

# What's Included?

## Unit Planning

- NGSS and APES Standards document
- Unit Pacing Guide for 50 min classes
- Differentiation ideas for honors students and virtual students **\*Digital links for virtual learning found here**
- Honors assignment list

## Notes

- Unit 2 PowerPoint (39 slides)
  - Minerals & Mining
  - Soil Composition & Conservation
- Cornell Notes Pages (4 pgs)
- Doodle Notes Pages (2 pgs)
  - Guide to Using Doodle Notes
  - Doodle Note Keys & Examples
- Web-quest (6 pgs) **\*Can be used as an alternative to notes**

## Activities

- Mineral Identification Lab (3 pgs)
- Mineral Social Media Profile Activity (3 pgs)
- Types of Rocks Jigsaw Activity (7 pgs + 32 slides)
- Edible Mining Simulation (6 pgs)
- Mining Impact Research (3 pgs)
- Soil Analysis Lab (5 pgs)
- Global Soil Profiles Research\* (3 pgs)
- Soil Erosion STEM Activity (8 pgs)
- Answer Keys for all activities

## Extensions

- Digging Deeper: The Mining Process (2 pgs)
- Dimensional Analysis: Coal Mining\* (3 pgs)
- Digging Deeper: The Smell of Soil (1 pg)
- Digging Deeper: Porosity v. Permeability (1 pg)
- Digging Deeper: Saving the Soil (1 pg)
- Data Analysis: Soil Erosion\* (1 pg)
- Answer Keys for all Extensions **\*Honors Options**

## Student Pages

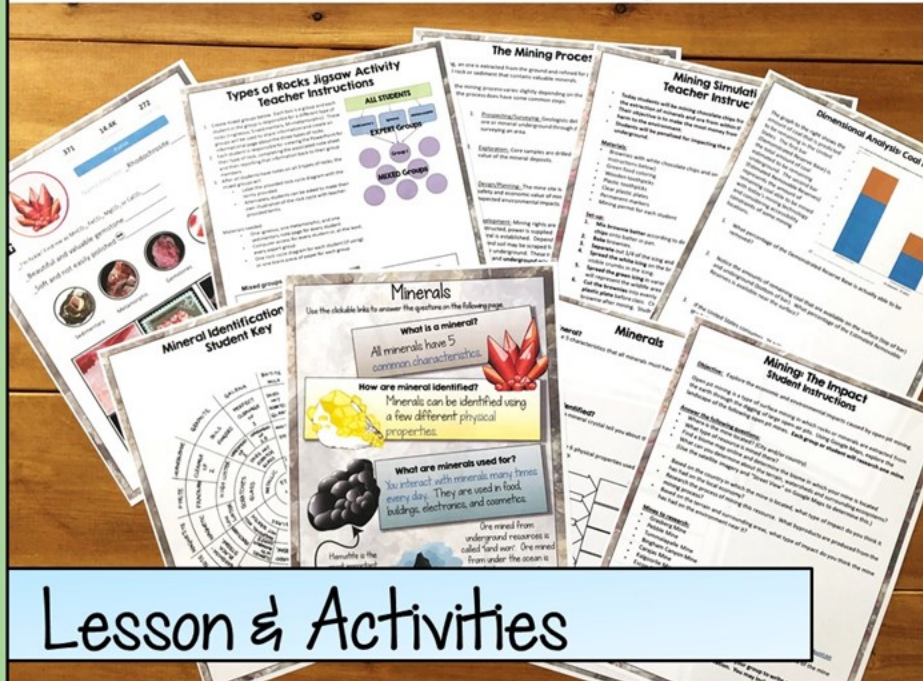
- This folder contains duplicate copies of every student page. They are in order according to the pacing guide for QUICK PHOTOCOPYING if you are using the pacing guide as is.

## Review and Assessment

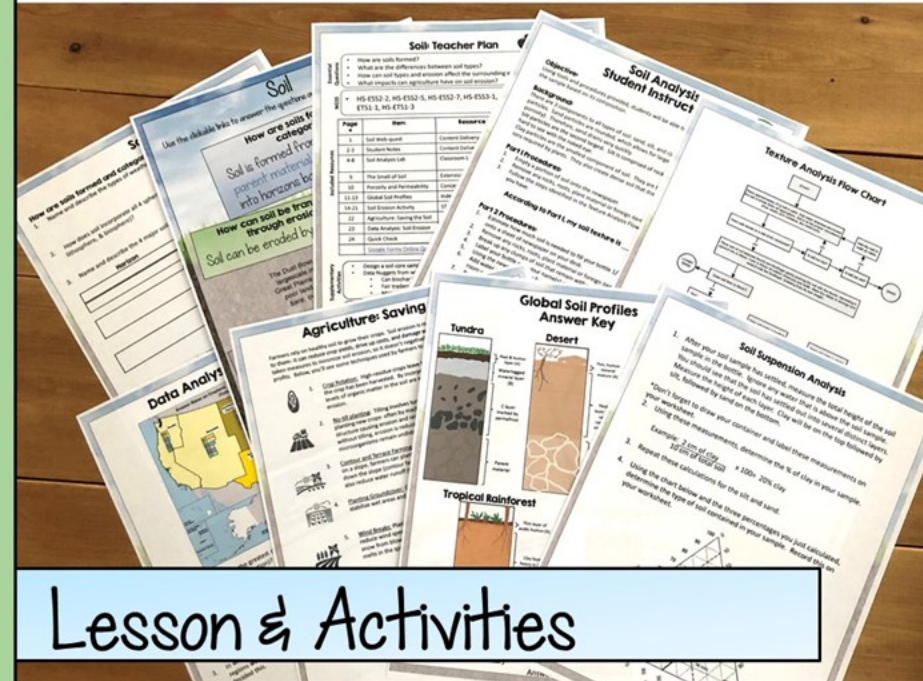
- Quick Check: Effects of Soil Erosion (1 pg)
- Minerals, Rocks, & Mining Quiz through Google Forms
- Soil Composition & Erosion Quiz through Google Forms
- Editable Task Card Review (26 cards) with answer sheet
- Minerals, Rocks, & Soil Test (paper)- both Honors and Regular versions with answer sheets

**Includes the following individual lessons which were previously available separately in my store:**

## **Rocks, Minerals, & Mining**



## **Soil Composition & Erosion**



If you've already purchased either of these individual lessons, please contact me at [support@suburbanscience.com](mailto:support@suburbanscience.com) for a discount on this unit.



# Unit Planning

## NGSS and APES Standards Document

If you have specific state standards, contact me by email ([support@suburbanscience.com](mailto:support@suburbanscience.com)) and I'll help you figure out which ones are covered!

**Not included:**

- Computers with internet access for students
- Mineral kit (including mineral samples, streak plate, magnet, & nail)
- Glass slide
- Brownie mix, white clay
- Clear plates, wooden
- Calculators
- Empty disposable water
- Droppers or pipettes
- Samples of soil
- Cups of water
- Permanent markers
- Metric rulers
- Newspapers
- Calculators
- 2 Disposable aluminum
- Kitchen or scientific scale
- One section of panty
- Permanent marker
- Ruler
- Watering can (preferably
- Water
- Scissors
- 12 Plastic cups
- 2 Twist ties
- 6 coffee filters
- Fill materials for erosion

**Materials:**

- Computers with internet access for students
- Mineral kit (including mineral samples, streak plate, magnet, & nail)
- Glass slide
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\*Honors Options

**Geosphere: Unit 2**

**Review and Assessment**

- Quick Check: Effects of Soil Erosion (1 pg)
- Minerals, Rocks, & Mining Quiz through Google Forms (Make a copy of this file to your Drive. Do NOT assign to students using this link.)
- Soil Composition & Erosion Quiz through Google Forms (Make a copy of this file to your Drive. Do NOT assign to students using this link.)
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**Student Pages**

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**Supplementary Resources**

- Design a soil core sampling tool from Teach Engineering website
- Data Nuggets from [www.datanuggets.org](http://www.datanuggets.org):
  - Can biochar improve crop yields?
  - Fair traders or freeloaders? (Rhizobia and legume relationship)
  - Marvelous Mud

**Standards:**

Topic	NGSS Standard	Description	APES Topics
MS-ESS2-4	Construct an argument supported by	4.2: Soil Formation	
HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.	5.9: Impacts of Mining	
HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	6.4: Distribution of Natural Energy Resources	
HS-ESS3-3	Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.	8.2: Human Impacts on Ecosystems	
HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.		
HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.		
HS-LS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.		
HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.		
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.		
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural and environmental impacts.		

