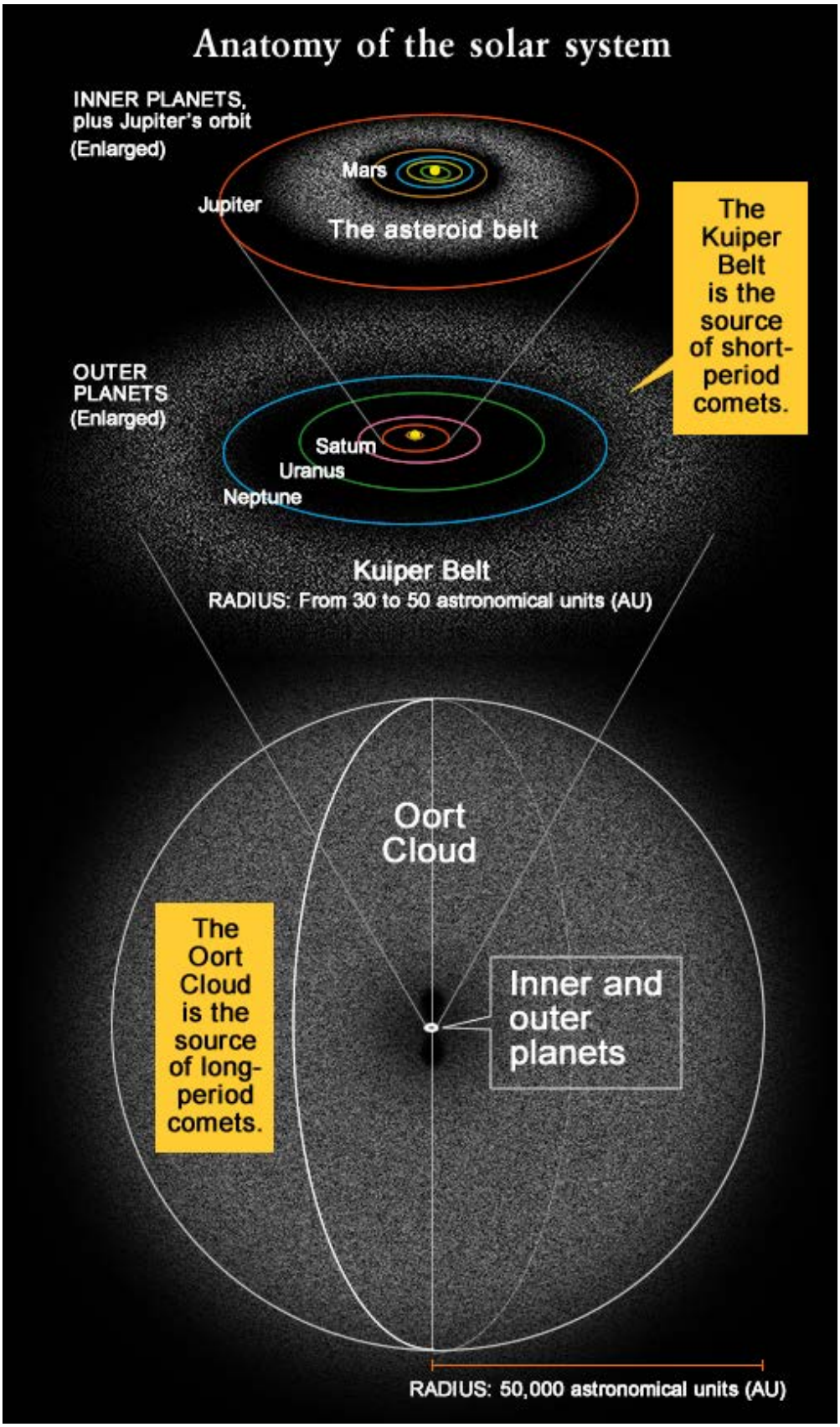
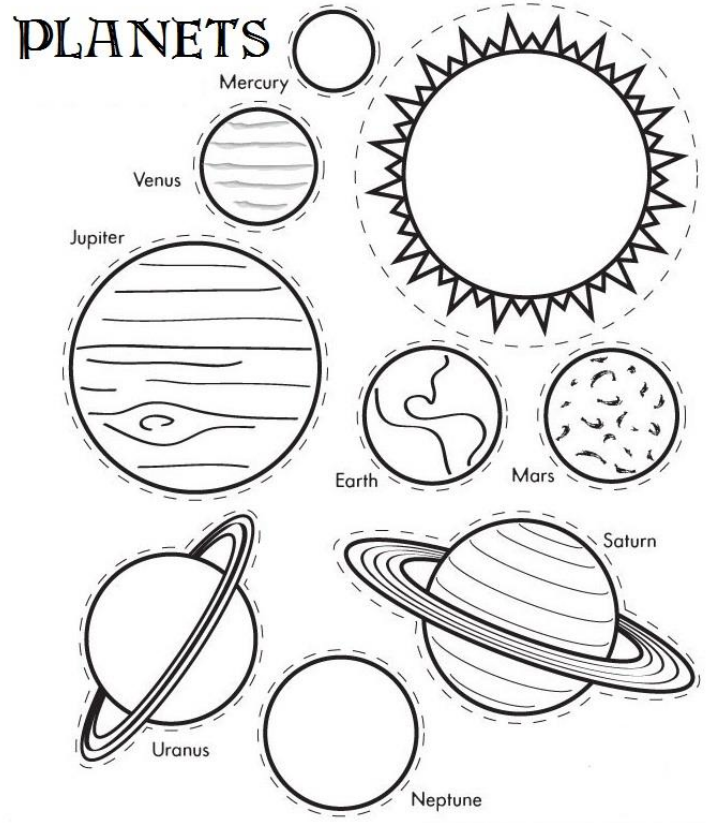
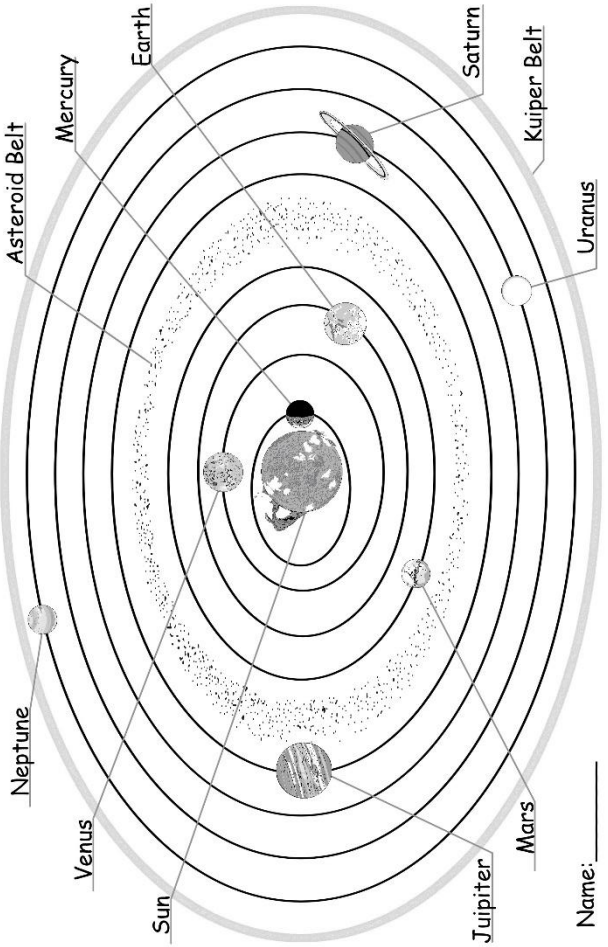

Anatomy of the solar system
INNER PLANETS, plus Jupiter's orbit (Enlarged)
Mars
Jupiter
The asteroid belt
The Kuiper Belt is the source of short-period comets.
OUTER PLANETS (Enlarged)
Saturn
Uranus
Neptune
Kuiper Belt
RADIUS: From 30 to 50 astronomical units (AU)
Oort Cloud
The Oort Cloud is the source of long-period comets.
Inner and outer planets
RADIUS: 50,000 astronomical units (AU)

