Cotton: From Dirt to Shirt—6th Grade

Purpose

The purpose of this project is twofold:

1. To show the cycle of connectedness from science to economics through use of math and language arts.
2. To utilize cotton as a source for comparison and discussion in all aspects of this project.

We understand that schools cannot solely devote their time to one crop for their source of material and discussion. We do recognize the importance of comparing crops through specific science units. Cotton is a versatile crop with a dynamic endurance to both natural change and economic change.

The purpose of this project is not to develop "extension lessons," but rather to help students engage deeper into understanding of content already outlined in the NC Public School Systems. You will note that all of these activities are meant to partner with lessons you may have already created for your classroom. The best way to read these activities is through the lens of the lessons you have already created. Therefore, the challenge becomes how can the entire lessons or portions be integrated into your established curriculum?

Subject Area(s)

Science

Common Core/Essential Standards

Science

- 6.E.2.1 Summarize the structure of the earth, including the layers, the mantle and core based on the relative position, composition and density.
- 6.E.2.3 Explain how the formation of soil is related to the parent rock type and the environment in which it develops.
- 6.E.2.4 Conclude that the good health of humans requires: monitoring the lithosphere, maintaining soil quality and stewardship.
- 6.L.1.1 Summarize the basic structures and functions of flowering plants required for survival, reproduction, and defense.

Agricultural Literacy Outcomes

Agriculture and the Environment

- Recognize how climate and natural resources determine the types of crops and livestock that can be grown and raised for consumption.
- Recognize the factors of an agricultural system which determine its sustainability.

Science, Technology, Engineering & Mathematics

- Provide examples of science and technology used in agricultural systems (e.g., biotechnology, soil testing, etc.); explain how they meet our basic needs; and detail their social, economic and environmental impacts.

Essential Questions

1. What are soil layers?
2. Describe the different types of soil layers.
3. What is erosion?
4. What are the different parts of a seed?
5. Define the function of the parts of a seed.

Vocabulary

Crust: the outermost layer of Earth, includes the oceanic crust, and continental crust
Oceanic Crust: the thin part of Earth's crust that underlies the ocean basins
Continental Crust: the thick part of Earth's crust that forms the large landmasses (continents)
Lithosphere: the outer part of Earth, consisting of the crust and upper mantle
Convection Currents: the flow that transfers heat, causing the heat to rise
Middle Mantle: the region of Earth's interior between the core (on its inner surface) and the crust (on its outer)
Lower Mantle: solid material extending all the way to Earth's core
Asthenosphere: softer part of mantle below the lithosphere; hotter and under more pressure than the lithosphere
Outer Core: layer of molten metal that surrounds the inner core; its movement creates Earth's magnetic field
Inner Core: dense ball of solid metal in the center of Earth
Sand: a loose granular substance, typically pale yellowish brown
Silt: sedimentary material consisting of grains, particles of disintegrated rock; smaller than sand and larger than clay
Clay: a stiff, sticky material that is pliable when wet; impermeable layer in the soil
Runoff: the draining away of water (or substances carried in it) from the surface of an area of land, building, structure, etc.
Erosion: a type of weathering in which surface soil and rock are worn away by natural forces

Mudslide: a mass of mud or earthy material falling down a slope
Landslide: a mass of earth or rock falling down from a mountain or cliff
Rockslide: a mass of rock or rock fragments falling down a slope
Mass Movement: movement of surface material caused by gravity; mudslides, landslides, and rockslides are examples of sudden mass movements
Conservation tillage: covering the soil in crop residue year-round.
Land tillage: sloping the land to prevent washing away of topsoil.
Organic debris: debris in nature that have come from a natural source, such as plants and animals
Seedling: a young plant that has grown from a seed
Germination: the process by which a plant grows from a seed
Pollination: the transfer of pollen from male reproductive structures to the female reproductive structures of the plant, allowing fertilization to occur
Seed Coat: the protective outer layer of a seed
Sprout: a shoot of a plant
Fertilization: the process occurring after pollination when the male and female reproductive cells of the plant produce a zygote (egg) which eventually becomes the fruit
Pollen: a fine powdery substance, typically yellow, consisting of grains discharged from the male parts of the flower.
Cotyledon: the first leaf produced by the seed
Epicotyl: the portion of the embryo or seedling above the cotyledons
Hypocotyl: the part of the stem of the embryo below the cotyledon that pushes the cotyledons above ground to develop
Cotton Boll: the seed vessel or pod of a cotton plant
Radicle: the part of the embryo that develops into the primary root
Endosperm: that part of the seed which stores the energy and food for the developing embryo

Background Knowledge

Note to instructor: As previously discussed, these lessons are meant to latch onto what you are already teaching in the classroom. These activities should coincide with the introduction of soil, and built as add-ons and expansions of lessons already taught in the curriculum. The outline of the activity is the only portion expressed within the procedures. It is necessary to know all vocabulary terms, and their definitions.