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Unit Overview Page

plus

Supplementary Resource Ideas  
and Materials Lists



# Editable Pacing Guides

50 min classes

	Day	Instruct	Assess	Homework
Soil	14	<ul style="list-style-type: none"> <li>Students begin <b>Soil Erosion Activity</b>. Materials: disposable baking pans, soil, scale, panty hose, permanent markers, rulers, water cans, water, scissors, plastic cups, twist ties, coffee filters, additional optional materials.</li> </ul>	<ul style="list-style-type: none"> <li>Informal assessment of student participation, progress, and understanding during lab work.</li> </ul>	
	15	<ul style="list-style-type: none"> <li>Student</li> <li>If student</li> <li>homework</li> </ul>		
	16	<ul style="list-style-type: none"> <li>Honors: as an In</li> <li>Check a</li> <li>Complete after co</li> <li>With re</li> <li>to sumr compos</li> </ul>		
	17	<ul style="list-style-type: none"> <li>Finish Soil</li> <li>Take Soil</li> <li>Google Fo</li> <li>document</li> </ul>		
	18	<ul style="list-style-type: none"> <li>Use <b>Task</b></li> <li>copy <b>Task</b></li> </ul>		
Review	19	<ul style="list-style-type: none"> <li>Take Unit</li> </ul>		
Assess				

Coincide with NGSS document in Unit Planning Folder

\*Bold items must be photocopied.

50 min classes

	Day	Instruct	Assess	Homework
Soil	11	<ul style="list-style-type: none"> <li>Unit 2 PPT (Sections 3 &amp; 4)</li> <li><b>Cornell Notes</b> (Soil Formation and Composition &amp; Soil Conservation) (Option 2: Use Soil web-quest instead of PPT &amp; Cornell Notes. Find web-quest links in "Differentiation Guide" within the "Unit Planning" folder or use PDF from Notes folder.)</li> </ul>	<ul style="list-style-type: none"> <li>Informal questioning during PPT</li> <li>Cornell notes summary</li> </ul>	All: Each student brings in a small bag of soil from their yard or a nearby area.
	12	<ul style="list-style-type: none"> <li>Student using th</li> <li>should c</li> <li>be able</li> <li>day. Lea</li> </ul>		
	13	<ul style="list-style-type: none"> <li>Student 2 with t</li> <li>haven't</li> <li>addition</li> <li>added t</li> <li>When fi</li> <li>comple</li> <li>Permea</li> </ul>		
	14			
	15			

50 min classes

	Day	Instruct	Assess	Homework
Rocks & Minerals	6	<ul style="list-style-type: none"> <li>Complete <b>Surface v. Subsurface Mining</b> page independently or as a class.</li> <li>Prepare students for mining simulation activity by discussing <b>Mining Rules &amp; Equipment</b> page.</li> </ul>	<ul style="list-style-type: none"> <li>Informal check of student understanding based on answers from Surface v. Subsurface Mining page.</li> <li>Have students think-pair-share on the difference</li> </ul>	
	7	<ul style="list-style-type: none"> <li>S</li> <li>it</li> <li>Material</li> <li>instru</li> <li>tooth</li> </ul>		
	8	<ul style="list-style-type: none"> <li>S</li> <li>N</li> <li>r</li> <li>a</li> </ul>		
	9	<ul style="list-style-type: none"> <li>Gr</li> <li>Im</li> <li>Stu</li> <li>co</li> <li>No</li> <li>Ho</li> <li>An</li> </ul>		
	10	<ul style="list-style-type: none"> <li>All</li> <li>Go</li> <li>do</li> <li>Ho</li> <li>Mi</li> </ul>		

Coincide with NGSS document in Unit Planning Folder

50 min classes


## Geosphere Unit 2 Pacing Guide

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	Day	Instruct	Assess	Homework
Rocks & Minerals	1	<ul style="list-style-type: none"> <li>Unit 2 PPT (Sections 1 &amp; 2)</li> <li><b>Cornell Notes</b> (Minerals &amp; Mining) (Option 2: Use Minerals web-quest instead of PPT &amp; Cornell Notes. Find web-quest links in "Differentiation Guide" within the "Unit Planning" folder or use PDF from Notes folder.)</li> </ul>	<ul style="list-style-type: none"> <li>Informal questioning during PPT</li> <li>Cornell notes summary</li> </ul>	
	2	<ul style="list-style-type: none"> <li>Complete <b>Mineral Identification Lab</b>. Each student (or group) will need one <b>Student Page</b> and each group will need one <b>Student Key</b>. Materials: mineral kit (see teacher instructions on lab for details), glass slide</li> </ul>	<ul style="list-style-type: none"> <li>Informal questioning while students work on lab</li> <li>Informal check of accuracy of specimen identification when finished.</li> </ul>	
	3	<ul style="list-style-type: none"> <li>Students research and create <b>Mineral Profile</b> (copy both research &amp; profile page). Provide example, if necessary. Materials: computers or devices with internet access, colored pencils or markers</li> <li>Read and complete <b>Rocks: An Overview</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Informal check of student progress during research</li> <li>Informal check of understanding based on accuracy of mineral profile page</li> </ul>	All: Finish Mineral Profile if necessary
	4	<ul style="list-style-type: none"> <li>Divide students into groups and complete <b>Types of Rocks Jigsaw Activity</b>. Also copy <b>Types of Rocks Jigsaw Notes</b>. Materials: computers or devices with internet access, colored pencils or markers</li> </ul>	<ul style="list-style-type: none"> <li>Informal check of progress and participation during group work</li> <li>Informal check of note pages completion</li> </ul>	
	5	<ul style="list-style-type: none"> <li>Finish activity from yesterday in groups by completing the <b>Rock Cycle Diagram</b> (coloring optional). Check answers as a class.</li> <li>As a class, read over <b>Digging Deeper: The Mining Process</b>.</li> </ul>	<ul style="list-style-type: none"> <li>Informal check of student understanding from accuracy of Rock Cycle Diagram.</li> </ul>	

Coincide with NGSS document in Unit Planning Folder

\*Bold items must be photocopied.

 This icon is found on the top right corner of Honors pages for easy identification.

The daily topics coincide with the previous standards document.

Lesson planning is now quick and easy!



# Differentiation Ideas for:

- Student Interest
- Student Ability
- Teaching Pace
- Teaching Environment (Virtual, in-class, or hybrid)

## Digital Differentiation

### Web-quests:

- [Minerals Web-quest](#)
- [Soil Web-quest](#)

### Other:

- [Unit 2 PowerPoint](#)
- [Student Pages for whole unit](#)
- [Hypothetical Soil Sample Jars](#) and [Answer Key](#)
- [Minerals, Rocks, & Mining Quiz](#) through Google Forms
- [Soil Composition & Conservation Quiz](#)

Important: NOT possible to directly assign it can be made into a file to assign to students

## Differentiation

### Student Ability

- **Advanced students**
  - **Honors options** are included in the student pages. These can be given to a whole advanced class or individual students, as needed.
  - **Editable Cornell notes** (found in the Notes folder)
    - Delete the fill-in-the-blank notes on the right side leaving only questions for a more independent note-taking experience.
    - Delete the summary and allow students to come up with their own.
  - **Tests:**
    - Use the "Honors" tests that include additional short answer questions.
- **Struggling students**
  - **Independent Work:** If students struggle with independent work in a timely manner, the Types of Rocks Jigsaw can be used as traditional lecture time and the teacher can go through all three rock PowerPoints (Igneous, Metamorphic, Sedimentary) while students take notes.
  - **Eliminating homework altogether** may work well for students that have trouble thinking independently or have home situations that don't allow for work outside of class. Make sure to account for the extra class time needed to complete all assignments in class.