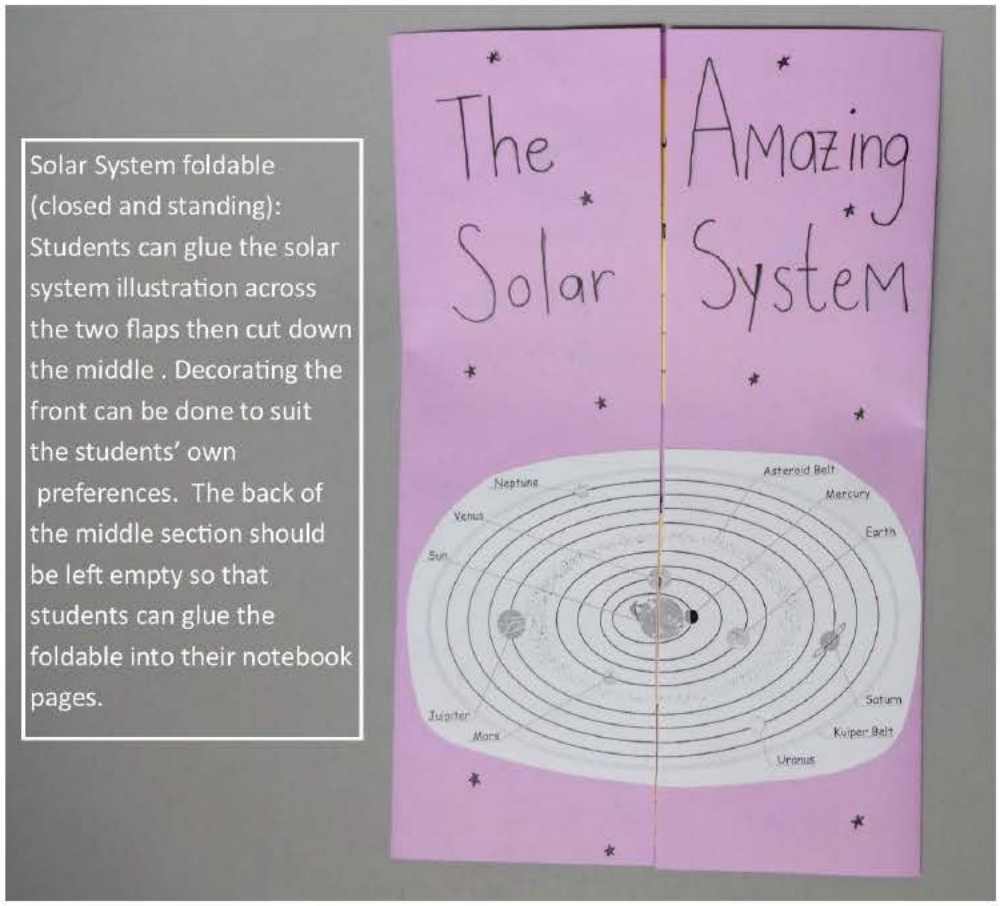
Solar System Bingo

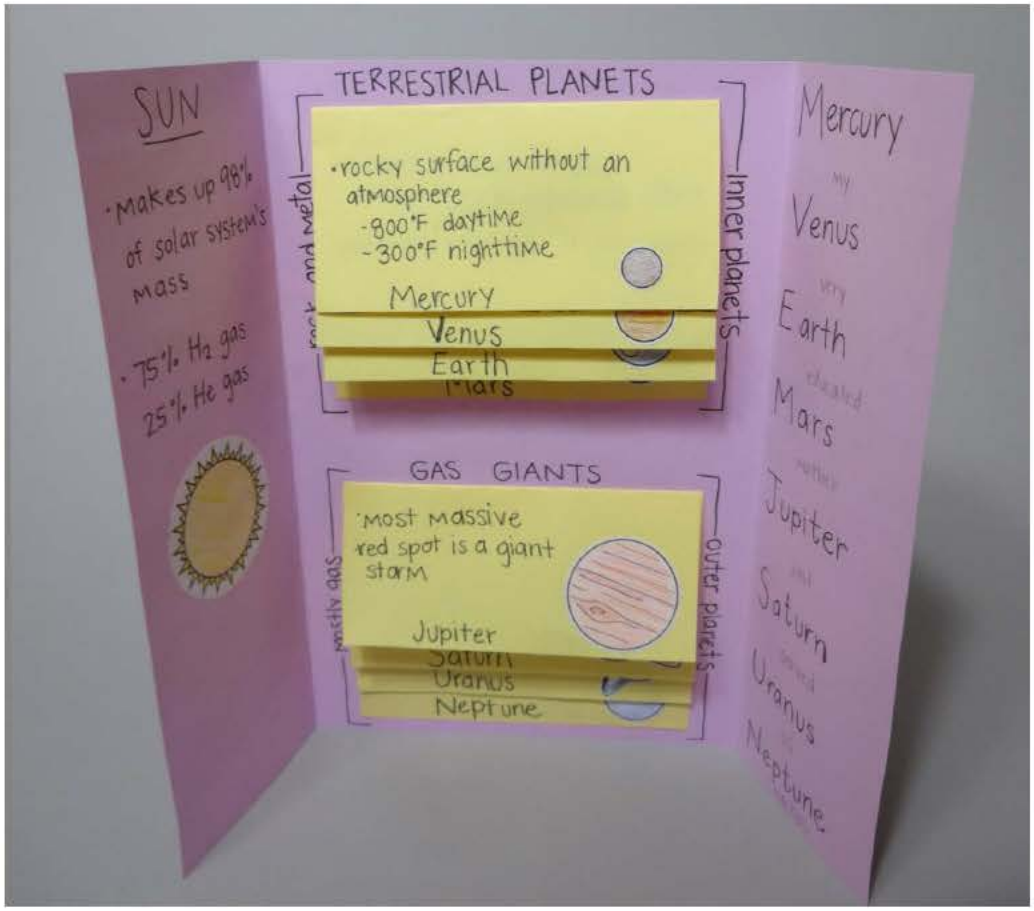
Teacher: MaST Academy (Daisy Wilson)
Subject / grade level: Astronomy
Materials: Planets printables (included in the file folder), scissors, glue, markers, bingo cards, bingo markers
Standards: Astronomy: 6(B), 9(B)
Lesson objective(s): Student will understand the planets in our solar system, their major characteristics, and the order in which they orbit the sun (from closest to sun to furthest). They will use this knowledge to play a bingo game based off of the information.
ENGAGEMENT Hand out slips of paper with the name of one planet or the sun out to each student. (If there are more than nine students, hand out multiple sets of solar system). Ask the students to put themselves in order starting from the sun and moving outwards- the trick is that they have to do this without talking. Once a group thinks that they're in order ask them to reveal their assigned planet to check.
EXPLANATION Guide students through creating the Solar System foldable (the images to be glued are provided in the file folder). Because this foldable is very involved have them create the Terrestrial Planet and Gas Giant inserts first. Then, go through creating the main foldable and gluing the inserts into the main section. Invite students to come up with their own acronym for remembering the orders of the planets.
ELABORATION Next, pass out one Bingo card to each student, several different Space Bingo Templates can be found, one of them is attached in the folder. The first few rounds, allow students to use their notes when you call out the Bingo spaces. The next few rounds, ask students to limit their note usage. During the Final Round, students should not use any of their notes.
EVALUATION Assessment can be conducted while students are putting themselves in order and during the Bingo Game. Use mistakes as opportunities to clarify information for students.


PLANETS
Mercury
Venus
Jupiter
Earth
Mars
Saturn
Uranus
Neptune

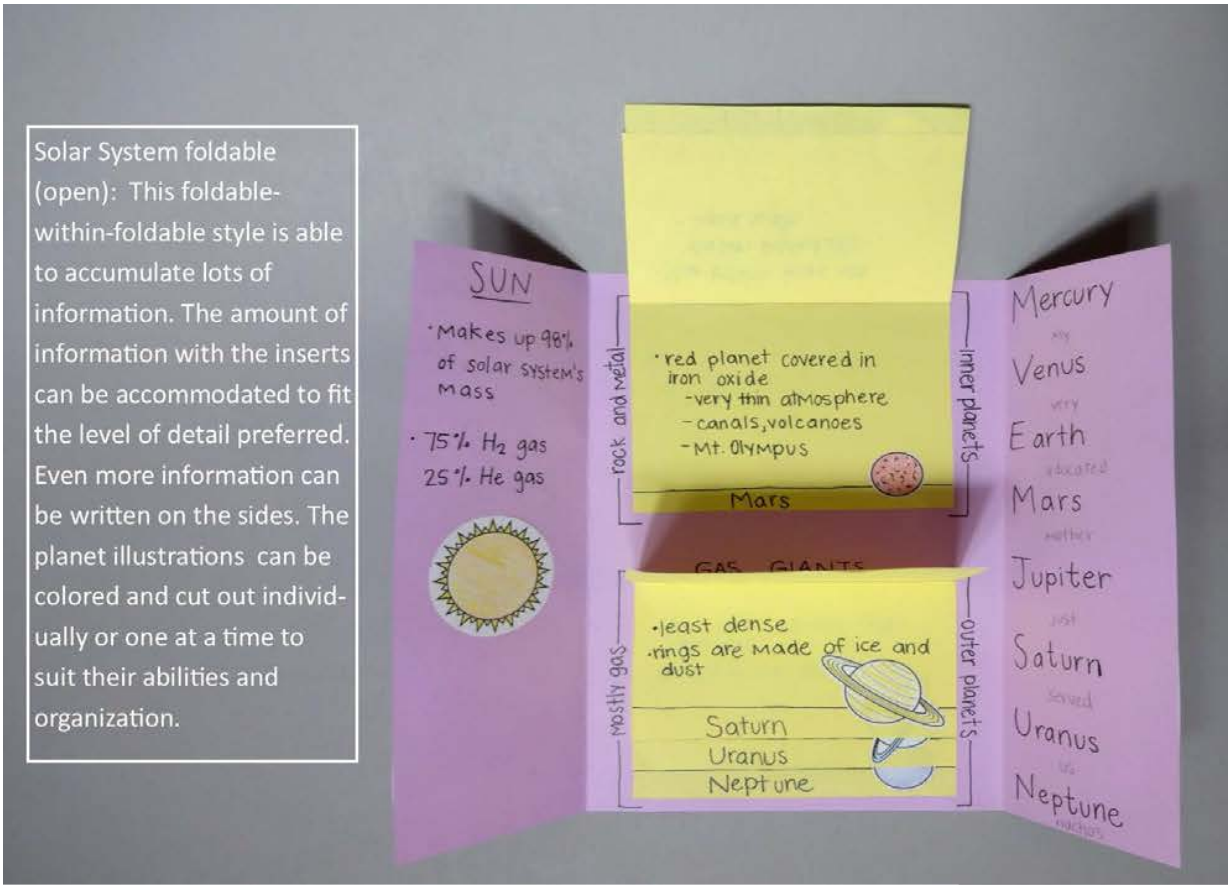

Asteroid Belt
Mercury
Earth
Saturn
Kuiper Belt
Uranus
Neptune
Venus
Sun
Juipiter
Mars
Name:_____

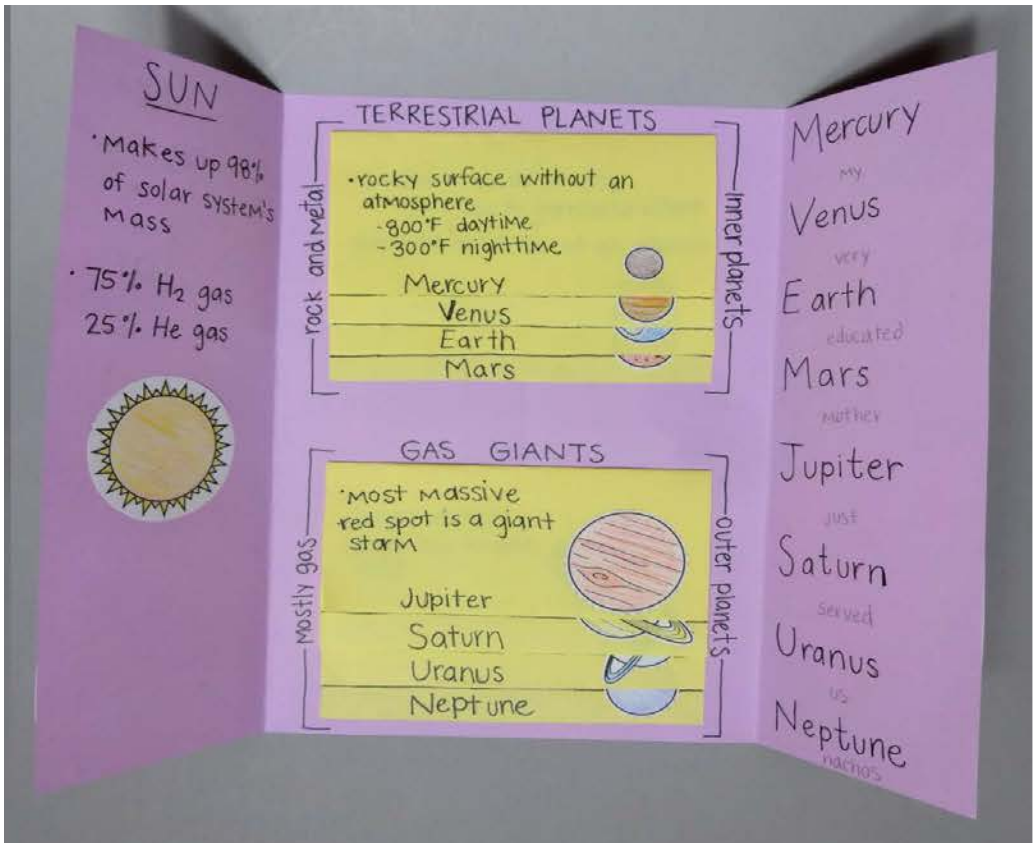
Solar System foldable (closed and standing): Students can glue the solar system illustration across the two flaps then cut down the middle . Decorating the front can be done to suit the students' own preferences. The back of the middle section should be left empty so that students can glue the foldable into their notebook pages.





