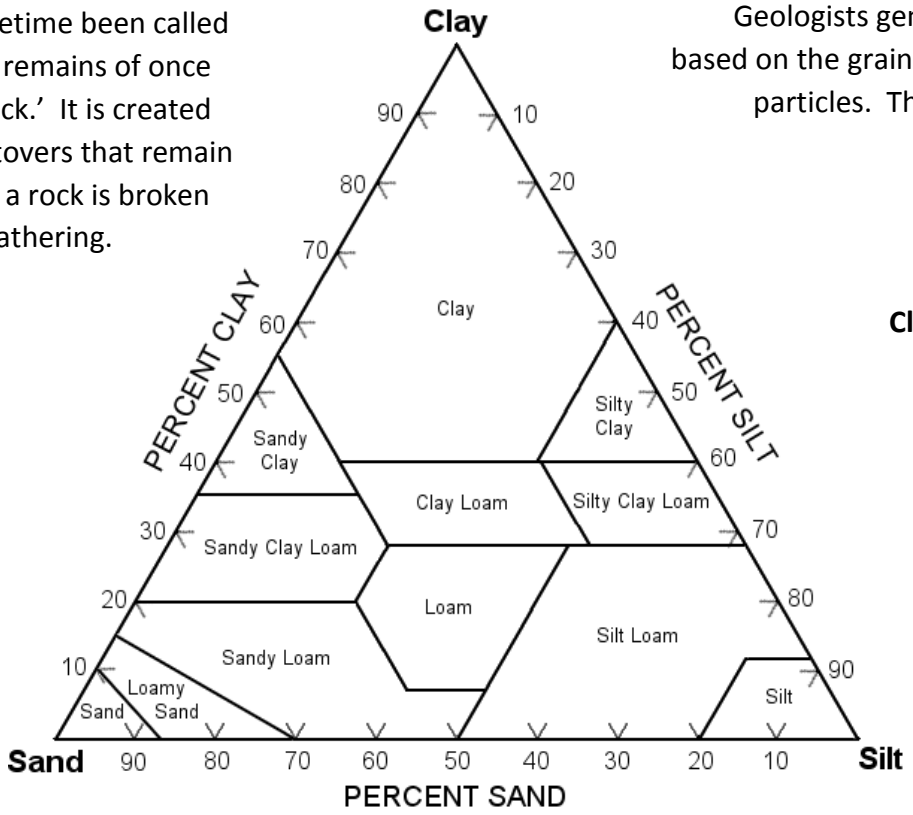
Soils, Drainage and Runoff

Goal 1: Classify soils by grain size

Watch this video first to learn how to use plot soil components on a ternary diagram:

https://www.youtube.com/watch?v=y4xndouxWPY

Soil has sometime been called 'the humble remains of once proud bedrock.' It is created from the leftovers that remain behind after a rock is broken down by weathering.



Geologists generally classify soil based on the grain size of its mineral particles. These fall into three categories:

Sand: gritty

Silt: dusty

Clay: fine and sticky

1. If a soil survey tells you that you have a 'sandy clay loam' on your property, what does your soil have in most abundance: sand, silt or clay?

2. If you send your soil out for a test and find out that it contains 75% silt and 25% clay, what kind of soil do you have?

3. Pure **loam** is considered to be the best kind of soil for a farm or garden and is often defined as a soil with roughly equal proportions of sand, silt, and clay. Is that what the diagram shows?

Goal 2: Run soil drainage experiments

This set of questions uses the website located at this address:
http://www.glencoe.com/sites/common_assets/science/virtual_labs/CT02/CT02.html

In this lab, you will simulate the soil type by moving the sliding bars in the "Soil Meter" to the left or right. The name of the soil will appear as you move the bars. Once you have your soil composition set, click test soil and wait as soil will be poured into your funnel. Then click "pour water" and wait until 1 one drop of water falls into your beaker. Record the percentages of each soil component and the total amount of water (ml) that had to be added before any water was able to drain through the soil.

Soil Type	Percentages			Amount of water needed to drain
	Sand	Silt	Clay	
Heavy Clay	--	--	100%	
Silty Clay				
Silty Clay Loam				
Silt	--	100%	--	
Silt Loam				
Loam				
Sandy Loam				
Loamy Sand				
Sand	100%	--	--	

Answer the following questions based on your virtual experiments:

1. Which type of soil drained the fastest (IE, the least amount of water needed to be added in order for a drip to appear)? Why do you think that soil drained so well?