### multiple methods of note-taking:

- Web-quest followed by PPT & Cornell notes will help to solidify student understanding rather than just one method. Doodle Notes can be used at the end of the topic as a student-led review. This allows students to have

## Honors Assignment List

Although there are no official education standards for what makes an "honors" class, honors assignments generally provide one of three options:

- Greater depth of knowledge
- Additional critical thinking
- More independent work

In this unit, you can find some additional assignments used to increase the depth of knowledge for honors students. These can certainly be used for all students and also be helpful for extra credit, homework, or sub days if you need them. Because answers to these assignments are often less straightforward, I recommend grading for completion and then discussing the answers to make sure they are correct.

Assignment	Type of work	Skills addressed
Dimensional Analysis: Coal Mining	Math Extension	Critical thinking, calculating conversions
Global Soil Profiles	Research Assignment	Critical thinking, greater depth of knowledge, independent work
Data Analysis: Soil Erosion	Interpretation of data & maps	Critical thinking, greater depth of knowledge

All honors assignments are designated by a  in the top right corner for easy identification.

## Differentiation

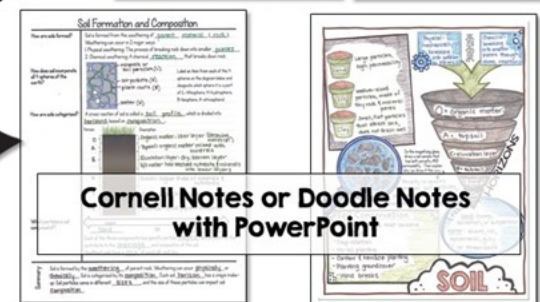
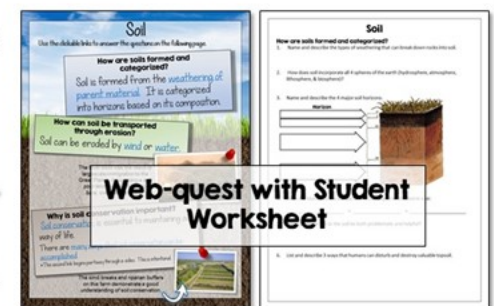
Differentiation is a key component to any unit. Here are some tips for differentiating based on student interest, ability and teaching environment.

### Student Interest/Choice

- **Three options for content delivery are included in this unit:**
  - **Web-quests:** Students can explore content through links and answer provided questions on a worksheet. This is ideal for independent learners or sub plans. Find these web-quests on the last page of this document.
  - **Cornell Notes:** Teacher lectures with included PowerPoint and students record information in guided Cornell notes. An editable version of the Cornell notes is provided so teachers can adjust the content.
  - **Doodle Notes™:** Teacher lectures with included PowerPoint and students record information on Doodle Notes™ pages.

Student-led

Teacher-led





# Content Delivery Option 1: Student Webquest

Live video  
links for  
independent  
learning on  
any device!



**Minerals**

Use the clickable links to answer the questions on the following page.






**What is a mineral?**  
All minerals have 5 common characteristics.

**How are minerals identified?**  
Minerals can be identified using a few different physical properties.

**What are minerals used for?**  
You interact with minerals many times every day. They are used in food, buildings, electronics, and cosmetics.

Hematite is the most important mineral ore of iron. Iron is an essential component of steel.

Ore mined from underground resources is called "land won". Ore mined from under the ocean is called "marine won".



**Minerals**

**What are mineral used for?**

5. Give examples of 5 ways minerals are used in your daily life.

6. Most products contain one / many minerals. (Circle one).

**Minerals**

**What is a mineral?**

1. What are the 5 characteristics that all minerals must have?

- 
- 
- 
- 
- 

**How are minerals identified?**

2. What does the size of a mineral crystal tell you about the magma from which it formed?

3. In the spaces below, list the 6 physical properties used to identify minerals and an explanation of each property.

**Corresponding Comprehension Questions**


4. Give an example of a mineral with a special property.



# Content Delivery Option 2: PowerPoint Presentation

39 editable, fully-animated slides

## What are the 6 physical properties used to identify minerals?

- Color
- Luster
- Hardness
- Streak
- Density
- Cleavage & Fracture



## How are minerals used?

Minerals are used in food, clothing, electronics, and cosmetics.

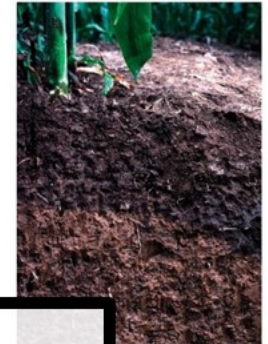
Many products contain many minerals.

**Example:** Hematite is a mineral made of iron and iron is an essential component of steel.



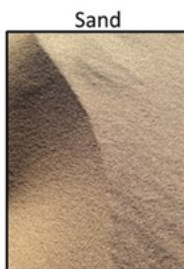
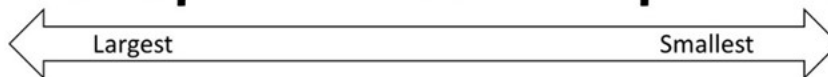
## How are soils categorized?

A cross-section of soil is called a **soil profile**, which is divided into **horizons** based on composition.



# Sample Slides

## Which particles is soil composed of?



## What are the 3 types of wind erosion?

**Creep:** Small soil particles roll or slide while maintaining contact with the ground.

**Saltation:** Grains of soil bounce across the ground.

**Suspension:** Soil moves through the air like in a dust storm.





# 4 pages of Cornell Notes

Big  
concept  
questions

Content  
summary for  
each page

## Soil Formation and Composition

**How are soils formed?** Soil is formed from the weathering of parent material (rock).  
Weathering can occur in 2 major ways:  
1. Physical weathering: The process of breaking rock down into smaller pieces.  
2. Chemical weathering: A chemical reaction that breaks down rock.

**How does soil incorporate all 4 spheres of the earth?**

Label an item from each of the 4 spheres on the diagram below and designate which sphere it is a part of (L-lithosphere, H-hydrosphere, B-biosphere, A-atmosphere)

**How are soils categorized?** A cross-section of soil is called a soil profile, which is divided into horizons based on composition.

Horizon	Description
O	Organic matter: litter layer (decaying material)
A	Topsoil: organic matter mixed with minerals
E	Eluviation layer: dry, barren layer b/c water has leached nutrients & minerals into lower layers
B	Subsoil: higher levels of minerals & nutrients
C	Parent rock: slightly weathered rock
R	Bedrock: solid parent material

**Which particles is soil composed of?**

Each of the three components has specific particle shapes and properties that contribute to the drainage and composition of the soil. Healthiest soils have a mix of sand, silt, and clay.

**Summary:** Soil is formed by the weathering of parent rock. Weathering can occur physically or chemically. Soil is categorized by its composition. Each soil horizon has a unique make-up. Soil particles come in different sizes, and the size of these particles can impact soil composition.

## Minerals

**What are the 5 characteristics of all minerals?**

1. Must occur naturally in the earth
2. Must be inorganic (not formed from living things or the remains of living things)
3. Are always solids
4. Have a definite chemical composition
5. Have atoms that are arranged in a definite (called a crystal structure)

**What are the 6 physical properties used to identify minerals?**

1. Color:
  - Most easily observed, but not
  - Many minerals come in a variety of colors due to exposure to certain conditions and radiation.
2. Luster: Luster is how a mineral reflects light.
  - Minerals that reflect light in the same way are said to have metallic luster.