Solar System foldable (open): This foldable-within-foldable style is able to accumulate lots of information. The amount of information with the inserts can be accommodated to fit the level of detail preferred. Even more information can be written on the sides. The planet illustrations can be colored and cut out individually or one at a time to suit their abilities and organization.

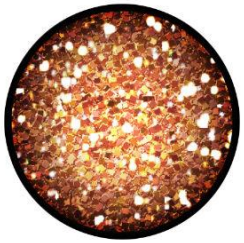




Venus

Kuiper Belt

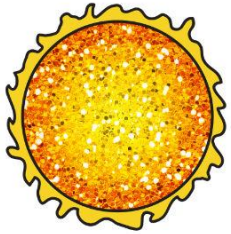
Asteroid Belt



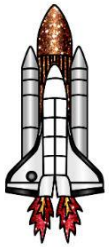
Dwarf Planet

Space Bingo Calling Cards

Uranus



Sun



Rocket

Saturn

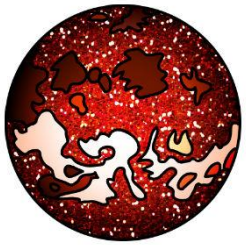
Pluto

Neptune

Spiral Galaxy

Mercury

Space Bingo Calling Cards



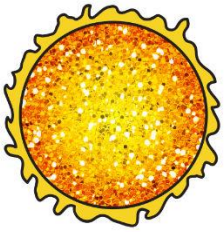
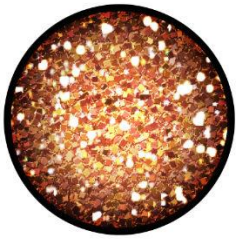
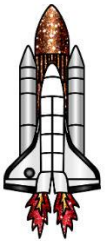
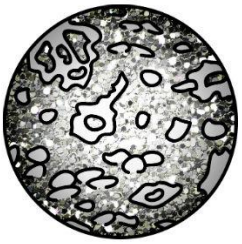
Mars

Jupiter

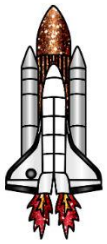
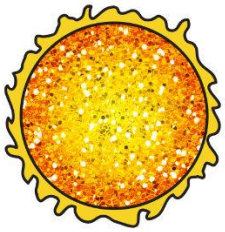
Moon

Earth

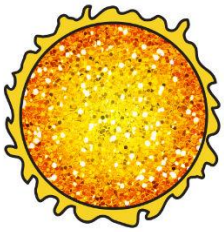
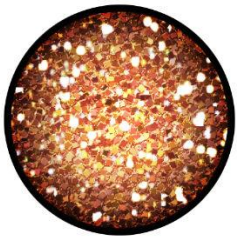
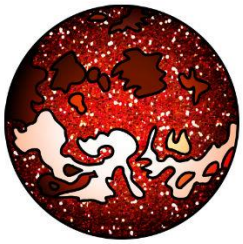
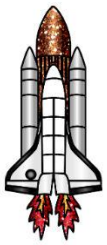
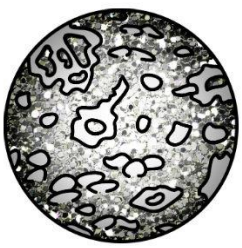
SPACE BINGO

 Sun	 Jupiter	 Spiral Galaxy	 Asteriod Belt
 Saturn	 Neptune	 Dwarf Planet	 Venus
 Rocket	 Moon	 Pluto	 Uranus
 Mercury	 Mars	 Kuiper Belt	 Earth

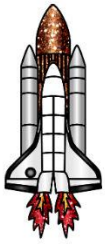
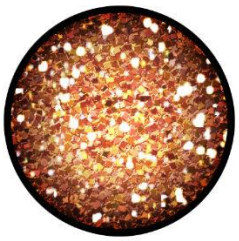
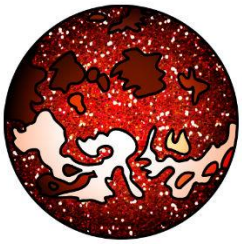
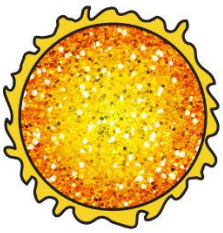
SPACE BINGO

 Mercury	 Mars	 Kuiper Belt	 Earth
 Asteriod Belt	 Venus	 Moon	 Spiral Galaxy
 Jupiter	 Uranus	 Rocket	 Saturn
 Dwarf Planet	 Sun	 Neptune	 Pluto

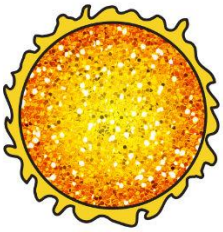
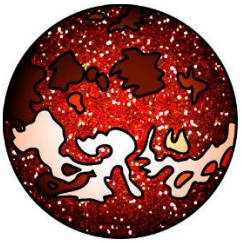
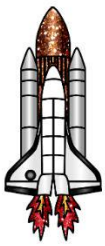
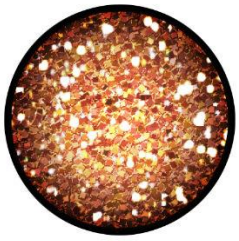
SPACE BINGO

 Neptune	 Uranus	 Sun	 Asteriod Belt
 Dwarf Planet	 Kuiper Belt	 Venus	 Jupiter
 Mars	 Pluto	 Spiral Galaxy	 Moon
 Saturn	 Earth	 Rocket	 Mercury

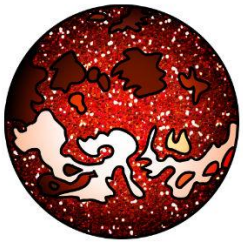
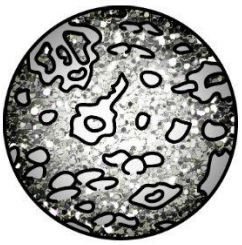
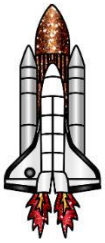
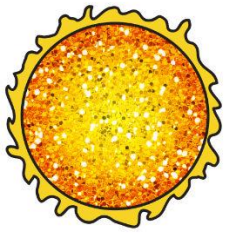
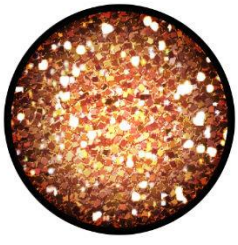
SPACE BINGO

 Rocket	 Dwarf Planet	 Earth	 Saturn
 Mars	 Uranus	 Kuiper Belt	 Mercury
 Neptune	 Venus	 Pluto	 Jupiter
 Sun	 Moon	 Asteriod Belt	 Spiral Galaxy

SPACE BINGO

 Saturn	 Moon	 Sun	 Asteriod Belt
 Kuiper Belt	 Earth	 Neptune	 Pluto
 Spiral Galaxy	 Mars	 Mercury	 Uranus
 Rocket	 Dwarf Planet	 Venus	 Jupiter

SPACE BINGO

 Earth	 Moon	 Jupiter	 Mars
 Mercury	 Spiral Galaxy	 Neptune	 Pluto
 Saturn	 Rocket	 Sun	 Uranus
 Dwarf Planet	 Asteriod Belt	 Venus	 Kuiper Belt

SPACE BINGO

Conics and the Solar System

Teacher: MaST Academy **(**Nohemy Aleman)

Subject / grade level: 9th /10th grade

Materials: Poster board, candles, matches, compressed air (duster), tape, rulers, graph paper, "alien" figures, 3D conics model

Standards: Algebra II: 5(A), 5(C), 5(D) Earth and Space Science 5(C), 5(E)

Lesson objective(s): Students will understand the different conic sections, including their origin and the equations that signify them. They will apply this knowledge to understand the difference between a circle and an ellipse regarding the solar system and finally by utilizing the properties of an ellipse to blow out a candle (without blowing air straight at the candle).

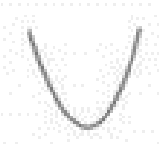
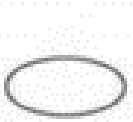
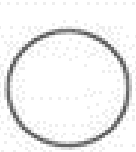
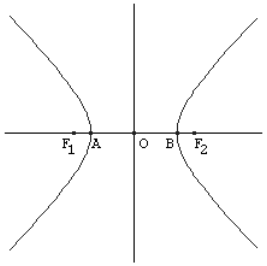
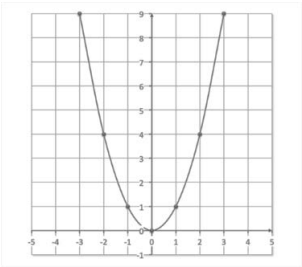
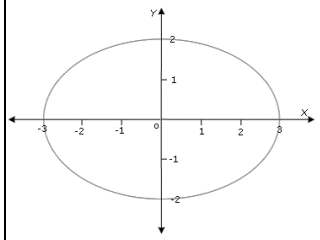
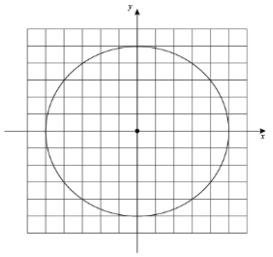
ENGAGEMENT Students are asked if they know where the center of the solar system is. Many will respond with the sun- this provides the opportunity to directly confront this misconception and apply the conics properties to real-world situations.

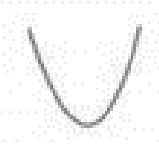
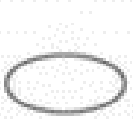
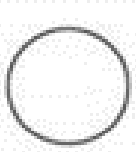
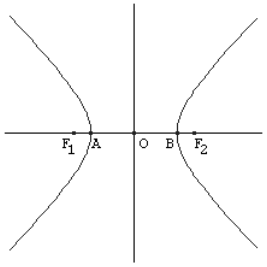
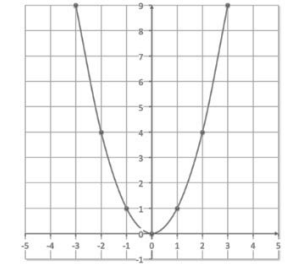
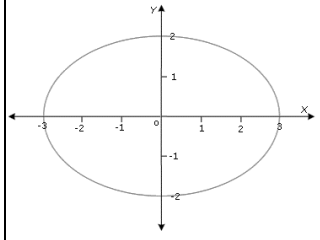
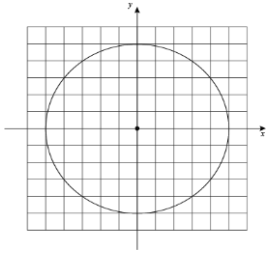
EXPLANATION Students will construct a "cube" foldable explaining the four conics sections, their characteristics, how they are derived from a cone, and the equation used to recognize them (images of this foldable can be found in the file folder). Several vocabulary words will be introduced during this period: ellipse, hyperbola, and parabola.