Cotton Connection

Because of the vast variety of soils and climate cotton is produced in, the production of soil based on sand, silt, and clay can range. These factors will also affect the irrigation of the cotton crop itself. Allow students to conduct experiments in lesson #7 of planting cotton seeds (and other seeds) by utilizing different levels of sand, silt, and clay within the soil to see how it would affect the growth and production of the cotton plant.

Cotton producers seek to minimize soil erosion due to the sensitivity that cotton can experience, most especially with the brittle and delicate stems that create the shoot of the cotton plant. Knowing how brittle the shoots can be, allow students to hypothesize what types of erosion affect the cotton plant the most. Have students explain their answers.

There are three principal groups of cotton:

1. *Gossypium hirsutum*, also called *American Upland* (native to Mexico and Central America); accounts for more than 95% of US production.
2. *G. barbdense*, also called *American Pima* (native to South America)
3. *G. herbaceum* and *G. arboretum* (native to India and Eastern India)

Cotton seeds, unlike many other seeds, have a poisonous layer that surrounds the seed called *Gosypol*. Unlike many other plants during the growth stage, the roots of the cotton plant grow more extensively than the shoot. This development allows for the cotton plant to become more drought-tolerant.

North Carolina Cotton

The first North Carolina cotton mill was established in 1815 near Lincolnton, and operated until 1819. [7] By 1840, cotton became a leading cash crop for North Carolina farmers due to the invention of the cotton gin, and also the ability for crops to be hauled overland or on river boats. [8]

The majority of cotton grown in North Carolina is the *hirsutum* (Upland) species. In 2015, cotton farmers harvested 355,000 acres, equating to 527,000 bales, and $143.3 million production value. [5, 7] The cotton industry provides an average of 15,886 jobs which are housed in 1,558 businesses, farms, gins, etc. [6]

Materials

Activity 1:

- Container with a lid (make sure the lid can be applied tightly), one per student
- Bucket or container of clay, one per table
- Bucket or container of silt, one per table
- Bucket or container of sand, one per table
- One ¼ measuring scoop, one per bucket
- One ¾ measuring cup, one per table

- One large beaker or container of water, one per table
- Scissors, one per student
- Glue, one per student
- Black marker, one per student
- 1 sheet of light brown, gray, dark brown, and white construction paper (4 sheets total), one per student

Activity 2:

Note: Depending on your access to resources, you may only have the option to host three stream tables in your lab, as opposed to several per class. Feel free to alter this based on your class resource availability. You can also alter this activity by using smaller boxes/buckets and have enough for each student. Bear in mind, the smaller the box, the higher the potential to skew anticipated outcomes.

- Any tray that is at least two feet long or larger; painter's trays also work
- Bag of sand
- Bag of Silt
- Bag of Clay
- Scissors, one per student
- Roll of string
- 2 liter soda bottles, one per stream table made
- Any object to prop up each tray/box (Depending on what type of box you use will determine how slanted it must sit. You may consider cutting off, or shortening the bottom lip of the box to maximize runoff results. You may also consider poking holes at the end of the box as well, to assist the runoff.)
- Science notebooks
- Pencil/pen
- Pitcher with water, one per student

Activity 3:

- 3 pans (make sure they have a lip at the bottom to prevent spillage)
  - Depending on class size, you might want to have 6 pans, 2 of each station
- Sand (you only need enough sand to pack together at the top of each pan, about a ¼ of the whole pan)
- 1 spray bottle
- Pack of ice cubes (the bigger the better)
- Extra-large straws (you will want to remind the students that the straw are only for blowing on the experiment, and not on each other's face)
- Goggles

- Blow dryer, optional

Activity 4:

Note: This activity will require you to pre-plan well in advance. You will need enough soda bottles for each student, plus the bottom of a second bottle. Encourage students to bring some in, but you may need to reach out to other groups to help you obtain materials. You may need to partner people up in groups of 2-3, due to your limitations. Groups should be no larger than 3 for this activity.

Remind students about safety with scissors and cutting the plastic bottles in this activity, as the plastic edges can be sharp and have the potential to cut their hands.