## Mining

**What does the size of a mineral crystal tell you about the magma from which it was formed?**

Mineral crystals are formed by cooling magma. If magma cools:
 

- Slowly - it makes large crystals.
- Quickly - it makes small crystals.
- Very quickly - no crystals form.

**What are some examples of special properties of minerals?**

Magnetite is strongly magnetic.  
Calcite will bubble in reaction to a weak acid.  
Halite can be identified by a salty taste.

Minerals are used in food buildings, electronics, and cosmetics. Most products contain many minerals.  
Example: Hematite is a mineral ore of iron and iron is an essential component of steel.  
Sand, gravel, and rocks come from quarries. Gold, copper, and iron come from mines.  
Plate tectonics moves mineral deposits under other pieces of land.

## Soil Conservation

**How do humans destroy valuable topsoil?**

Erosion removes valuable topsoil through wind and water runoff.  
Compaction removes pore spaces in soil that would hold roots and water.  
Salinization occurs when irrigation water causes an accumulation of salts until the soil is unable to grow crops.

**What are the 3 types of wind erosion?**

**What are the 5 types of water erosion?**

Sheet: loss of thin uniform layers over a full field.  
Rill channels of rills forming runoff, randomly located.  
Ephemeral channels/depressions that form in the same place each year.  
Gully: large channels, not able to be repaired by tilling of fields.  
Streambank: erosion of the sides of a stream over time.

**Why is soil conservation important?**

It takes hundreds of years for one inch of topsoil to be created. Soil is being lost 17 times faster than it is being formed.

**Why does heavy tilling make it more difficult to grow nutrient dense food?**

Heavy tilling can compact soil, destroy topsoil, and kill microorganisms. To make the soil suitable for growing crops, commercial fertilizers and chemicals must be added.

**What farming methods can be used to conserve soil?**

Briefly describe each technique below:

- Conservation tillage: disturb soil & plant cover as little as possible.
- Crop rotation: planting different crops in one field each year.
- Contour plowing: planting fields along curves of a slope.
- Conservation buffers: waterways & riparian buffers promote biodiversity.
- Windbreaks: rows of trees or shrubs to prevent wind erosion.
- Terracing: stair step planting to prevent water runoff.
- Wetlands: catch & hold water to slow soil erosion.

**Summary:** Erosion, compaction, and salinization are all processes that can destroy topsoil. Water and wind erosion move soils in different ways. Soil is being lost much more quickly than it is being formed. Farming practices can damage soils or be used to conserve them.


Each page is **editable**.

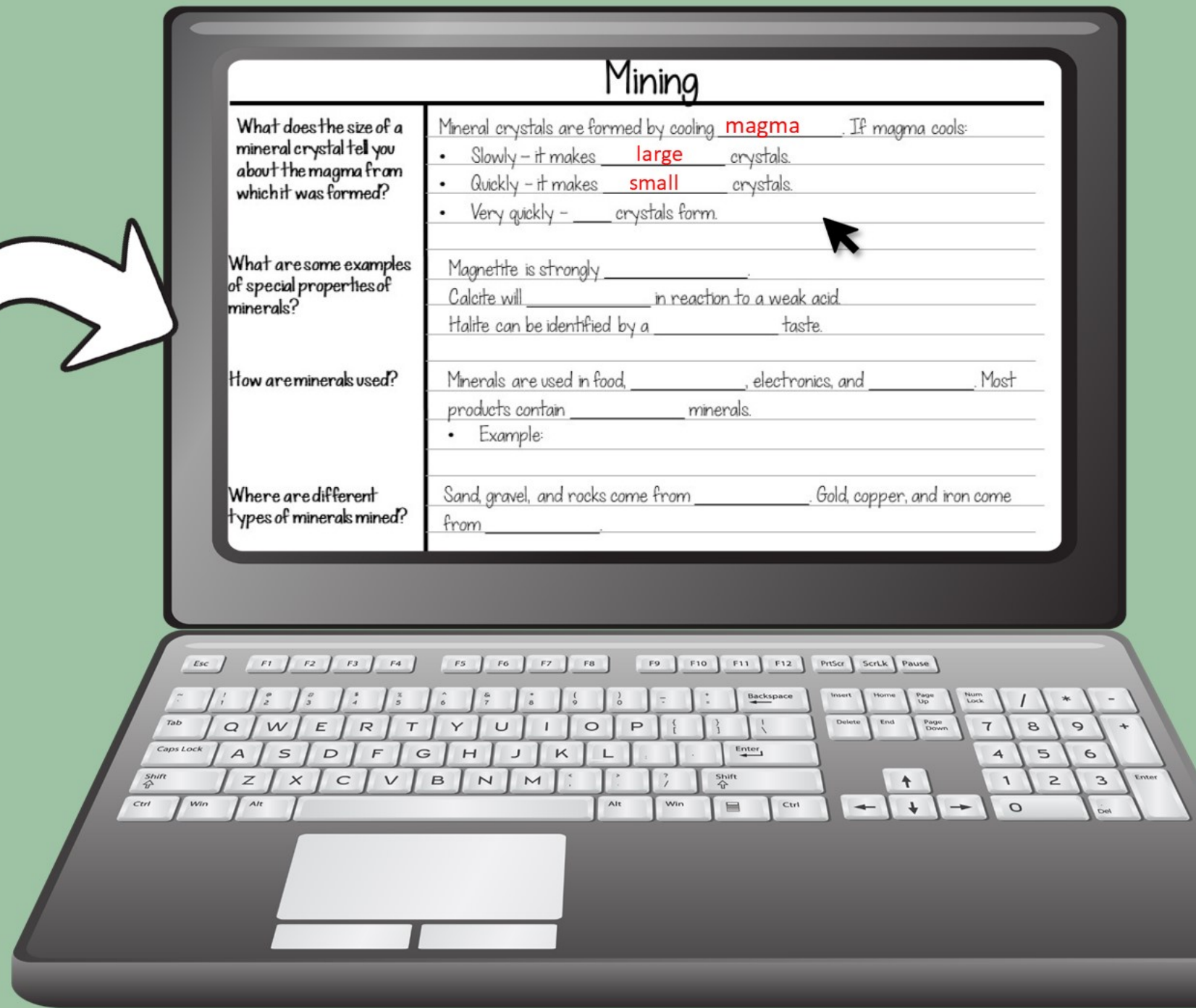
Add and delete text, questions, and summaries to meet the needs of your students.



# Every student page also comes in a **digital** version on Google Slides

Virtual, hybrid, or  
absent students  
can stay right on  
track!