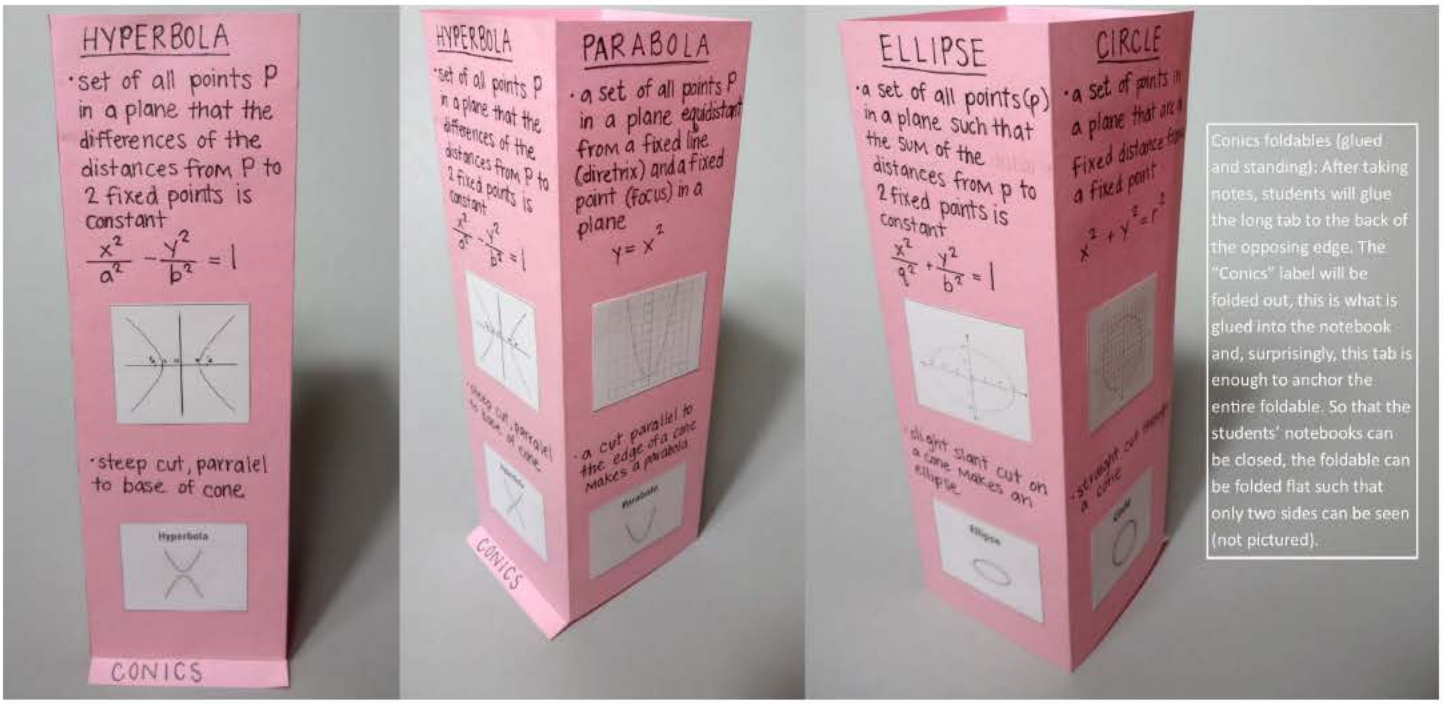
ELABORATION Demonstrate how to draw an ellipse using a piece of yarn on the board (tape both ends of the yarn to the board then place your marker/chalk along the yarn and draw the ellipse). Use this drawing to identify the components of an ellipse (the two foci) as well as important components of Earth's orbit (aphelion, perihelion). Two additional ellipses can be drawn (with foci close together and very far apart) to show how the distance between foci affect the ellipse shape- explain that the foci of the solar system are quite close together so the orbit is very nearly circular and thus Earth's orbit is not the cause of the seasons experienced on Earth. Conics can also be applied to the orbits of other planetary bodies, such as comets and asteroids- comets have an elliptical orbit with foci that are far apart so their path around the sun is very oval.

EXPLORATION Students are challenged with utilizing the symmetrical properties of the ellipse in order to blow out a candle by blowing compressed air at the corresponding point on the other side of the ellipse. They students are given the coordinates for one half of the ellipse; students have to plot the other half then tape a piece of poster board along those coordinates. This creates half of an ellipse but still can be used to demonstrate the symmetrical properties. A story aligned to this challenge can be that: upon arriving on a mysterious planet, students realize that a dangerous group of aliens have come onto their spaceship. The students have to hide from the aliens and to make matters worse, a fire has started on the ship! Fortunately, the ship's interior is a perfect ellipse and the students can use the ellipse's properties to extinguish the fire without being found out by the aliens.

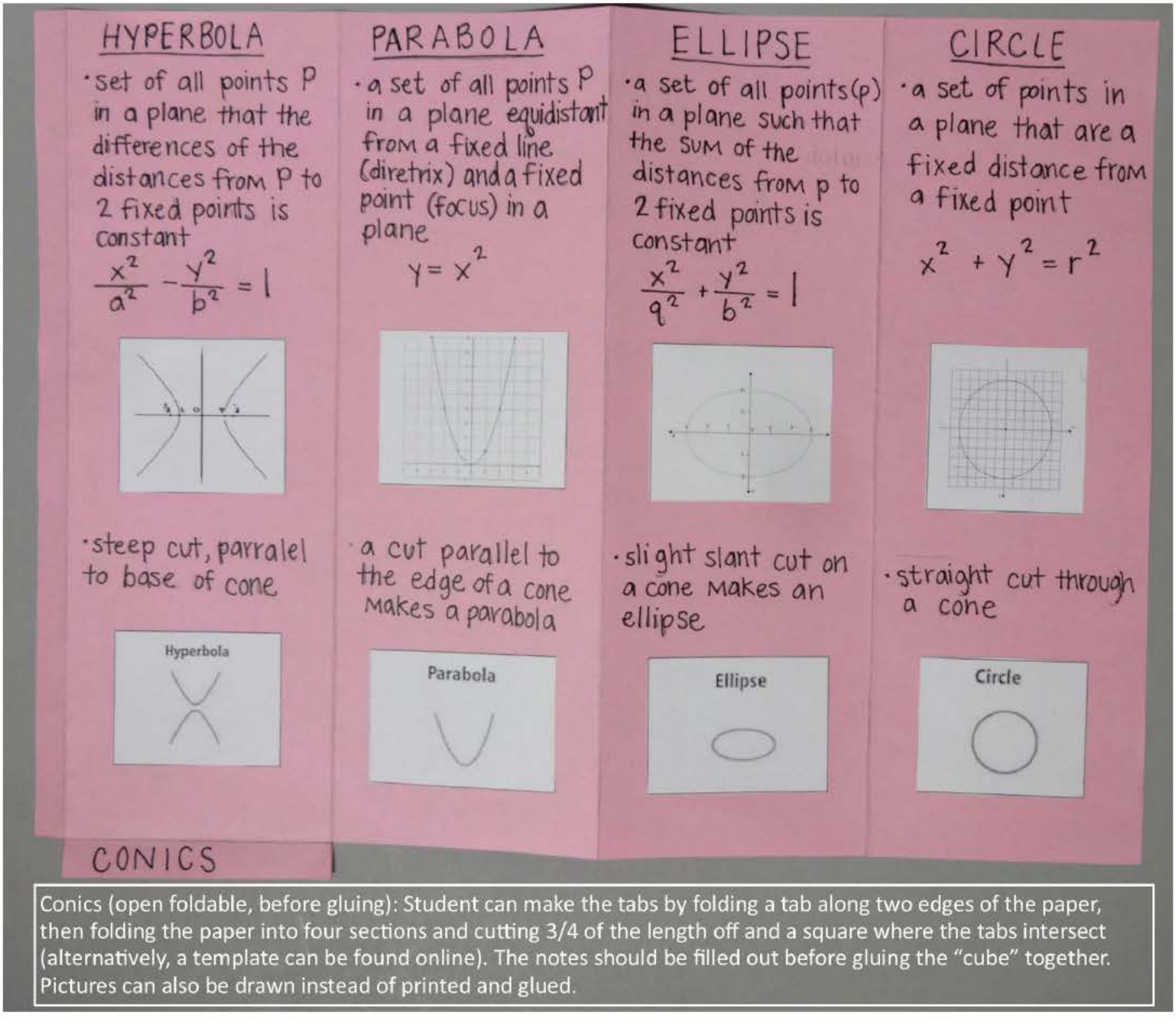
EVALUATION A general assessment can be conducted during the exploration phase, based off of whether or not the students are able to plot the other half of the ellipse and also if the students are successful at blowing out the candle. However, guidance should be provided if they are experiencing difficulty so that every group of students are successful.

Hyperbola	Parabola	Ellipse	Circle
			
			

Hyperbola	Parabola	Ellipse	Circle
			
			



Conics foldables (glued and standing): After taking notes, students will glue the long tab to the back of the opposing edge. The "Conics" label will be folded out, this is what is glued into the notebook and, surprisingly, this tab is enough to anchor the entire foldable. So that the students' notebooks can be closed, the foldable can be folded flat such that only two sides can be seen (not pictured).



Conics (open foldable, before gluing): Student can make the tabs by folding a tab along two edges of the paper, then folding the paper into four sections and cutting 3/4 of the length off and a square where the tabs intersect (alternatively, a template can be found online). The notes should be filled out before gluing the "cube" together. Pictures can also be drawn instead of printed and glued.

Parametric Equations

Teacher: MaST Academy (Valerie Gonzales)
Subject / grade level: Math- Precalculus
Materials: Graphing calculators, parametric equations worksheet (included in the file folder), poster board, markers, meter sticks
Standards: Precalculus: 5(D)
Lesson objective(s): Students will be able to understand the variables in a parametric equations, figure out the *x* and *y* values, and graph the function.
ENGAGEMENT Ask students how they would go about traveling through outer space. How do you change direction in a space ship? What if you run out of fuel? Ask guiding questions to lead students to discussing movement in two directions in space. Tell students that their calculators can actually graph movement (not just stagnant plots).
EXPLANATION Guide students through plugging in values for into the first two functions. For problem #1 guide students through the problem, narrating your thought process and asking them for confirmation of the process. Instruct them to fill in the table first, then plot the points onto the graph. After that, have the students complete problem #2 on their own, if they get stuck, try asking guiding questions and encouraging them to try. Go over the problem together and clarify any questions the students might have.
EXPLORATION Group the students into groups of 3 and assign each of them a set of functions. The assignment is to figure out *x* and *y*, enter them into the table, and plot them on the graph. After you have checked and approved their graphs ask them to write a story about the shape and movement of the function- related to traveling through space- because time is the main parameter. Ask students to draw a poster of their graph and write the story underneath.
ELABORATION Once all students are finished with their posters have them do a gallery walk where they present their function and story to the rest of the class.
EVALUATION Assessment is ongoing throughout the activity- direct evaluation can be done when students graph their set of functions (if it was correct).

