



## Soil Formation & Edible Horizons

### Description:

In this hands-on fun activity, students learn what a soil profile looks like and the composition of soil. Students are introduced to the five soil forming factors and soil horizons.

### Background:

All soil is made up of solid materials (sand, silt, clay) and organic matter, just in different quantities depending on their location and CLORPT factors. CLORPT stands for Climate, Organisms, Parent material, Time and Topography. These five soil factors affect all of the soils on the planet.

### Part I: Soil Horizons Forming in the Blink of an Eye

Soil horizons form over hundreds, thousands and even millions of years. It is a process we can see *after* it has happened, but not in action. This demonstration will help show students how horizons are formed – a sort of time-lapse soil horizons.

- 1) Explain to students: *Before* soil horizons form they start as a mix or jumble of solid and organic materials. Volcanic eruptions or floods are examples of these mixing events. A mass of similarly mixed materials are spewed out and with the passage of time, and the effects of climate, organisms, parent material, time and topography (CLORPT), soil horizons are formed.
- 2) Combine the salad dressing spice mix, oil and vinegar in a clear jar.
- 3) Vigorously stir the salad dressing and watch the dressing mix up. This is equal to a volcanic eruption or flooding event.
- 4) Place the dressing where everyone can see it settle out.
- 5) Using a watch, announce the passing of every 30 seconds to the students and have them observe and record what is happening at each interval on their Soil Formation & Edible Horizons Worksheet. Each 30 seconds is equal to approximately 100 years of actual soil horizon forming. As the dressing settles out it will show “virtual” soil horizons forming.
- 6) Explain to students that the ingredients in the jar represent the horizons in soil. The spices are the parent materials, the lightest layer is top soil, etc.

### Part II: Student Gallery Walk

1) Using the Soil Information Cards, stage the room with cards hung on the wall in sequential order. There are two different sets of cards the first 1-9 describe the soil horizons and their composition the second set 1-8 describe the soil forming factors in detail (CLORPT), the first three cards in each set are identical to provide some background information.



**Grade Level:** 5-12

**Essential Skills:** 1, 2, 3, 4, 9

**NGSS:** 5-ESS2-1, 5-ESS3-1, 5-PS1-3, MS-ESS2-4, MS-PS3-5

**CCSS:** RI.5.7, RST.6-8.3, W.5.9, WHST.6-8.7, SL.5.5

**Social Sciences:** 5.7, 6.12, 7.8, HS.14

**Time:** 1 class period

### Materials:

#### Part I: Soil Horizons Formation

- 1 Italian salad dressing spice packet
- 1 cup oil
- 1 cup vinegar
- 1 clear jar
- Watch with a second hand
- Soil Formation & Edible Horizons Worksheet

#### Part II: Gallery Walk

- Soil Information Cards

#### Part III: Edible Soil (per pair of students)

- 1 Ziploc bag with 4 chocolate cookies
- 1 Ziploc bag with 2 chocolate graham crackers
- 1 Chocolate pudding cup
- 1 Vanilla pudding cup
- 2 Clear plastic cups
- 1 paper cup with 1/3 cup of chocolate chips
- marker
- Spoons
- Gummy Worms

- 2) Have students partner up, one partner will go to the soil horizon information cards and the other will go to the soil formation factors cards. Depending on class size you may want to have two sets of each of the cards.
- 3) Students should fill in their Soil Formation & Edible Horizon worksheet with the information they read on the cards. Once they have completed their set of cards and notes, they should meet with their partner and share what they learned, taking notes on their partner's card sets.
- 4) Once students have collected all of the information, have them answer the review questions in preparation for the classroom discussion.

### **Review Questions:**

- 1) Explain how some horizons support plant growth better than others and how the color of the soil signifies the nutrient availability within the soil.
- 2) When looking at a soil profile, how do you distinguish horizons from one another?