- 1, 16 oz. soda bottle with bottom still attached, one per student
- Bottom of 1, 16 oz. soda bottle, one per student
- String, 20" per student (to start with)
- Potting soil, enough to fill all three bottles 3/5 to the top
- Organic debris (e.g. twigs, leaves)
- Water
- Direct sunlight
- Scissors
- Table
- Permanent marker, or tape and a marker (for labeling)
- Cotton seeds, 3-4 per student
    - Contact Casey Ferns, Cotton, Inc. for more information on acquiring seeds
        - 919-678-2271, cferns@cottoninc.com
- Hole puncher or something sharp to poke holes through plastic bottle

Activity 5:

Note: This activity will require you to locate spots in your class or outside of your class. There are numerous ways you may accomplish this, and you will have to assess your resources available to you to determine what will suit your students best. The following are options you can consider:

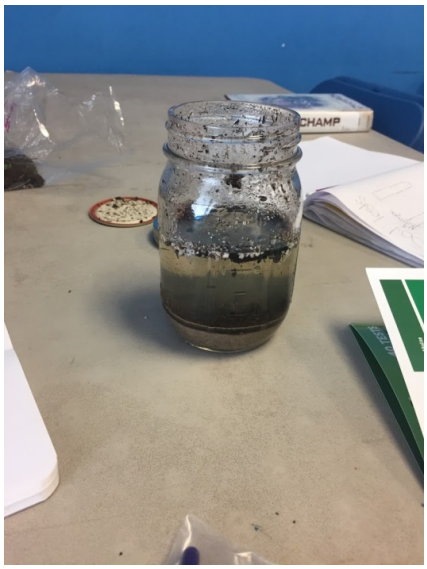
- Garden beds
- Pots
- Milk jugs
- Plastic planters
- 3-4 different types of seeds, make sure one of the seeds is a cotton seed (3-4 seeds per student)
- Rubber, latex, or garden gloves, see the **Note** included with **Activity 7** under **Procedures.**

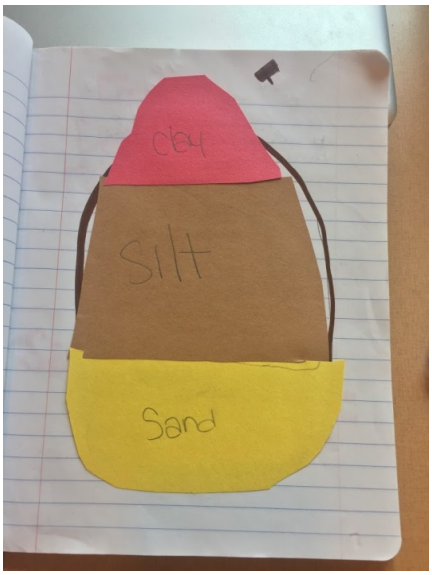
No matter what, make sure that you have enough direct sunlight for the seeds to grow, or have a plant stand with indoor UV light attached