Parametric Equations

Sometimes a graph is described by two equations rather than just one. For example, the coordinate (x, y) of a moving point are often described by two equations using the variable t for time.

$$x = t \qquad y = t^2$$

These are called **parametric equations** for the location of the point at time t; the variable t is often the parameter.

Parametric equations are often used because an equation involving only x and y would be too complicated. Sometimes parameters provide the most straightforward description of the problem being solved.

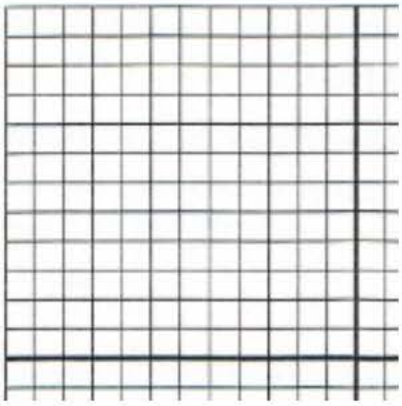
Make a table of values and then sketch the graph of each set of parametric equations; the axes shown will help you choose appropriate values for t.

1. $x = t - 2$

   $y = 2t + 3$

t	x	y

ALTAIR

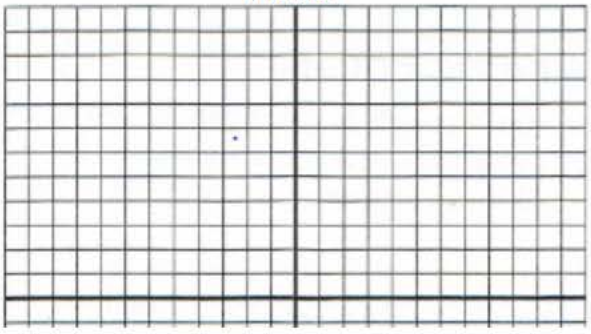


2. $x = t$

   $y = t^2$

t	x	y

VEGA

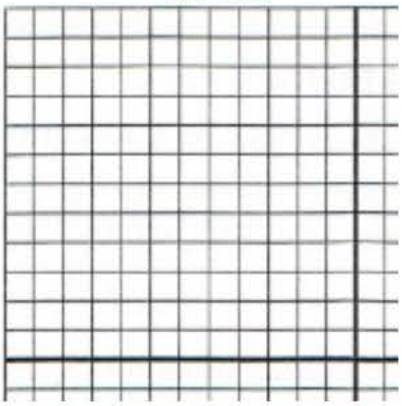


3. $x = t - 2$

$y = t^2 - t + 1$

t	x	y

DENEB

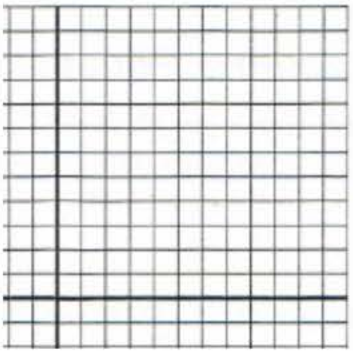


4. $x = t^2$

$y = t$

t	x	y

ARCUTURUS

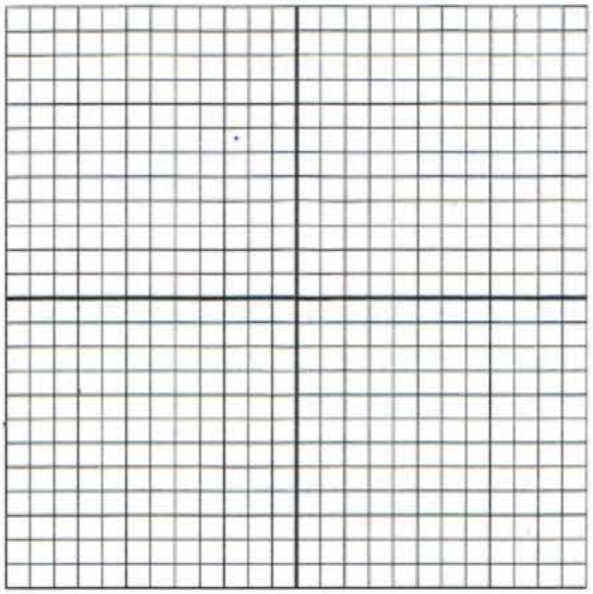


5. $x = 2t - 1$

$y = t^2 - 4$

t	x	y

POLARIS

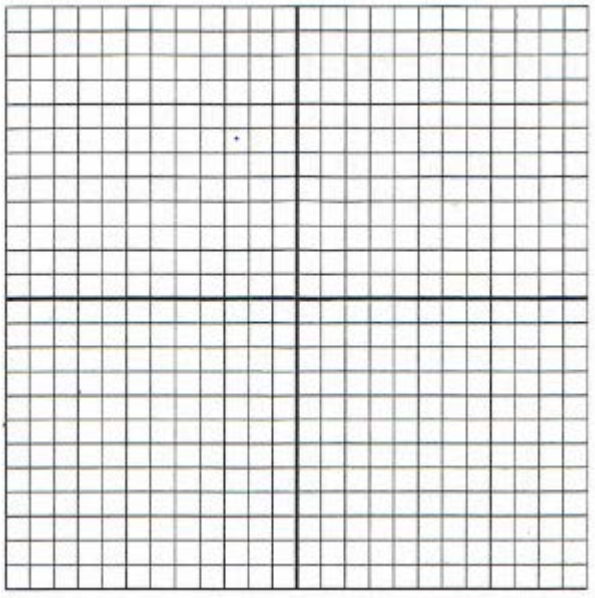


6. $x = t + 1$

$y = t^2 - 4$

t	x	y

ANTARES

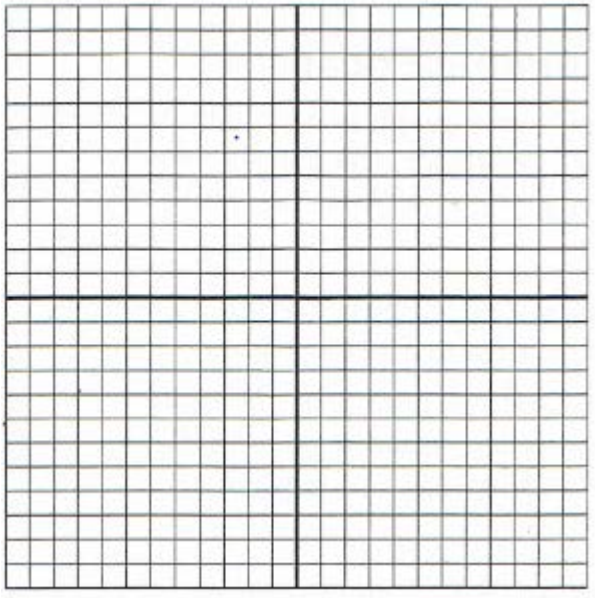


7. $x = t^2 + t$

$y = 2t - 1$

t	x	y

REGULUS



Newton's Laws and Rockets

Teacher: MaST Academy (Christina Garcia)

Subject / grade level: Physics

Materials: Per student: 1 film canister, 1 antacid tablet, 1 sheet of colored construction paper, safety goggles; for students to share: water, tape, scissors, markers

Standards: Physics: 4(B), 4(D)

Lesson objective(s): Student will understand the three laws of motion and how they apply to the motion of an antacid rocket.

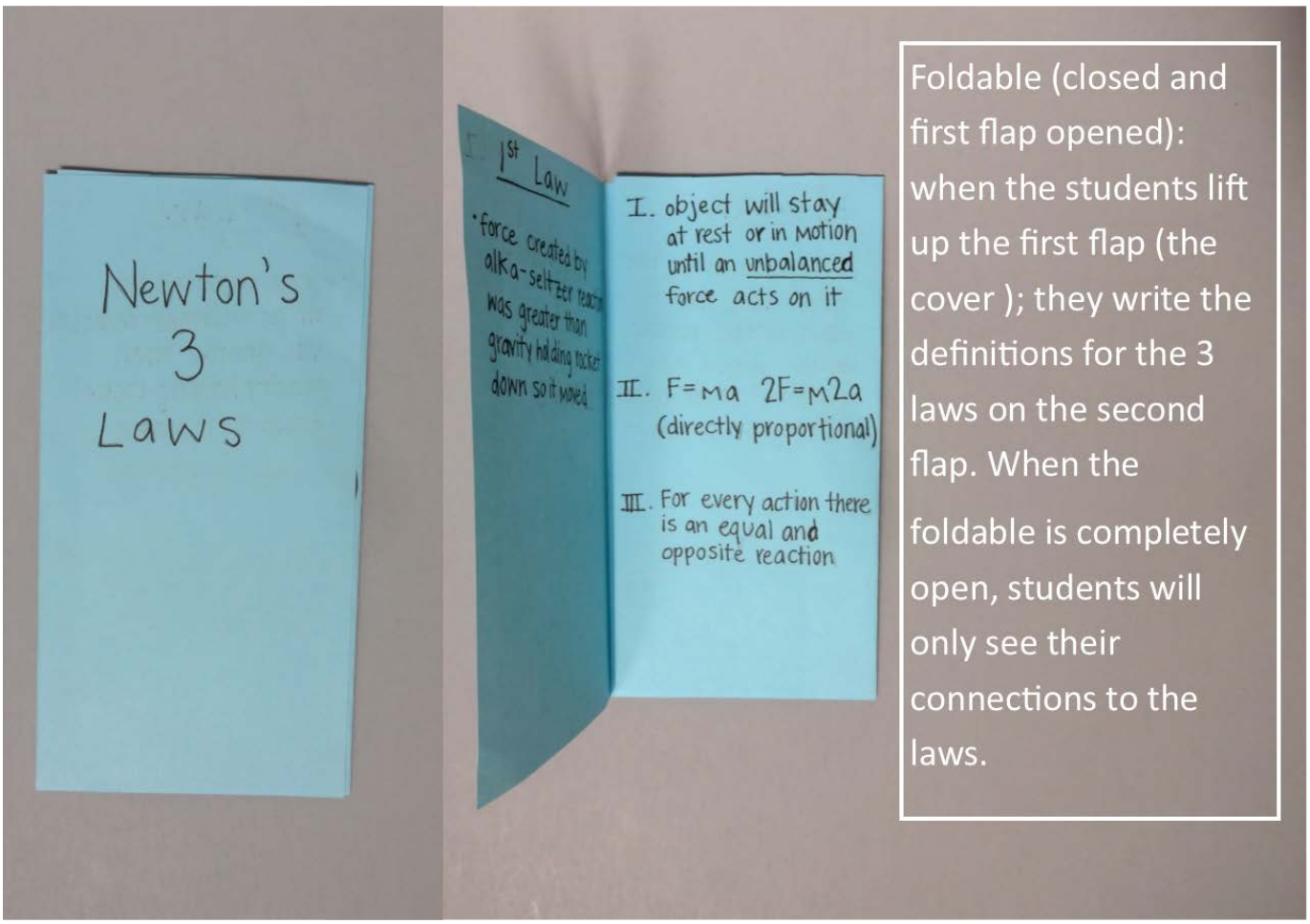
ENGAGEMENT Students use the iPads to log into and play a Kahoot© Quiz on Newton's laws to bring up students' prior knowledge and gauge what the students already know. The competitive nature of the quiz helps get students motivated to participate.