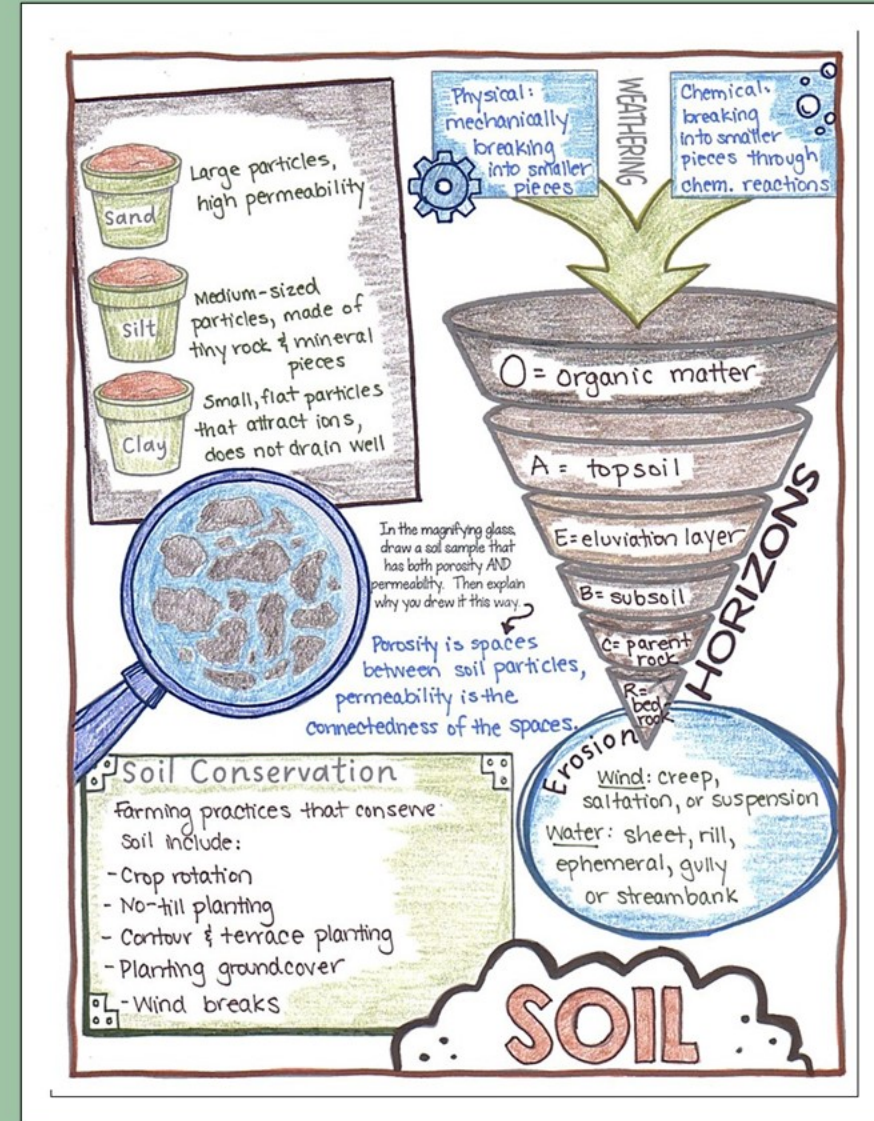
Mining	
What does the size of a mineral crystal tell you about the magma from which it was formed?	Mineral crystals are formed by cooling _____. If magma cools: <ul style="list-style-type: none"><li>• Slowly - it makes _____ crystals.</li><li>• Quickly - it makes _____ crystals.</li><li>• Very quickly - _____ crystals form.</li></ul>
What are some examples of special properties of minerals?	Magnetite is strongly _____. Calcite will _____ in reaction to a weak acid. Halite can be identified by a _____ taste.
How are minerals used?	Minerals are used in food, _____, electronics, and _____. Most products contain _____ minerals. <ul style="list-style-type: none"><li>• Example: _____</li></ul>
Where are different types of minerals mined?	Sand, gravel, and rocks come from _____. Gold, copper, and iron come from _____.
How do mineral deposits get underground?	Plate tectonics moves mineral deposits _____ other pieces of land. <ul style="list-style-type: none"><li>• Land won one: Ore mined from _____.</li><li>• Marine won one: Ore mined from under the _____.</li></ul>
What problems are expected in the future regarding mineral supply?	Mineral supplies have been _____ used in the past century. As these supplies _____, costs to extract deeper deposits will _____.
What can we do to help preserve our mineral resources?	We can _____ materials and products that already contain minerals. We can also encourage more _____ use of mineral deposits. <div style="text-align: center;"></div> <p>On the mineral pile, let the benefits of mining minerals. On the cart, let the consequences.</p>
Summary	Mineral crystals are formed by _____ magma and the crystals vary in size based on how _____ the magma is cooled. Minerals often have _____ properties that can be used to help identify them. Minerals are moved _____ by plate tectonics. Minerals are used in many of the items we use every day, but mineral supplies are _____. We must be careful to practice _____ use of mineral resources.



Can be used in Google Classroom, Microsoft OneDrive or  
many other platforms!



# 2 pages of Doodle Notes for Summarizing & Review



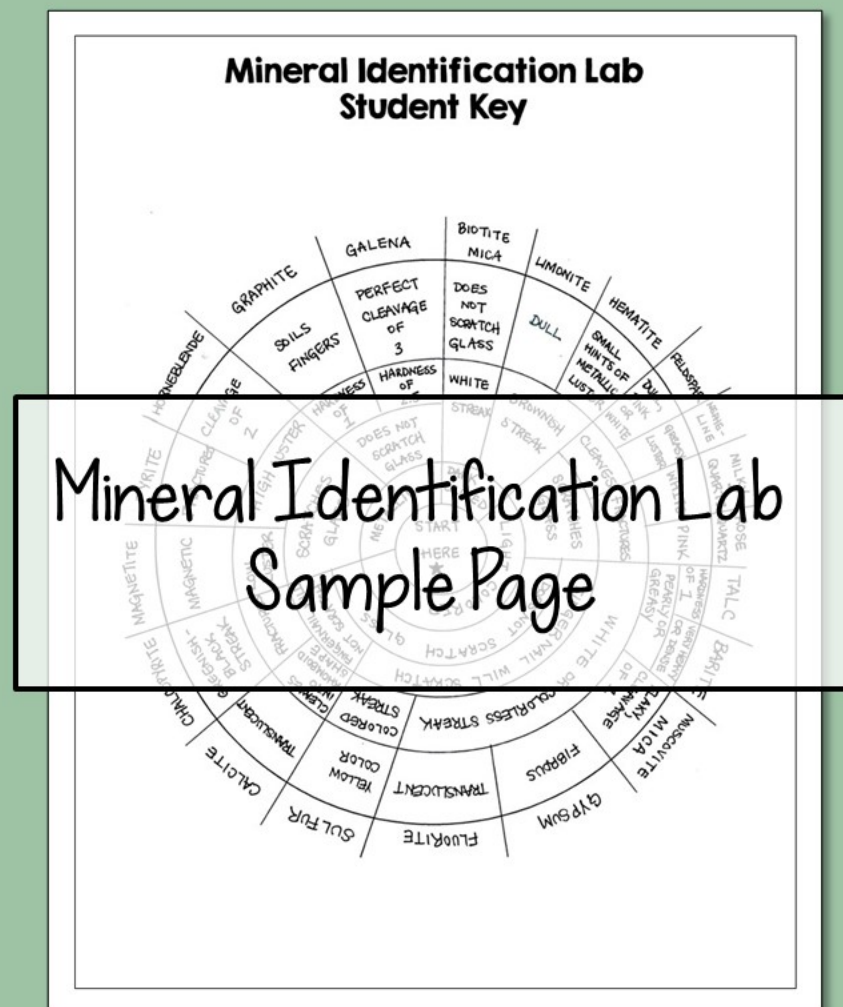
Doodle Notes™ increase student focus and memory-  
and they're great fun!

A guide for using them in your classroom is included.



# Includes 8 Activities

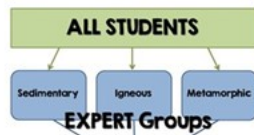
- Mineral Identification Lab
- Mineral Social Media Profile
- Type of Rocks Jigsaw Activity
- Edible Mining Simulation
- Soil Analysis Lab
- Global Soil Profiles Research
- Mining Impact Research
- Soil Erosion STEM Activity





## Types of Rocks Jigsaw Activity Teacher Instructions

1. Create mixed groups below. Each box is a group and each student in the group is responsible for a different type of rocks (I=igneous, S=sedimentary, M=metamorphic). These groups will be used to share information and create an informational page about the rock cycle.
2. Each student is responsible for viewing the PowerPoint for their type of rock, completing the associated note-sheet and then reporting that information back to their group members.
3. After all students have notes on all 3 types mixed groups will
  - Label the provided rock cycle diagram with terms provided
  - Alternately, students can be asked to draw their own illustration of the rock cycle with provided terms.