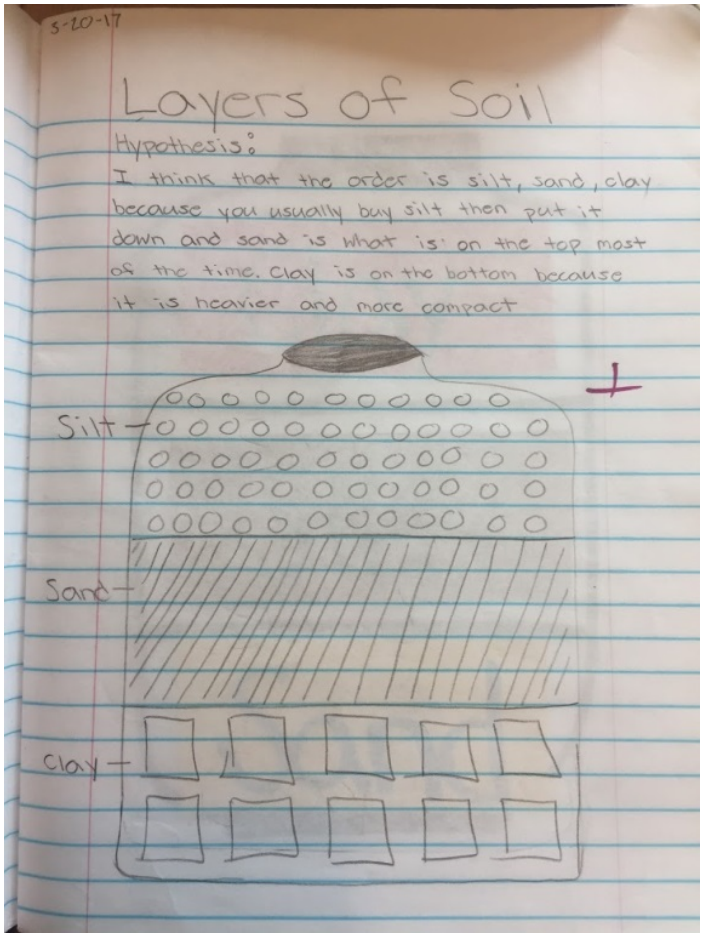
Procedures

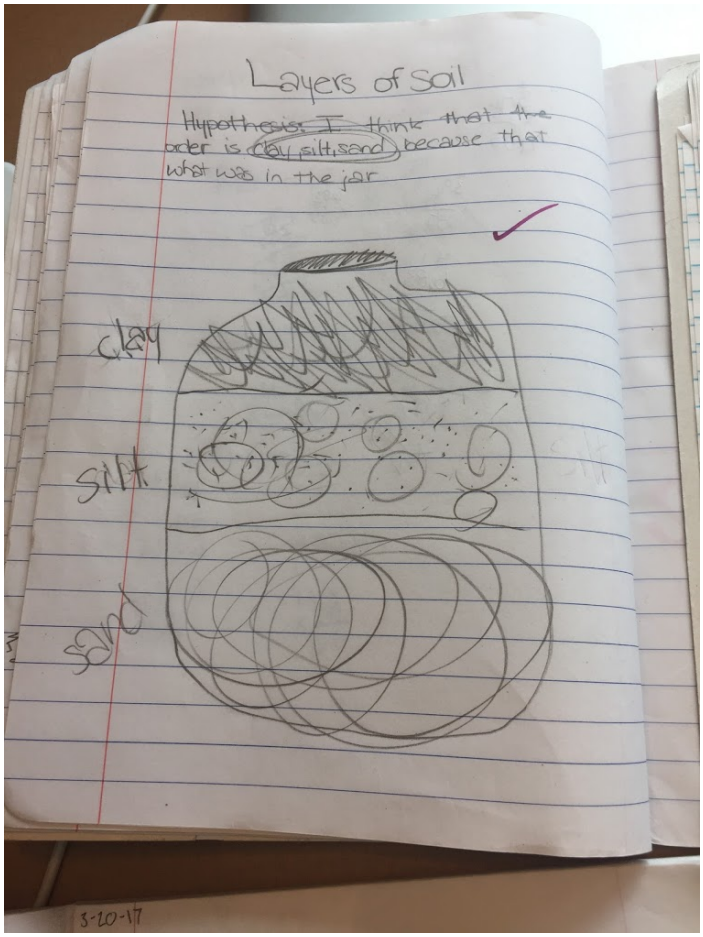
Activity 1: Soil Types (One 50-minute class period recommended)

1. Have several images of sand, silt, and clay ready to be displayed on the board/screen as you discuss each one of these layers.
2. Have students use the white paper to cut out the background in the shape of the container they are using. For example, if you're using mason jars, students should trace and cut out the shape of a mason jar. Students should make these cut outs as large as possible,
3. Students will take one scoop of each sample and place it into their container.
4. Have students pour ¾ cup of water into the sample.
5. Have students place lids tightly onto their containers and shake the containers for up to 20 seconds. Place the container down on the table once complete. Allow 15-20 minutes for sediments to settle.
6. During this break, go over your lesson and introduce further the concept of sand, silt, and clay.
7. Come back to the containers and allow students to make immediate observations.
8. Ask each table to make a list of four major observations they immediately see.
9. Students will then take each piece of construction paper and cut a thick piece that will fit on their white sheet.
10. Have students glue each color, one overlapping the other just slightly. On each piece of paper, students should take the black marker and create a symbol that will go across the strip and represent the layer. For example, using circles that sit together to represent sand; small dots to represent silt, etc.
11. On the back of each flap, students should label each layer.
12. Ask students to work together at their tables and come up with a working definition for each of the three layers.









Activity 2: **Stream Tables** (Two or more 50-minute class periods)
Note: Depending on your access to resources, you may only have the option to host three stream tables in your lab, as opposed to several per class. Feel free to alter this based on your class resource availability. You can also alter this activity by using smaller boxes/buckets and have enough for each student. Bear in mind, the smaller the box, the higher the potential to skew anticipated outcomes.