EXPLANATION After the quiz, students are guided in making a foldable about Newton's laws (images of the foldable are in the file).

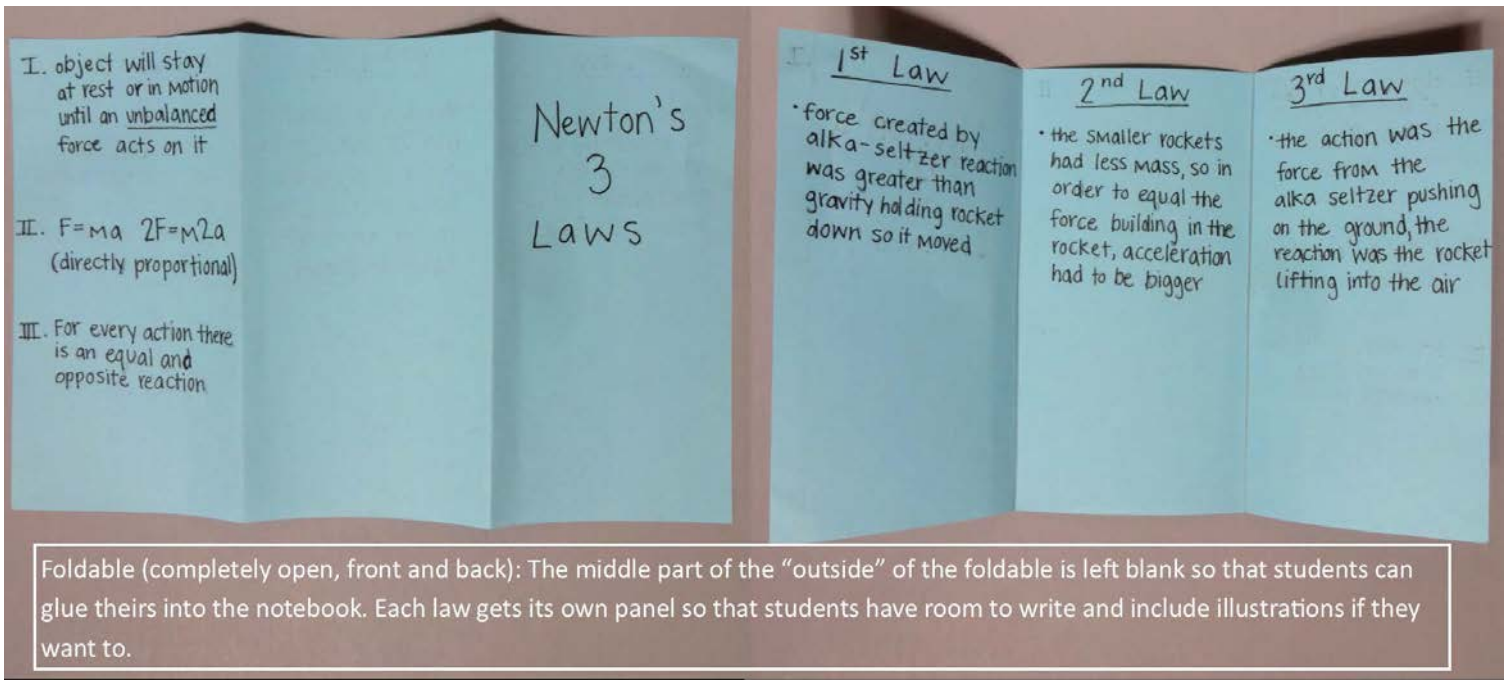
EXPLORATION Students are given the film canister and 1 sheet of colored construction paper; they are instructed to create a rocket using the canister and paper- they are not given any detail on how to build the rocket or what size/shapes of fins or nosecones should be taped onto it. Students are encouraged to decorate their rockets to signify the ownership of the rocket. Then, the students will go outside and shoot their rockets: the students add some water into the canister (amount is open to their discretion), add half an antacid tablet snap close the lid and set the rocket down). Students will be guided into observing how their rockets flew- did they go high, spin around, go to one side, etc. Students return to the classroom and alter their rocket design and/or amount of water added to try to achieve the highest flight- based completely off of their observations of their rockets and the others

ELABORATION. Students are asked to finish filling in their foldable by relating each of the three Newton's laws to their rockets lift off and height reached. After this, a classroom discussion can clarify what occurred and students can volunteer to share how they altered their rocket and/or how they connected rockets and the laws of motion.

EVALUATION Assessment can occur while students are changing the design of their rocket- do the alterations have a sound reason for them? Based off of what observations? Also, the students' understanding of the laws can be evaluated by the correctness/details of their connections to the rocket flight.



Foldable (closed and first flap opened): when the students lift up the first flap (the cover); they write the definitions for the 3 laws on the second flap. When the foldable is completely open, students will only see their connections to the laws.



Foldable (completely open, front and back): The middle part of the "outside" of the foldable is left blank so that students can glue theirs into the notebook. Each law gets its own panel so that students have room to write and include illustrations if they want to.

Pythagorean Stars

Teacher: MaST Academy (Clarissa Valles)

Subject / grade level: Math- Geometry

Materials: Cut-out stars, tape measures, protractor, iPads, black paper, graph paper, glue, chalk

Standards: Geometry: (b) 8. (C)

Lesson objective(s): Students will be able to use the Pythagorean Theorem to find the distance between stars (use the two legs of a right triangle to find the hypotenuse)

ENGAGEMENT Engage the students by showing them pictures of constellations and asking them what pictures they see in the stars. Have a discussion about how people came up with constellations by pointing out that the imaginary lines connecting the stars make geometric shapes. Then, introduce the problem: you want to travel from one star to another but in order to bring the right amount of fuel you need to know what distance between them. You already know the distance to two other neighboring stars. (Suggest using the Pythagorean Theorem as a tool).

EXPLANATION Define: *right angle, legs, and hypotenuse.* Students practice identifying and labeling the right triangle, legs, and hypotenuse. Define the Pythagorean Theorem. Discuss the formula for a square and build squares using each side of the triangle.

EXPLORATION Students will explore the geometric proof for the Pythagorean Theorem. They will be given the dimensions of a right triangle and graph paper. Have students cut the c^2 square and place the pieces such that they make the two smaller squares (a^2 and b^2).

ELABORATION Point out to students that they can use the technique to find the missing side of a right triangle when two sides are known. Demonstrate how to set up the equation by plugging in *a, b,* and *c* into an example. Then show them how to plug in a^2+b^2 in to the calculator to find c^2. Point out that this gives us c^2, not c. Then show them how to find the square root of the value to get c.

EXPLORATION Students will be placed into groups and then instructed to use iPads to find constellations, pick their favorite one, and recreate it using the cut-out stars onto the large sheet of black paper. Then, they will identify a right triangle created by three stars and connect them on the paper. Students will measure the two legs of the triangle using the tape measures and then utilize the Pythagorean theorem to find the hypotenuse or distance between two stars.

EVALUATION Students will take turns sharing their constellation and calculations with the entire class. Evaluation and correction of their methods will have been done while the students worked in the previous Exploration section.

Future Adaptations

Teacher: MaST Academy (Sue Huffman)

Subject / grade level: 9th grade, Biology

Materials: iPads, shoe boxes, art supplies (pipe cleaners, "googly" eyes, fur, sequins, string/yarn, colored paper, scissors, glue, markers, tissue paper, tape, ribbon, feathers, clay, saran wrap)

Standards: Biology: 7(D), 7(E), 12(B) Astronomy: 9(A), 9(B)

Lesson objective(s): Student will understand the features necessary for life to evolve on a planet and that those features are malleable; they will use this knowledge to design a planet and the type of life that could exist there.

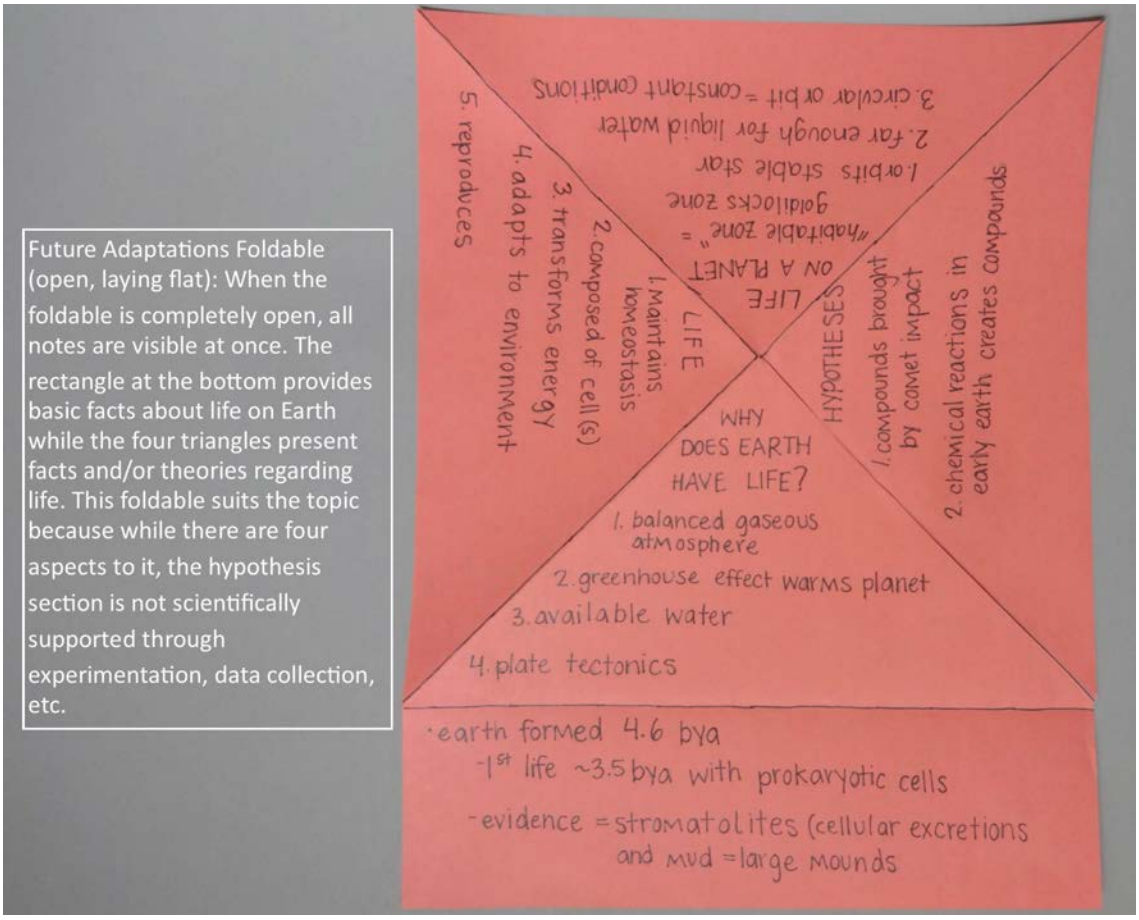
ENGAGEMENT Present students with a question: is there life on other planets? How did it get there? Give them ~2 minutes to discuss amongst their groups and then have a class discussion on the topic where volunteers can share their answers. Maybe try to reach a class consensus on if it's possible as well as why or why not?