- Materials needed:
- One igneous, one metamorphic, and one sedimentary note page for every student
  - Computer access for every student
  - One rock cycle diagram for every expert group or one blank piece of paper for each

Mixed groups:

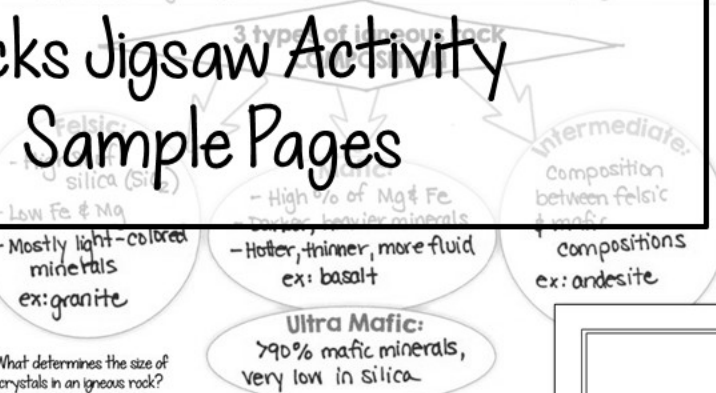
(I)	
(S)	
(M)	
(I)	
(S)	
(M)	
(I)	
(S)	
(M)	

## Types of Rocks Jigsaw Notes Igneous Rocks

Igneous rocks are formed from: the cooling & hardening of magma

**Plutonic:** Form underground  
*Granite, diorite, gabbro, etc.*

**Volcanic:** Form on surface when  
*lava cools after erupting (extrusive)*



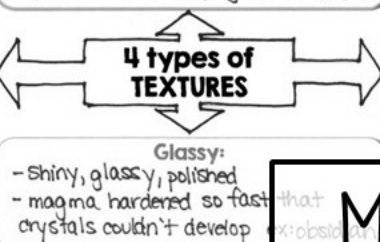
What determines the size of crystals in an igneous rock? Determined by how fast the magma hardens.

**Coarse grained:**

- Crystals are roughly same size & big b/c magma cooled within crust (slowly)
- ex: gabbro

**Fine grained:**

- Made of interlocking crystals that are very small b/c the magma cooled quickly after reaching surface
- ex: basalt



## Mining Simulation Teacher Instructions

- Today students will be mining chocolate chips from inside brownies to simulate the extraction of minerals and ore from within the earth.

## Mining Simulation: Student Worksheet

1. How did you decide which brownie to select?

Draw a topographic map of the surface of your brownie before excavation:

Draw a topographic map of the surface of your brownie after excavation:

## Edible Mining Simulation Sample Pages

Now mine as many white chocolate chips from your brownie as possible. You have mining expenses, so be careful not to spend more than you might earn.

Expenses:  
Tools: \_\_\_\_\_  
Salary: \_\_\_\_\_  
Penalties: \_\_\_\_\_

Income:  
Chocolate Chips: \_\_\_\_\_

Total Profit: \_\_\_\_\_

It is moved to get to a resource is called **overburden**.  
What did the brownie represent the overburden?

How did you decide which brownie to select? How might these decisions affect your mining?



Green icing = wildlife areas;  
Additional penalty for disturbance

## Mining: The Impact Student Instructions

**Objective:** Explore the economic and environmental impacts caused by open pit mining.

Open pit mining is a type of surface mining in which rocks or minerals are extracted from the earth through the digging of large open-air pits. Using Google Maps, explore the landscape of the following open pit mines. **Each group or student will research one mine.**

**Answer the following questions:**

- Where is the mine located? (City and/or country)
- What type of resource is mined there?
- Find a biome map online and determine the biome in which your mine is located
- What can you determine about the terrain, watersheds and surrounding ecosystems? (Use the satellite imagery and "Street View" on Google Maps to determine this.)

- What has had on the local economy?
- Research in the process of mining the resource. What byproducts are produced from the mining process?
- What has had on the environment near it?

**Mines to research:**

- Grasberg Mine
- Pebble Mine
- Tummalapalle Mine
- Bingham Canyon Mine

- Carajas Mine
- Kalgoorlie Mine
- Escondida Mine

Watch this video about mine reclamation: <https://www.youtube.com/watch?v=uYw06osVLM>

What types of reclamation would help to reduce the environmental impacts of the mine you researched?

After you are finished researching, collaborate with your group to write a one-page summary of your research about the mine location. You may include a picture of the site if your teacher allows.

## Mining Impact Research Activity Sample Page



## Soil Analysis Student Instructions

### Objective:

Using the tools and procedures provided, students will be able to determine the type of soil in the sample based on its composition.

### Background:

There are 3 components to all type particles. Sand particles are round porosity). Therefore, sand drains v Silt particles are the second largest hard to see with the naked eye. Clay particles are the smallest com ions required by plants. They also

### Part 1 Procedures:

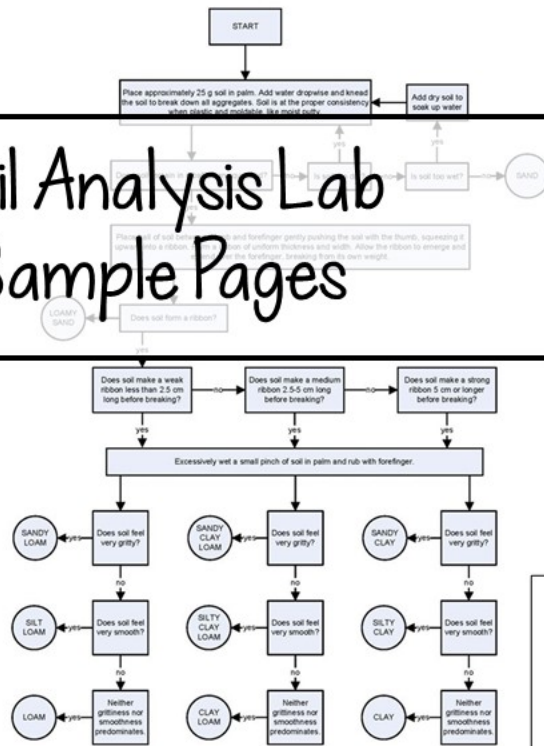
1. Remove any rocks, roots, plant
2. Follow the steps identified in you have.

According to Part 1, n

### Part 2 Procedures:

1. Estimate how much soil is nee onto a sheet of newspaper or
2. Remove any rocks, roots, plant
3. Break up any clumps of soil th
4. Label your bottle with your ne
5. Using the newspaper as a fun
6. Add water to the bottle until room when shaking.
7. Put the lid on your container
8. Shake the container gently un suspended in the water. Don't it to settle!
9. Let the container settle for at
10. Complete the soil suspension

## Texture Analysis Flow Chart



## Soil Analysis Lab Sample Pages

## Global Soil Profiles Grading Rubric

### Score

Soil profile is not correct or not detailed	Soil profile is not correct nor detailed
Soil profile has fewer than 3 horizons labeled	Soil profile has only 1 horizon correctly labeled.
Explanation of soil shows a partial understanding of soil water flow and vegetation interactions with the horizons.	Explanation of soil profile shows little understanding of soil types, water flow and how vegetation interacts with the horizons.
punctuation & spelling mistakes	grammar, punctuation & spelling mistakes

## Global Soil Profiles

### Objective:

Learn about the soil profile for a biome from the list below. Draw the soil profile, label any visible horizons, and explain how the soil profile relates to the vegetation of that biome.