### **Part III: Edible Soil Horizons**

- 1) Working in partners, one student from each partner group should collect the supplies from you. Make sure to remind students that they may not start eating their Soil Horizons cup until you have approved their work.
- 2) Provide each set of students with: 1 ziploc containing 4 chocolate cookies, 1 ziploc with 2 graham crackers, one chocolate pudding cup, one vanilla pudding cup, 2 clear plastic cups and one paper cup with 1/3 cup of chocolate chips. (Older students can read through the directions on their worksheet to complete the activity, younger grades may have to do the activity as a class one task at a time.)
- 3) When all students have the supplies, have each partner grab one of the ziploc bags containing food items, the partner with the chocolate cookies will want to break up the cookies into large chunks by squeezing them in the bag. The partner with the graham crackers will want to break it up into tiny pieces by squeezing them in the bag.
- 4) Next, each student will grab one of the clear plastic cups, this will hold their soil profile. Make sure to instruct students not to mix up their ingredients as they are placing each item in the cup.
- 5) In the bottom of the cup, each partner group will divide the chunks of chocolate cookies from the ziploc bag and place them in their cup.
- 6) Then, divide the chocolate chips that you have in the paper cup amongst your cups.
- 7) The vanilla pudding will be next, divide the pudding cup evenly between you and your partner and place in your cup.
- 8) Add the chocolate pudding next, dividing it up the same way you did with the vanilla.
- 9) Then, divide up the crushed graham cracker and add it to the top.
- 10) Now, using what you know about soil layers, label each layer with the horizon it represents in order. Also, provide labels such as top soil, subsoil, parent material, etc.
- 11) Have students raise their hand once their soil profile is complete with labeling for approval from you to eat it.
- 12) Review each soil profile and provide students with a couple of organisms (gummy worms) and a spoon for their soil! Enjoy your soil profile!



## Soil Formation & Edible Horizons

Student Name: \_\_\_\_\_

All soil is made up of solid materials (sand, silt, clay) and organic matter, just in different quantities depending on their location and CLORPT factors. CLORPT stands for Climate, Organisms, Parent material, Time and Topography. These five soil factors affect all the soils on the planet. Soil horizons form over hundreds, thousands and even millions of years. It is a process we can see *after* it has happened, but not in action.

### Part I: Soil Horizons Forming in the Blink of an Eye

Observe and record what's happening to the salad dressing mixture as it settles out, your teacher will announce the passing of 30 seconds. Every 30 seconds describe in words or by drawing a picture what is happening in the chart below. Each 30 seconds is equivalent to approximately 100 years of soil horizon formation, calculate the equivalent amount of years at each 30 seconds during your observation.

Time	Observation
30 seconds What is the equivalent in years? _____	
1 minute What is the equivalent in years? _____	
1 minute, 30 seconds What is the equivalent in years? _____	
2 minutes What is the equivalent in years? _____	
2 minutes, 30 seconds What is the equivalent in years? _____	
3 minutes What is the equivalent in years? _____	
3 minutes, 30 seconds What is the equivalent in years? _____	
4 minutes What is the equivalent in years? _____	
4 minutes, 30 seconds What is the equivalent in years? _____	
5 minutes What is the equivalent in years? _____	

## Part II: Gallery Walk

1) Find a partner who will work with you on the remaining parts of this project.

2) There are two different sets of Soil Information Cards that are hung on the wall in sequential order. One set of cards describe the soil horizons and their composition, the second set describes the soil forming factors in detail (CLORPT). The first three cards in each set are identical to provide some background information.

3) One partner will go to the soil horizon information cards and the other will go to the soil formation factors cards.

4) As you read through the cards be sure to record the information below. Once you have completed taking notes on your set of cards, work with your partner to exchange the information that each of you recorded from your different topics. During the exchange of information, each partner should be describing what they learned from their sets of cards, not just having their partner copy what they wrote down.

### General Questions (Cards 1-3)

1) What is soil?

2) What is a soil horizon?

3) What is a soil profile?

### Soil Formation Cards

1) How does soil form?

<b>Soil Forming Factor</b>	<b>Description</b>
CL- Climate	
OR-Organisms	
P-Parent Material	
T- Topography	
T-Time	

## Soil Horizon Cards



Horizon Name	Description
O	
A	
E	
B	
C	
R	

*Fig.1 Huddleston, J., & Kling, G. F. (1996). Manual for Judging Oregon Soils (6th ed., p. 9). Corvallis, OR: Oregon State Extension Service.*

### **Review Questions:**

Complete the following questions to review concepts learned in today's lesson.