EXPLANATION Guide students through making and filling out a foldable on the elements "necessary" for life; hypotheses on how it got here or on other planets, and how a planet's position in its star system is important as well. (Images of the foldable can be found in the file folder)
Questions to ask during presentation to bring up prior knowledge and engage students: What is one thing you cannot live without? What is your favorite fairy tale? How did life get to Earth? Ask for volunteers or use popsicle sticks, etc. to listen to students' ideas.

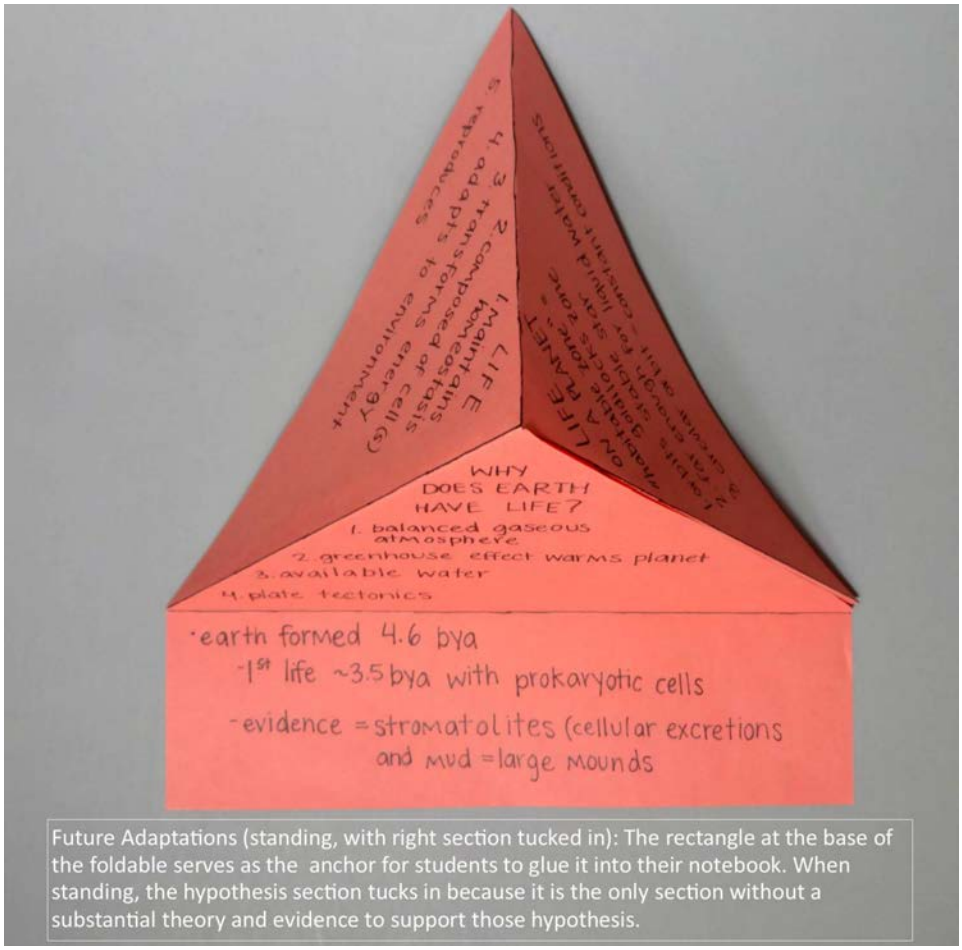
EXPLORATION Pair students up and ask them to design a planet and describe its characteristics (suns, other planets, moons) as well as the geology and ecosystem of its surface. Make sure to tell students to be scientific in their creations- they can use the Internet to find the details of real planets that have been found.
In their designs, students need to answer questions like: How did this planet come to be? How does its neighbors affect its suitability for life, if at all?
After that, have the students come up with life that could have adapted to live there: plants, bacteria, animals and why. They will use the shoeboxes and art supplies to create a diorama of the planet surface and the life on there. During this process, students should also ask themselves: How did this life get there? What aspects of the environment made them look that way?

EXPLANATION As students complete their dioramas at their own pace, they are tasked with writing a description of their planet. They have choice in how to do this: a narrative, a table describing the life, a journal entry describing the planet, etc.
Students will then do a gallery walk in which the pairs describe their planet surface and its life, justifying their decisions to their classmates and asking/answering questions.

EVALUATION General evaluation conducted during the lesson includes questions asked while students are designing their planets and its life (such as why is there water there? etc.)



Future Adaptations Foldable (open, laying flat): When the foldable is completely open, all notes are visible at once. The rectangle at the bottom provides basic facts about life on Earth while the four triangles present facts and/or theories regarding life. This foldable suits the topic because while there are four aspects to it, the hypothesis section is not scientifically supported through experimentation, data collection, etc.



Future Adaptations (standing, with right section tucked in): The rectangle at the base of the foldable serves as the anchor for students to glue it into their notebook. When standing, the hypothesis section tucks in because it is the only section without a substantial theory and evidence to support those hypothesis.

Rockets and Right Triangles

Teacher: MaST Academy (Christina Garcia & Clarissa Valles)

Subject / grade level: Geometry

Materials: Estes rockets (students put these together prior to the lesson/launch; 1 per pair of students), Launching pad, Alti-track tool (students create these), flying rocket procedures, field notes worksheet, "Soh-Cah-Toa" foldable, "Finding the height" worksheet

Standards: Geometry 11(C)

Lesson objective(s): Student will understand what trigonometric ratios are and how to apply knowledge of these ratios to indirectly determine the height of a rocket.

ENGAGEMENT Students are shown a video of a rocket being launched and asked how a person can determine how high the rocket flew into the air (when being viewed at ground-level). Students are closely guided through building their own rockets, each component of the rocket and it purpose are discussed during this process. Teamwork is monitored and encouraged throughout (Partner A does this while Partner B does that, etc.).

EXPLANATION Students are guided through creating a foldable illustrating a right triangle and the trigonometric ratios that can be derived. Vocabulary to be included: opposite, adjacent, hypotenuse, tangent. Because this is a preliminary and quick lesson, the details behind SOH-CAH-TOA are not discussed. Students are asked how a rocket being launched is similar to a right triangle.

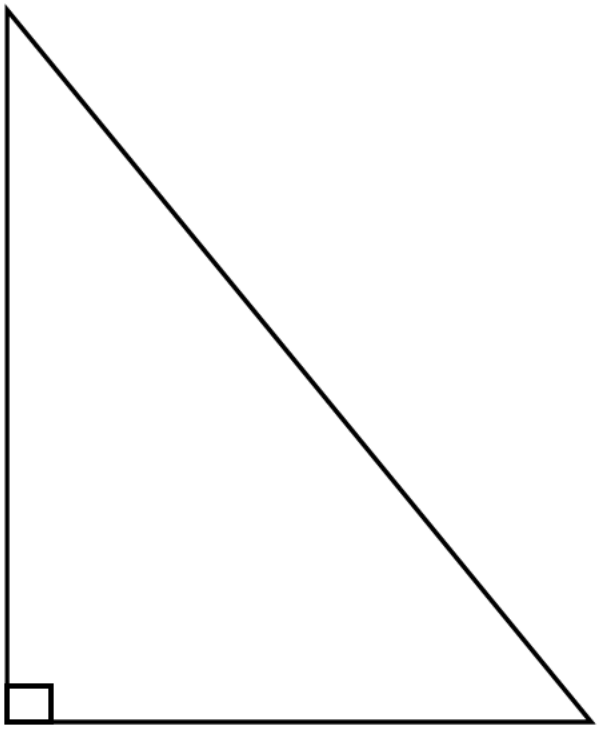
ELABORATION Before students fly their rockets they are introduced to and guided through creating their alti-tracker tools (these instructions are included in the file folder). Then, students will become familiar with the safety measures to be taken, procedures to be followed, and the team member duties (one partner launches the rocket, while the other tracks the height using the tool). Students will go outside to a designated location (such as a soccer or baseball field), take turns launching their rockets, and collecting data.

EXPLORATION Students will become familiar with relating rocket and right triangles by cutting out and completing an illustration in which a flying rocket, the Alti-tracker tool, and launch pad as well as the angle of elevation, height of rocket, distance from launching pad are glued onto their corresponding location within a right triangle (also found in the folder). They will then apply this knowledge and the data they collected outside to find the height of their rocket.

EVALUATION Assessment is ongoing throughout the lesson. Particularly during the relating rockets to right triangles activity to ensure that students are on the right track to understanding how the two concepts fit together. Also, students can be assessed on whether or not they used the correct trigonometric ratio (and calculated correctly) to find the height of their rocket.

Relating Rockets and Right Triangles

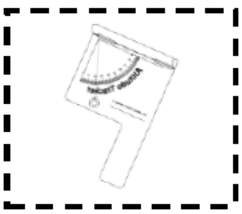
1. Cut out the pictures and labels below.
2. Discuss with your team where on the right triangle each should be placed so that the right triangle models the activity of flying a rocket.
3. Glue in the pictures and labels once you come to an agreement.



Angle of elevation

Height of rocket

Distance from launching pad

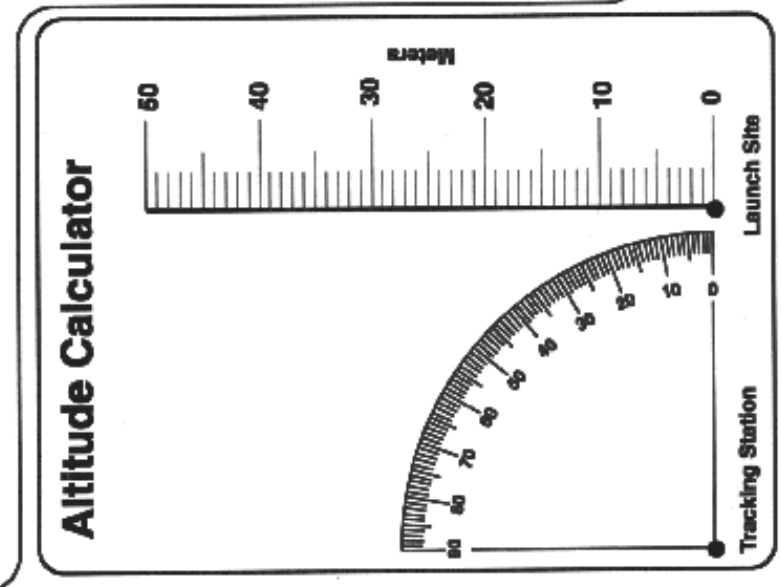


Roll this section over and tape the upper edge to the dashed line. Shape the section into a sighting tube.

