5E Lesson Plan
"Hitting the BIG TIME with Climate Science"
Trevor Hance / Kevin Befus

Teacher: Trevor Hance / Kevin Befus

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Subject area / course / grade level: Climate Science, G5

Materials:

- 6 tall graduated cylinders
- 6 water containers (beakers)
- 6 water droppers/syringes
- 6 stirring spoons
- 6 ziplock bags
- 6 timers
- Several different colors of art sand
- Paper towels (as needed)

TEKS/SEs:

Primary: 5.8A – Differentiate between weather and climate
Secondary: 5.5A, 5.5C, 5.5D, 5.7A, 5.9A

Lesson objective(s):

Our district provides us with the following definitions and guidelines for weather and climate:

- Weather refers to the daily environmental changes we experience around us. It is also used to describe the condition of the atmosphere in a place at a certain time.
- Climate refers to the average conditions in a place over a longer period of time.
- Weather can be observed each day, whereas climate must be observed over time.

This is the third learning experience in a series relating to (temporal) magnitude.
Through this learning experience, students will create a speleothem model using art sand to create "drip castles," similar to those many students make at the beach, reinforcing their growing understanding of time in the weather/climate analysis.

Differentiation strategies to meet diverse learner needs:

Flexible grouping. Students are divided into 6 groups of 3-4 students for this learning experience.
Scaffold writing support as appropriate.

ENGAGEMENT

- Get Dr. Jay Banner to lead your students on his "off trail" adventure at Inner Space Caverns!
- Give students the transition lab-sheet and mini-assessment regarding their understanding of tree rings and climate and introduction to speleothems w/4-6 minutes to read and complete.
- Give students 3-5 minutes of free play in their groups with instruction for the group to work together and

create the tallest drip castle.

- 4-6 minute discussion regarding how the drip castles were formed. Identify successes for each group and the primary variable.

EXPLORATION

- Re-direct attention to front for mini-lesson on formation of speleothems as a climate proxy.
- http://www.esi.utexas.edu/outreach/caves/infosheets/CoolFormations.pdf
- http://www.nps.gov/grba/naturescience/speleothems-cave-formations.htm

Tell students they will be creating a multi-layered drip castle that represents a stalagmite. They will mix art sand and water and pour the mixture for 1 minute intervals using the following steps to create the model:

1. "Stuff" paper towels into your graduated cylinder until they reach the bottom and form a semi-flat surface. The paper towels will act as a sponge and filter so that the speleothem can grow.
2. Measure the top of your paper towels and record it _____.
3. Cut a very small hole in one corner of your ziplock bag. Place the bag on the graduated cylinder with the cut end down inside the cylinder. You will use this as a sort of funnel that will resemble the point at which the groundwater enters your cave.
4. In a 100ml beaker, mix 40 ml of yellow art-sand with 20 ml of water .
5. Once mixed, start your timer and pour the mixture into to your ziplock bag so it drips through and lands on the paper towel.
6. At the end of one minute, record the net growth of your speleothem model in the chart on the next page and describe it.
7. You will repeat this process up to 3 times during today's class using three different colors of sand, **importantly,** this is where the variable comes in:
    - You should vary the simulated rainfall by adding water to your mixture using the 5ml dropper at 15 and/or 30 and/or 45 seconds.
    - You may only have 3 "rain events" in any given period.
8. Record the variables along with changes in growth (total height vs. net growth) of your speleothem during each period as indicated on the chart provided.

Once groups have formulated a plan for rain events for each of the 5-time intervals, have each group develop a hypothesis regarding the periods that will have the most speleothem growth. Scaffold as necessary: *"Based on* _____ *we expect* _____ *(periods) will experience the most growth because* _____*"*

EXPLANATION

- Each group compares results to their hypothesis (group discussion).
- Each groups shares results, recorded by teacher on the board (class share).

ELABORATION or EXTENSION

- Have students identify questions they have related to the speleothem model.
- Have students compare the validity and reliability of the speleothem model to the tree ring model.
- Have students identify other things that could be studied to help develop climate models in Texas.
- Have students identify other things that could be studied to help develop climate models anywhere in the world.

- Have students identify other things that could be studied to help develop climate models for other planets (i.e. – Curiosity)
- Field trip!

EVALUATION

Fill in the blank (attached). Scaffold as appropriate.

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Weather and Climate, Water Cycle and Objects in the Sky

- By now you know that weather refers to the daily environmental changes we experience around us. It is also used to describe the condition of the atmosphere in a place at a certain time and climate refers to the average conditions in a place over a longer period of time. In short, weather can be observed _____, whereas climate must be observed _____.
- We've looked at tree rings as one way to measure climate conditions, and now we want to stretch our understanding of time a little further by looking at Speleothems, or, stalactites and stalagmites.
- The formation of a speleothem depends on chemistry and time. Basically, as slightly acidic water passes through limestone, it dissolves calcite through the process of _____. Over time, more and more calcite is eroded and mixes with the water, forming a _____. Eventually, the water droplet enters a cave, where the air impacts it once again, and the calcite is deposited and forms a stalagmite or stalactite. It is kind of high level chemistry for what we are doing, but just know that once again, the foundations of what you are doing in fifth grade form the basis for some pretty advanced stuff.
- Stalactites and stalagmites are hypothesized to be the best way to study and analyze climate conditions in Central Texas, because scientists believe that their growth rate relates to the amount of rainfall in a period. Because they grow slowly, these scientists believe they give a unique window into what the atmosphere and ocean levels looked like years and years ago. In fact, researchers at the University of Texas have found speleothems locally that are about 330,000 years old – that's about 6000 hallways!
- Look at the pictures below from the UT ESI website to get a better understanding of what we are talking about:

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http://www.esi.utexas.edu/outreach/caves/formations.php

CAVE

Weather and Climate, Water Cycle and Objects in the Sky

Name: _____
Number: _____

- Let's investigate the following question: ***Has the climate changed over the past 60,000 years?***
- TEAM Hypothesis:

_____

because _____

- Collect and analyze data:

1. Build your model from oldest to most recent.
2. Record data as follows.

Interval	Sand Color	Initial Mixture	5ml of water added at	Total height	Net growth this interval	Notes
1	Yellow	40ml sand / 20 ml water	15 sec 30 sec 45 sec			
2	Blue	40ml sand / 20 ml water	15 sec 30 sec 45 sec			
3	Pink	40ml sand / 20 ml water	15 sec 30 sec 45 sec			
4	Purple	40ml sand / 20 ml water	15 sec 30 sec 45 sec			
5	Green	40ml sand / 20 ml water	15 sec 30 sec 45 sec			
6	Red	40ml sand / 20 ml water	15 sec 30 sec 45 sec			
Notes						

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