2. If you were farming on that type of soil, what kinds of problems would you have?

3. Which type of soil drained the slowest (most amount of water needed to be added)?

4. If you were farming on that type of soil, what kinds of problems would you have?

Goal 3: Find out how soils react to rainfall

The United States Department of Agriculture (USDA) classifies soils in a different way than geologists do – by looking at how well they hold water or let it drain out after a rainfall event. Farmers need to know whether their soils will need constant irrigation during dry spells or, on the other extreme, if they will become waterlogged and cause crops to rot after a lot of rain.

The following table shows how the USDA groups soils by their water retention behavior.

Hydrological Soil Group	**Geologic Soil Types based on grain size**	**When it rains, what happens to the water?**		
		Infiltration	**Drainage**	**Runoff**
Group A	Sand, loamy sand, sandy loam	High	High	Low
Group B	Silt loam, loam, silt	Moderate	Moderate	Moderate
Group C	Sandy clay loam	Low	Moderate	High
Group D	Clay loam, silty clay loam, sandy clay, silty clay, clay	Low	Low	High

1. Color all the members of Soil Group A in yellow on the previous page. How will these soils react to a heavy rainfall? Is this good for farmers?

2. Color all the members of Soil Group B in green. Explain why the hydrologic characteristics of this group help to make loam the perfect farming soil.

3. Color all the members of Soil Groups C and D in red. Why are these soils dangerous after a heavy rainfall?

4. If you start a farm on a clay loam soil, will you need to irrigate your crops? Why or why not?

Goal 4: Discover the soils we live on

1. Use your smart phone's web-browser, or the work-tablet, to load up the **Soil Web** site:

   http://casoilresource.lawr.ucdavis.edu/gmap/

2. Click on the menu in the upper left, then choose "Zoom to Location" and put in IUP's zip code (15705). When the map loads up, click on the soil under the IUP stadium (ErB).

3. Click on the name with the highest percentage, which should be Earnest. Answer the following questions by clicking on the Soil Profiles and Hydraulic and Erosion Ratings links:

How organic-rich is the topsoil here? (click on it to see a graph with percentage or organic matter)	
What does this soil have more of: clay or sand? Or are they about equal (click on each component and compare the two graphs)	
What hydrologic groups (A, B, C or D) does this soil belong to?	
Is there a risk of flash flooding for structures built on this soil?	
Click on the pH and find out if this soil is acid (below 7), neutral (exactly 7) or alkaline (above 7).	
If you wanted to farm or garden on this soil, what should you add? (Adding lime makes soil more alkaline, adding peat moss makes it more acid and mushroom manure makes it more organic-rich.)	

NOTE: these questions can be adapted to any locality where this exercise is used, to help students understand the variety of soils that exist around them.

4. Click on the band of soil that runs along Marsh Creek beside the stadium (HoA). The name with the highest percentage should be Holly. Answer the following questions by clicking on the Soil Profiles and Hydraulic and Erosion Ratings links:

How organic-rich is the topsoil here? (click on it to see a graph with percentage or organic matter)	
What does this soil have more of: clay or sand? Or are they about equal (click on each component and compare the two graphs)	
What hydrologic groups (A, B, C or D) does this soil belong to?	
Is there a risk of flash flooding for structures built on this soil?	
Click on the pH and find out if this soil is acid (below 7), neutral (exactly 7) or alkaline (above 7).	
Would this be a better soil to farm or garden on than Earnest soil is? Why or why not?	

5. Now, let's check out a soil in the bread-basket state of Kansas. Close the IUP soil map and put in the zip code 66616 (Topeka, Kansas). The soil map here shows numbers instead of names – click on 7214 and choose the Eudora soil to fill in the chart.

How organic-rich is the topsoil here? (click on it to see a graph with percentage or organic matter)	
What does this soil have more of: clay or sand? Or are they about equal (click on each component and compare the two graphs)	
What hydrologic groups (A, B, C or D) does this soil belong to?	
Is there a risk of flash flooding for structures built on this soil?	
Click on the pH and find out if this soil is acid (below 7), neutral (exactly 7) or alkaline (above 7).	
Explain why soils like this make Kansas such a good place to farm.	

6. Now it's time to put your own zip code into the Soil Web site! Zoom in to find your house and click near it. (Ignore the Urban Land category) What is the name of the main soil near you?

Use the Soil Profiles and Hydraulic and Erosion Ratings to answer the following questions:

How organic-rich is the topsoil here? (click on it to see a graph with percentage or organic matter)	
What does this soil have more of: clay or sand? Or are they about equal (click on each component and compare the two graphs)	
What hydrologic groups (A, B, C or D) does this soil belong to?	
Is there a risk of flash flooding for structures built on this soil?	
Click on the pH and find out if this soil is acid (below 7), neutral (exactly 7) or alkaline (above 7).	
If you wanted to garden in your backyard soil, what should you add? (Remember: lime makes soil more alkaline, peat moss makes it more acid and mushroom manure makes it more organic-rich.)	