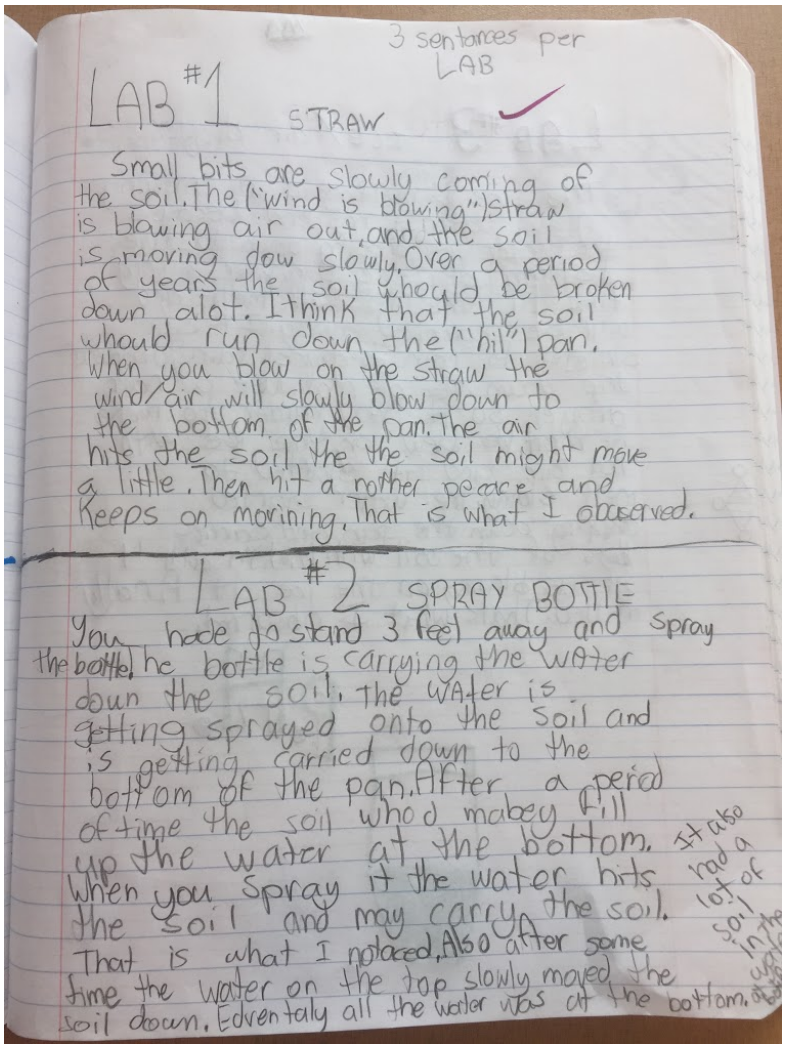
1. Provide each student with a box/tray.
2. Have them set up their tray by propping it at an angle to facilitate runoff.
3. Have the students cut off the bottom quarter of the 2 liter bottles.
4. Puncture several holes (approximately 3-4) at the top of the cut off bottle; this is where the string will later be placed.
5. At each hole, an individual string should be tied off. Have the students tie them off good and tight.
6. Puncture a hole at the bottom of the tray/box. Bring all 3-4 string ends together through this one punctured hole and tie a tight knot so the string does not slip through, even when wet.
7. Have students fill up the top half only of their tray with one of the three sediments (sand, silt or clay).
8. Make sure they pat down the sediment tightly so it doesn't fall down out of the tray.

9. Once done, have students pour water slowly onto the sediment in the tray to observe what happens.
10. While observing, have students answer the following questions in their journals:
    a. What do you observe happening to the sediment?
    b. Why is this happening?
    c. Is this a positive or negative result? Justify your reasoning.
11. You can expand the activity by having students place a line of playdough or clay at the bottom of the tray. As students pour out the water again, have them access what is happening. Have them respond to the questions in their journals:
    a. What do you observe happening to the sediment?
    b. Why is this happening?
    c. Is this a positive or negative result? Justify your reasoning.

    Hopefully students will focus on the water and color that it is changing to, due to the combination of sediment and clay/playdough coloring.

Activity 3: Soil Samples (One 50-minute class period recommended)
Note: Prior to the lab, you will need to set up each station.

1. Students will be placed in small groups for this activity, and should be working together to make observations of what is occurring. Students should be answering three specific questions during the activity, per station.
    a. What is happening to the soil?
    b. Why do you think this is happening?
    c. What do you think this type of reaction would to the soil over a period of years?
2. At Station #1, students will take the water spray bottle and will continually spray the water onto the soil until it has made a change.
3. At Station #2, students will take ice cubes and place them at the top of the soil pile. In order to move the process along, you may need to use a blow dryer at a very low speed, but high temperature to make the ice melt faster.
4. At Station #3, students will take their straws and blow through them onto the soil from the top, aiming toward the bottom of the pan.
5. Following the stations, have the students share their observations with the class.
6. During the discussion, begin giving students vocabulary words. Instead of outright giving them words, allow them to use their logical reasoning and experience through observations to take guesses at which vocabulary word belongs with which definition.