### Possible biomes:

- Desert
- Tundra
- Tropical Rainforest
- Grassland
- Temperate Forest

## Global Soil Profiles Research Activity Sample Pages

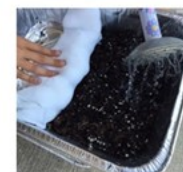
## Soil Erosion Activity Teacher Instruction

### Lab Overview:

Throughout this lab, students will be causing erosion in an area a disposable baking pan. After determining the rate of erosion control, students will create an erosion control barrier using p types of materials. Students will test materials to determine w the best erosion control by containing sediment flow without s water flow.



No erosion control



Picture of actual erosion control barrier

### Modifications:

If you are using an electronic scale or balance, you can have st exact with their measurements. For example, if you use a scale of the plastic cup and subtract the weight of the water from the water weight.

### Extensions:

Students can make a bar graph of their results

Students can measure additional variables such as time of water cost of barrier materials, etc.

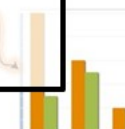


### Part 2: Erosion control

Erosion is often controlled through the use of a sediment barrier like the one in the picture below. They can be filled with any number of materials, based on the location, cost, and goal of the developer using it. You will create a model of this barrier using the pantyhose provided.



1. First, choose one material to fill the pantyhose. Write this material down in the second row of your data table.
2. Close the end of the pantyhose with a twist tie and lay it on the marker line in the pan. Make sure that you have filled the pantyhose with enough material that it is the height of the pan.
3. Repeat steps 1-2 for each material. This time, fill your plastic cup with the material you chose to fill your pantyhose.
4. Continue running this experiment using different materials or combinations of materials inside the pantyhose at least 4 more times, completing the data table as you go.
5. Create a bar graph showing the heights in a double bar graph.
6. Answer the discussion questions after finishing the activity.



## Soil Erosion STEM Lab Sample Pages

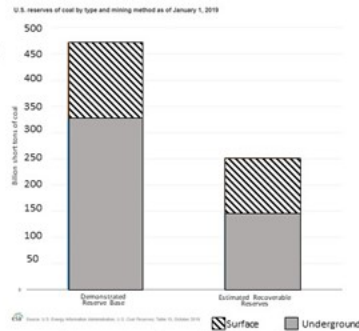


# 6 Extension Pages

Math skills check!  
(great for standardized  
test prep)

## Dimensional Analysis: Coal Mining

The graph to the right shows the amount of coal that is predicted to be remaining in the United States. The first bar (Demonstrated Reserve Base) is the total amount of coal estimated to be remaining underground. The second bar (Estimated Recoverable Reserves) represents the amount of remaining coal able to be mined with today's mining technology and considering accessibility constraints of some mining locations.



1. What percentage of the Demonstrated Reserve Base is actually able to be removed?
2. Notice the amounts of remaining coal that are available on the surface and underground. What percentage of the Estimated Recoverable Reserves is available near the surface?
3. If the United States consumes .76 billion short tons of coal per year, how long will the Estimated Recoverable Reserves last?

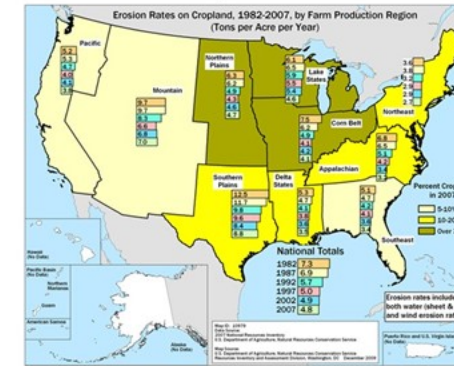
## Digging Deeper: The Mining Process

In mining, an ore is extracted from the ground and refined for practical use. An ore is simply a natural rock or sediment that contains valuable minerals.

Although the mining process varies slightly depending on the type of mineral being extracted, the process does have some common steps:

1. **Prospecting/Surveying**- Geologists determine the availability of an ore or mineral underground through digging or electronically surveying an area.
2. **Exploration**- Core samples are drilled to examine the size and value of the mineral deposits.
3. **Design/Planning**- The mine site is evaluated to determine the safety and economic value of mine construction, as well as the expected environmental impacts.
4. **Development**- Mining rights are purchased, roads are constructed, power is supplied and the path to extract the mineral is established. Depending on the location of the deposit, rock and soil may be scraped from the surface or may be dug from deeper underground. These two methods are known as **surface mining** and **subsurface (underground) mining**.
5. **Production**- This is the actual process of excavation. It also involves the extraction of the valuable materials (minerals or

## Data Analysis: Soil Erosion



1. Which region had the greatest decrease in soil erosion from 1982 to 2007? What was the decrease (in % reduction)?
2. Which region do you think had the greatest impact on the National Totals between 1982 and 2007? Why?
3. In which regions would you expect water to be the primary source of erosion? In which regions would you expect wind to be the primary source of erosion? Explain how you decided this.

## Digging Deeper: Saving the Soil

Farmers rely on healthy soil to grow their crops. Soil erosion is more than just an inconvenience to them- it can reduce crop yields, drive up costs, and damage water quality. Many farmers have taken measures to minimize soil erosion, so it doesn't negatively affect their operations and profits. Below, you'll see some techniques used by farmers to prevent soil erosion in their fields.

1. **Crop Rotation**: High-residue crops leave behind a lot of plant material after the crop has been harvested. By incorporating these crops on a regular cycle, levels of organic matter in the soil are improved and less soil is exposed for erosion.
2. **No-till planting**: Tilling involves turning over the top layer of soil before planting new crops- often by machinery. This loosens plant roots and soil structure causing erosion and reducing soil porosity. By planting new seeds without tilling, erosion is reduced, and beneficial nutrients and microorganisms remain undisturbed.
3. **Contour and Terrace Farming**: Slopes increase water erosion. When planting on a slope, farmers can plant horizontally around hills rather than up and down the slope (contour farming). Cutting flat step-like fields into a series can also reduce water runoff (terrace farming).
4. **Planting Grass**: Grass can help stabilize wet areas and bind soil to prevent erosion.
5. **Wind Breaks**: Planting a row or two of larger trees or shrubs between fields can reduce wind speeds and decrease soil erosion from wind. They can also keep snow from blowing away, allowing for a natural water source as the snow melts in the springtime.

**Critical Thinking:** Choose one of the techniques above. Explain what costs it may have for the farmer and 2 ways the farmer will benefit from the technique.

## Digging Deeper: The Smell of Soil

*Streptomyces* is a bacterial genus including over 500 species. It is a primary cause of organic decomposition within topsoil. *Streptomyces* is filamentous and produces spores, making it similar in structure to fungi. As a spore germinates, it grows a mycelium which serves as a food source for aerial hyphae. To protect the nutrients of the dying mycelium, the bacteria produces antibiotics within the soil. These antibiotics have become the source of many well-known antibiotics that are used to treat human bacterial infections today.

In addition to antibiotics, *Streptomyces* produce a secondary metabolite known as **geosmin**, which gives soil its characteristic smell. Although we may enjoy the smell of earth in our yard, the smell is apparently less welcome in our food and water supply. Humans are able to detect extremely small amounts (only 5 parts per trillion!) of geosmin. Even low concentrations within fish and drinking water cause consumers to complain and the quality to be reduced. Freshwater aquaculture companies regularly test for geosmin levels to prevent the loss of profits.

Camels have a pretty good sense of smell for geosmin, too. Wild Bactrian camels of the Gobi desert are reputed to be able to find water up to 50 miles away. Scientists now believe that the camels can detect the smell of *Streptomyces* within damp ground, leading them to a possible water source.



Greater depth of knowledge, scientific literacy, & critical thinking

produce geosmin. It is a highly coveted discovery for factories that manufacture antibiotics from *Streptomyces*. How will this discovery help those companies?