Altitude Tracker

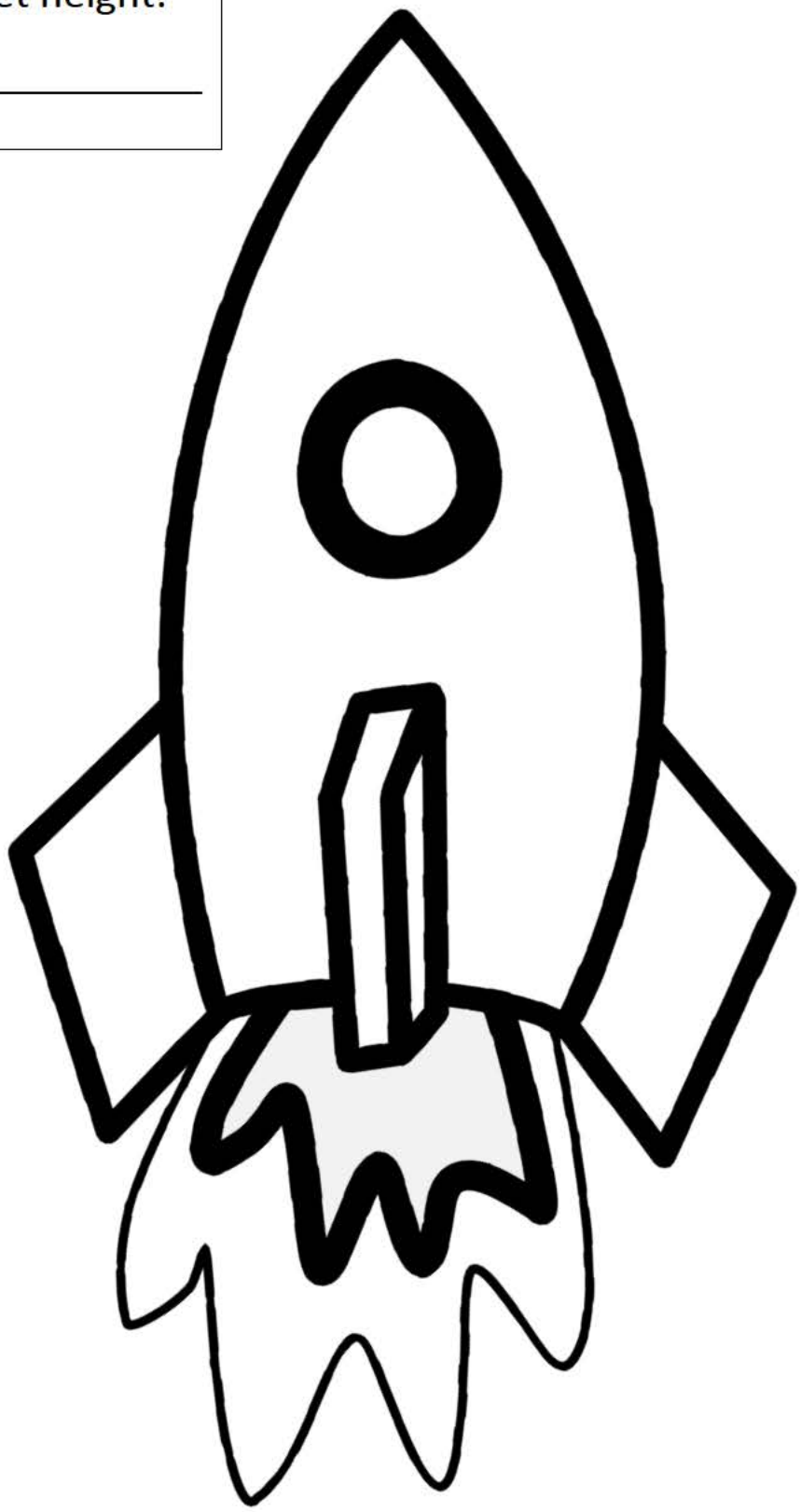
This Altitude Tracker belongs to

_____



My rocket height:

_____



Time	Wesley	Nohemy	Valerie	Clarissa	Adriano
8:00 a.m. arrive to Canutillo					
9:00 a.m. arrive to Dino. Tracks					
11:30 a.m.-12:30 p.m. Lunch at UTEP					
12:30 – 12:50	Introduction				
12:55 pm	Geology Bldg. (Sue)	Cent. Lawn (C)	Phys. Sci. (S)	CCSB (P)	Leech grove (B)
	Walk to next station				
1:10 pm	Cent. Lawn	Phys. Sci.	CCSB	Leech grove	Geology Bldg
	Walk to next station				
1: 25 pm	Phys. Sci.	CCSB	Leech grove	Geology Bldg.	Cent. Lawn
	Walk to next station				
1:40 pm	CCSB	Leech grove	Geology Bldg.	Cent. Lawn	Phsy. Sci.
	Walk to next station				
1:55 pm	Leech grove	Geology Bldg	Cent. Lawn	Phys. Sci.	CCSB
	Walk to next station				
2:00 – 2:10	Close	Close	Close	Close	Close
2:15-3:15 p.m. Lawn activities (ping pong ball, running picture, hoop/circle game)					
3:15-3:30 p.m. Pack up, bathroom break, load the bus					
3:30 p.m. Leave UTEP					
4:00 p.m. Arrive at Canutillo High School					

SUPPLIES:

-Meter sticks
-Clip Boards
-Pencils
-Maps
-Ping pong ball tote
-Hoops

*Geology Bldg = Geologic Time Scramble
*Centennial Lawn = Dino Height Research
*Phys. Sci. = Deciphering RNA
*CCSB = Cladogram Construction
*Leech grove = Dino Math

Geologic Time Scale

Eon	Era	Period	Millions of years ago	Major biological events
Phanerozoic Eon	Cenozoic Era	Neogene	Today – 23	The beginning of the Neogene is when the first hominids (early humans) appeared. Modern humans appeared and developed civilization by the end of this period. Mammoths, sabre-toothed cats, and giant camels dominated until 10,000 years ago when many large mammals went extinct.
		Paleogene	23 – 65	Rise of the mammals and birds. Rodents, primates, pigs, cats, dogs, bears and whales appear. Flowering plants spread across the globe.
	Mesozoic Era	Cretaceous	65 – 145	Dinosaurs continue to dominate the land. Marsupials, modern sharks, bees and butterflies appear. Flowering plants appear. Period ends with the mass extinction of the dinosaurs and many plants.
		Jurassic	145 – 200	Dinosaurs dominate the land. Mammals are common but small. Feathered dinosaurs and birds appear. The most common land plants are ferns, palm-like trees called cycads, and grasses.
		Triassic	200 – 251	The few survivors of the Permian extinction go on to populate the land and oceans. New species like mammals, dinosaurs and crocodiles appear.
	Paleozoic Era	Permian	251 – 299	Amphibians dominate the land. Early cone-bearing plants like pine trees appear. Period ends with the largest mass extinction known with 95% of all marine species and 50% of all animals going extinct.
		Carboniferous	299 – 359	Many swamps on land and sponge reefs in the oceans. Reptiles appear. Early winged insects and cockroaches appear.
		Devonian	354 – 417	Fish spread across the oceans. Amphibians appear. The first trees and other plants spread across the land creating the first forests.
		Silurian	417 – 443	Spiders, scorpions, insects, complex plants, and fish with bony jaws appear. Fish adapt to living in rivers and fresh water for the first time.
		Ordovician	443 – 488	First land plants appear. Primitive fungi and sea weed appears. The oceans are full of corals, mollusks, worms, primitive fish, and echinoderms like starfish.
		Cambrian	488 – 543	A large number of new animal species appear in a relatively short time. First fish appear. No known life on land yet.
Proterozoic Eon			543 – 2,500	First multi-celled organisms like sponges appear. Earliest complex life forms are algae from 1.4 billion years ago. Oxygen begins to accumulate in the atmosphere.
Archean Eon			2,500 – 3,800	Earliest life on Earth are bacteria from 3.5 billion years ago. Earth is very different from today. The atmosphere is mostly methane and ammonia. The continents only just have begun to form.
Hadean Eon			3,800 – 4,570	No known life. The Earth's crust cools and solidifies. The moon forms.

Morse Code	My Code
A .-	A
B -...	B
C -.-.	C
D -..	D
E .	E
F ..-.	F
G --.	G
H	H
I ..	I
J .---	J
K -.-	K
L .-..	L
M --	M
N -.	N
O ---	O
P .--.	P
Q --.-	Q
R .-.	R
S ...	S
T -	T
U ..-	U
V ...-	V
W .--	W
X -..-	X
Y -.--	Y
Z --..	Z

What does this secret message say?

.. .-.. --- ...- . .-.. . .-
.-. - .. - --.

.- -... --- ..- - --. . -. .
- .. -.-. ... !

Read my secret message below.

Genetic Code

Step #1: Transcribe DNA → RNA

A → U T → A C → G G → C

For example:

DNA (decode top strand) A C A T C T T A T A C G T T C
T G T A G A A T A T G C A A G

Becomes RNA U G U A G A A U A U G C A A G

Step #2: Translate RNA → Protein (chain of amino acids)

Second Letter

First Letter	U	C	A	G	Third Letter
U	UUU Phenylalanine (F) UUC Phenylalanine (F) UUA Leucine (L) UUG Leucine (L)	UCU Serine (S) UCC Serine (S) UCA Serine (S) UCG Serine (S)	UAU Tyrosine (Y) UAC Tyrosine (Y) UAA Stop UAG Stop	UGU Cysteine (C) UGC Cysteine (C) UGA Stop UGG Tryptophan (W)	U C A G
C	CUU Leucine (L) CUC Leucine (L) CUA Leucine (L) CUG Leucine (L)	CCU Proline (P) CCC Proline (P) CCA Proline (P) CCG Proline (P)	CAU Histidine (H) CAC Histidine (H) CAA Glutamine (Q) CAG Glutamine (Q)	CGU Arginine (R) CGC Arginine (R) CGA Arginine (R) CGG Arginine (R)	U C A G
A	AUU Isoleucine (I) AUC Isoleucine (I) AUA Isoleucine (I) AUG Methionine (M)	ACU Threonine (T) ACC Threonine (T) ACA Threonine (T) ACG Threonine (T)	AAU Asparagine (N) AAC Asparagine (N) AAA Lysine (K) AAG Lysine (K)	AGU Serine (S) AGC Serine (S) AGA Arginine (R) AGG Arginine (R)	U C A G
G	GUU Valine (V) GUC Valine (V) GUA Valine (V) GUG Valine (V)	GCU Alanine (A) GCC Alanine (A) GCA Alanine (A) GCG Alanine (A)	GAU Aspartic acid (D) GAC Aspartic acid (D) GAA Glutamic acid (E) GAG Glutamic acid (E)	GGU Glycine (G) GGC Glycine (G) GGA Glycine (G) GGG Glycine (G)	U C A G

For example:

RNA U G U A G A A U A U G C A A G

Becomes protein C R I C K

What does this secret message say?

T A A G A A T A G T T C T T T A C C G T T G A G T A
A T T C T T A T C A A A G A A A T G G C A A C T C A T