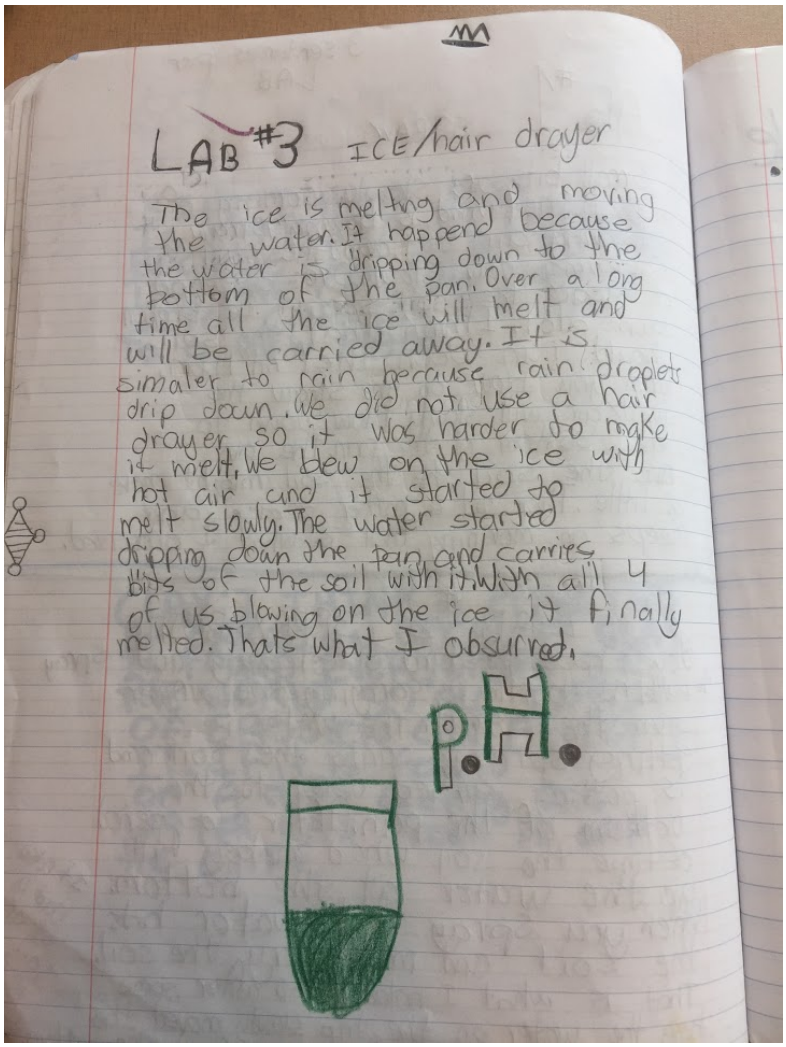
3 sentances per LAB

LAB #1 STRAW

Small bits are slowly coming of the soil. The ("wind is blowing") straw is blowing air out, and the soil is moving dow slowly. Over a period of years the soil whould be broken down alot. I think that the soil whould run down the ("hil") pan. When you blow on the straw the wind/air will slowly blow down to the bottom of the pan. The air hits the soil the the soil might move a little. Then hit a nother peace and keeps on morining. That is what I observed.

LAB #2 SPRAY BOTTLE

You hade to stand 3 feet away and spray the bottle. The bottle is carrying the water down the soil, the water is getting sprayed onto the soil and is getting carried down to the bottom of the pan. After a period of time the soil whod mabey fill up the water at the bottom. It also had a lot of soil in the When you spray it the water hits the soil and may carry the soil. That is what I noticed. Also after some time the water on the top slowly moved the soil down. Edventaly all the water was at the bottom.



LAB #3 ICE/hair drayer

The ice is melting and moving the water. It happend because the water is dripping down to the bottom of the pan. Over a long time all the ice will melt and will be carried away. It is simaler to rain because rain droplets drip down. We did not use a hair drayer so it was harder to make it melt. We blew on the ice with hot air and it started to melt slowly. The water started dripping down the pan and carries bits of the soil with it. With all 4 of us blowing on the ice it finally melted. Thats what I obsurved.

P.H.