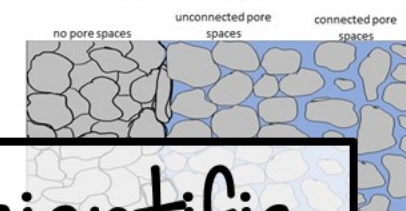
### Fun Fact:

The smell of rain is called "petrichor". It is thought to be caused by geosmin mixed with an oil produced by plants during dry periods.

## Digging Deeper: Porosity v. Permeability

**Groundwater** is water that is found underground. Sometimes when discussing groundwater, we think of large rivers and lakes of water under our feet. Although some groundwater exists in areas like this, most of it is found in the small spaces between particles of rocks and soil.

Porosity and permeability are related properties of any rock or sediment. Both describe the openings within a rock or rock layer. **Porosity** is the rock's ability to hold fluid based on the amount of open space within the rock. **Permeability** is a measure of how easily fluid can flow within a rock or rock layer. A rock with many internal spaces may be porous, but those spaces must be connected in order for the rock to also be permeable.



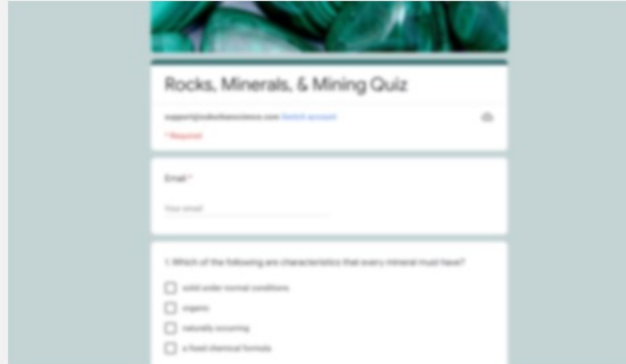
### Discussion Questions:

1. Although clay is the smallest of the soil particles, it is also quite flat (see photo). These flat sheets can hold water because of their large surface area. Knowing that clay soils are some of the most difficult to drain, what can you determine about the porosity and permeability of clay soils?
2. You've decided to dig a shallow hole to obtain groundwater because the area has high porosity. Why would you also want the soil in that location to have LOW permeability?
3. Some individuals in areas with high clay soils are known to spread sand in their yards. What property would they expect to be improved by this?

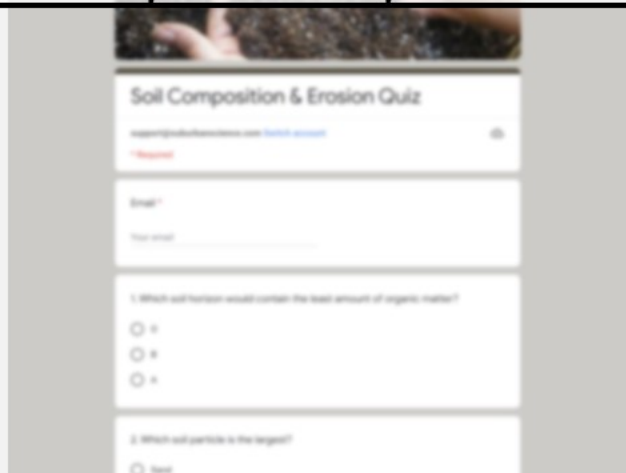


# Assessment

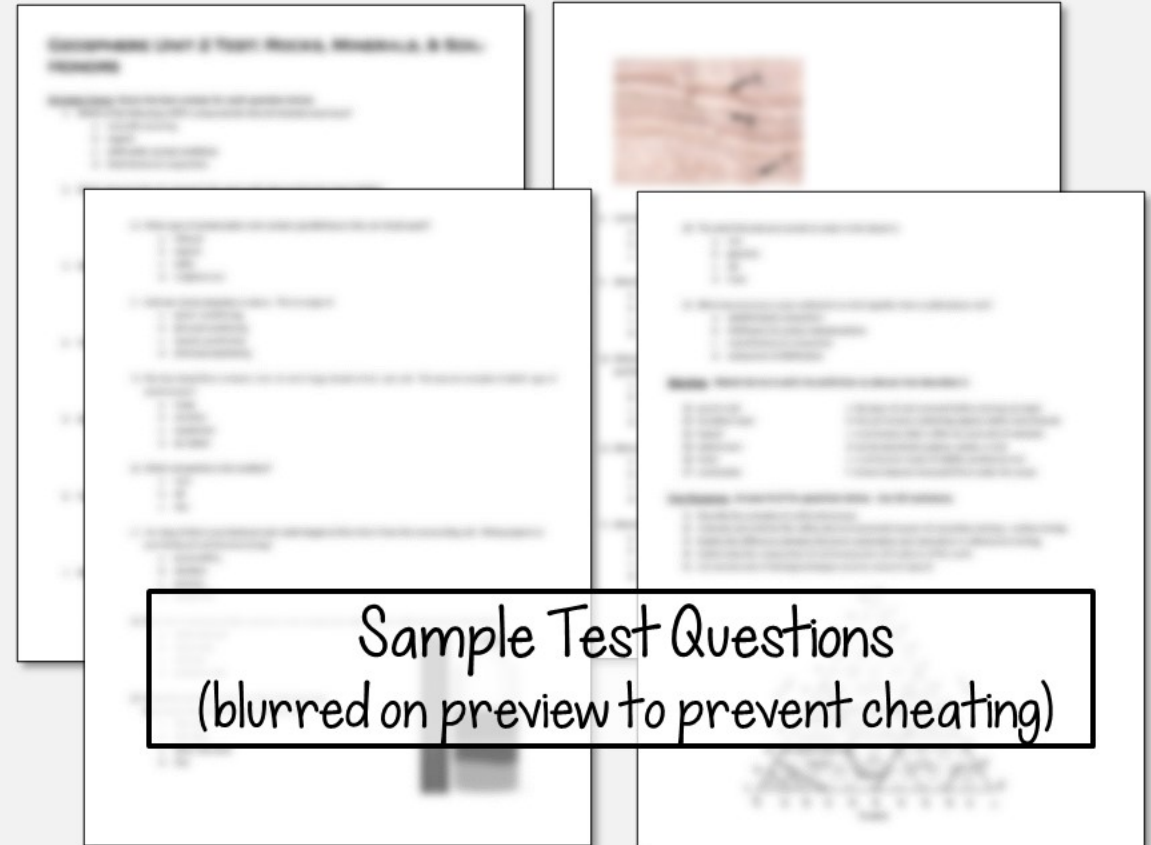
## Editable Online Quiz through Google Forms



Sample Quiz Questions  
(blurred on preview to prevent cheating)



- 25 multi-part questions
- Fully editable
- Answer key included for automatic grading



Sample Test Questions  
(blurred on preview to prevent cheating)

- 21 multiple-choice questions
- 6 matching questions
- 5 free response questions
- Both Honors & Regular versions included with answer keys



# I'd love to hear from you!

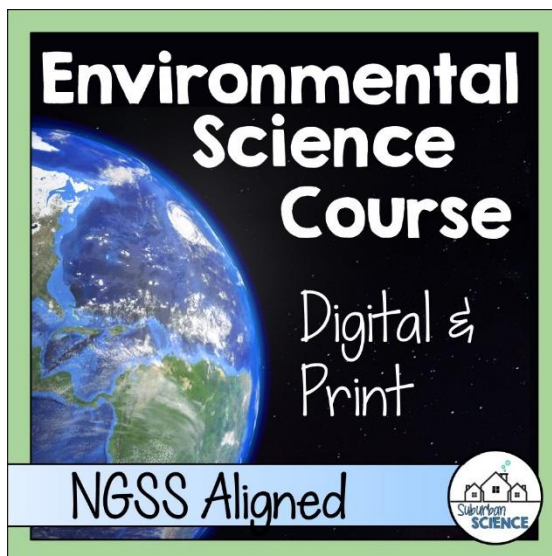
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You can also follow me on TpT or social media:



Sincerely,  
Anne from Suburban Science