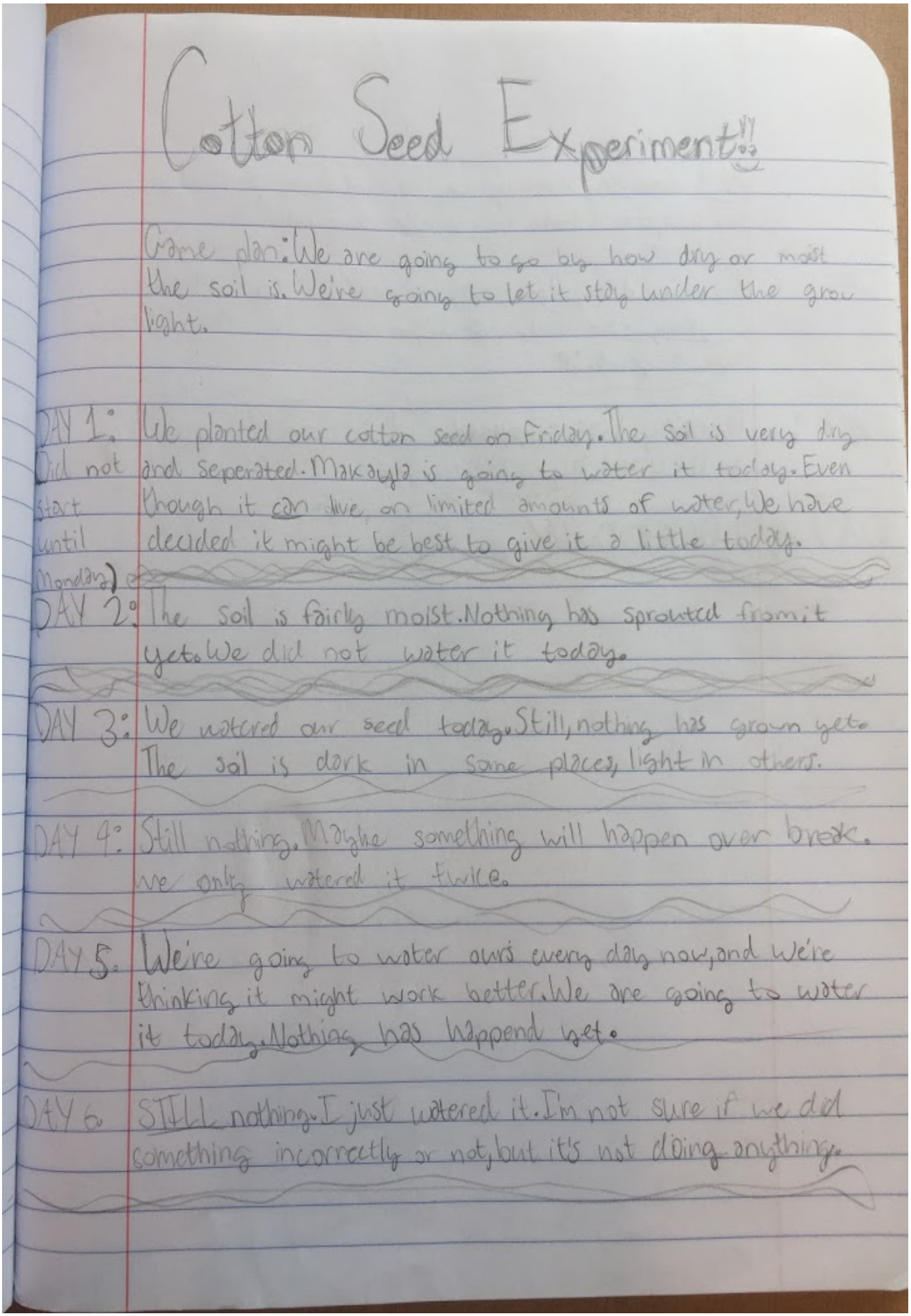
Activity 4: Erosion Bottles (One 50-minute class period recommended)
Note: This activity will be one to revisit over time, as seedlings need time to develop and sprout. Also, see the Note under the Materials section.

1. Have students take each soda bottle and cut it in half, horizontally, starting at the bottom and getting as close to the top as possible, without cutting off the lid.
2. With the second bottle, have students measure up 5" from the bottom, and cut off the bottom.
3. The teacher should go around and poke two holes on each side of the cut off bottom for each student.
4. Take the string and tie each end into the holes of the bottom cut out. If it needs to be shortened, students may gauge for themselves.
5. In each bottle, students should label their bottles with their names, prior to moving on from this step.
6. Students should fill each open water bottle ¾ fill with soil. No need to compact.
7. In one bottle, students should take half of the seeds they were given and plant them in the soil. Make sure they space them out, and do not plant them directly on top of each other.
8. In the second bottle, have students place organic debris on top of the soil creating a light covering.
9. In the third bottle, have students leave only soil visible.
10. Take the cut bottoms with the strings attached and place each of them on the bottles with the soil in them.
11. Take the bottles and place them on a table that is sitting in direct sunlight.
12. Once the planted bottles have begun to rise and are growing healthily, have students fill a pouring container with two cups of water. Each plastic bottle will need two cups of water for this experiment.
13. Students should pour the two cups of water into each bottle and observe what happens to the water as it trickles out.
14. In between the time of waiting for the seeds to grow, have the students use their previous observations and hypothesize what they think will happen. Explain that the water will be poured on top of each bottle of soil. Have students draw out their hypothesis in their Science Journals. When this activity is revisited in several days, students can look at their hypothesis and compare with what actually occurred and dictate the differences.

Picture Source: https://s-media-cache-ak0.pinimg.com/736x/ff/83/bc/ff83bcea75cfedecc13b495c33055969.jpg

Activity 5: Plant Study (This particular activity is built to last several days and does not take an entire period; however, it should correlate with the lessons you have already created around the life of a plant.) See **Note** in Materials regarding this Activity.

1. After you have decided how the students will plant their seeds, have students plant their seeds into the soil. When planting cotton seeds, you will need to make sure that students wear gloves when handling, or that they wash their hands thoroughly as the Gosypol on the outside of the cotton seed can be dangerous if consumed. Also, you may want to double check with each student regarding allergies, depending on the other types of seeds you plant.
2. Students should document the growth of their seedlings and subsequent reactions every three days. Documentation should happen one of two ways:
    a. Technology – students use technology devises to help them document the changes by capturing images/pictures on the device. These images should then be placed on a subsequent document, either printed out or on a journal keeping tech app (such as Google Docs).
    b. Paper/Color Pencils – students should trace out a general sketch, with specific details using their paper journal and color pencils. They should be using proper colors for specific parts. For example, if the sprout of the seed includes two small leaves, they should trace this out. If those leaves are yellow, their drawing should reflect that.
3. Students should document in their journals any specific changes that they have done to or for their seed (added water, moved locations, added decomposing material, etc.).
4. Have students write several sentences about what they are observing, using appropriate vocabulary and terminology to emphasize what is happening in the cycle.
5. Have students end their journal entries by hypothesizing what they anticipate seeing next with their seedling. They should also briefly explain why they feel that they will see this.
6. Students will probably recognize that their cotton plants are exhibiting faster, or firmer growth than some of the other plants they may have initiated into the soil. Allow students to observe the differences and to hypothesize on why these differences exist.



Cotton Seed Experiment

Game plan: We are going to go by how dry or moist the soil is. We're going to let it stay under the grow light.

DAY 1: We planted our cotton seed on Friday. The soil is very dry and seperated. Makayla is going to water it today. Even though it can live on limited amounts of water, We have decided it might be best to give it a little today. (Did not start until Monday)

DAY 2: The soil is fairly moist. Nothing has sprouted from it yet. We did not water it today.

DAY 3: We watered our seed today. Still, nothing has grown yet. The soil is dark in some places, light in others.

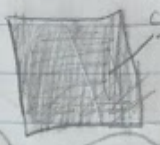
DAY 4: Still nothing. Maybe something will happen over break. We only watered it twice.

DAY 5: We're going to water ours every day now, and we're thinking it might work better. We are going to water it today. Nothing has happend yet.

DAY 6 STILL nothing. I just watered it. I'm not sure if we did something incorrectly or not, but it's not doing anything.

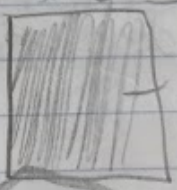
Cotton Seed experment
Game Plan
Every day water
Grow in light

Day 1: Nothing is growing. Just soil. The soil is dry but sort of not dry.



DAY 2: The soil is supper dry. Needs to be waterd. Going to get waterd everyother day.

DAY 3: The soil is supper dry. We changed it to water every day. To see if it will help the seed grow.



DAY 4: The is still really dry. The seed still has not been sprouting. I am not sure if the light is help it.

Suggested Companion Resources

- Illinois Soil Ag Mag
  http://www.agintheclassroom.org/TeacherResources/AgMags/Interactive_soil_agmag.pdf

Ag Facts

- American paper currency is made of 75% cotton. [1]
- In North Carolina, cotton is planted in April and May and harvested in the fall. [2]
- Nearly one million acres of cotton is grown in North Carolina. [2]
- Soil exists in a variety of different colors, from black to yellow to deep red. [3]
- North Carolina has over 400 different types of soil, but Cecil and Sandhill soil are the most common. [4]

Extension Activities

- Students can create their own document, foldable, or design at home (using any medium) that expresses all of the Earth's Layers you have discussed in Activity 1.
- Provide students with a set of golf balls, marbles, and beads. Ask them to create a visual model that displays sand, silt, and clay, similar to what they observed in Activity 2. They should be able to explain what each object is meant to represent as they create their visual model.
- Students can create their own vocabulary quiz using Quizlet, Google Forms, or another tool that utilizes the major vocabulary from Activities 7 and 8.

Sources & Credits

1. http://www.cottoncampus.org/CC-Cotton-101/Cotton-Fun-Facts/
2. http://upchurch.farm/cotton-facts/
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Lesson Author

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