- 1) Explain how some horizons support plant growth better than others and how the color of the soil signifies the nutrient availability within the soil.
  
- 2) When looking at a soil profile, how do you distinguish horizons from one another?
  
- 3) With your partner, develop a mnemonic device to remember the order of the soil horizons (CLORPT is an example of a mnemonic device). Write down your mnemonic device and be prepared to share with the class.

### Part III: Edible Soil Horizons

1) Working in partners, one student from each partner group should collect the supplies from the teacher. You should have the following supplies:

- 1 Ziploc bag with 4 chocolate cookies
- 1 Ziploc bag with 2 chocolate graham crackers
- 1 Chocolate pudding cup
- 1 Vanilla pudding cup
- 2 Clear plastic cups
- 1 paper cup with 1/3 cup of chocolate chips

2) Each partner grab one of the ziploc bags containing food items, the partner with the chocolate cookies will want to break up the cookies into large chunks by squeezing them in the bag. The partner with the graham crackers will want to break it up into tiny pieces by squeezing them in the bag.

4) Next, grab one of the clear plastic cups, this will hold your soil profile. **Don't mix up the ingredients until your teacher approves the cup at the end of the activity when you can eat it.**

5) In the bottom of the cup, divide the chunks of chocolate cookies between you and your partner and place them in your cup.

6) Then, divide the chocolate chips that you have in the paper cup amongst each of your cups.

7) The vanilla pudding will be next, divide the pudding cup evenly between you and your partner and place it in your cup.

8) Add the chocolate pudding next, dividing it up the same way you did before with the vanilla.

9) Then, divide up the crushed graham cracker and add it to the top.

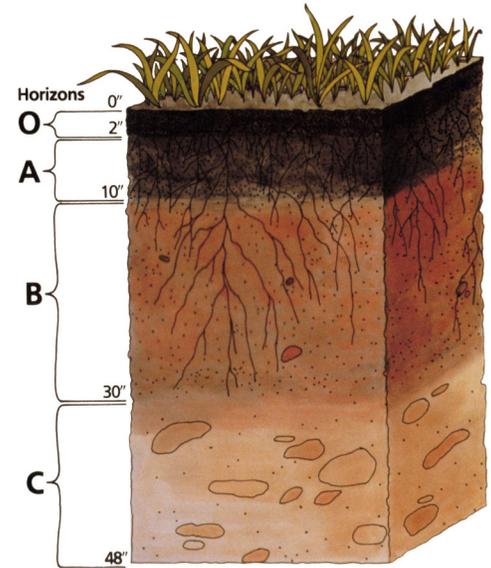
10) Now, using what you know about soil layers, without your worksheet, label each layer with the horizon it represents in order. Also, provide labels such as top soil, subsoil, parent material, etc.

11) Once your soil profile is complete with labeling done, raise your hand for approval from your teacher.

12) Your teacher will review the soil profile and provide you with a couple of organisms(gummy worms) for your soil and a spoon! Enjoy your soil profile!

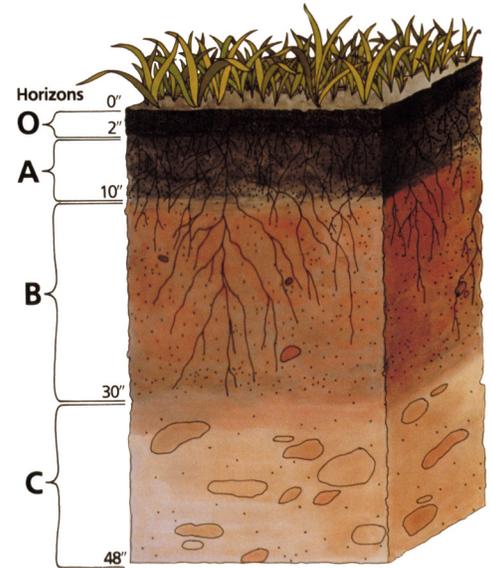
## ***A Horizon- Surface Layer***

The A horizon is often called the top soil. This layer is where most of the organic matter is found (i.e. worms, bugs, plant growth, microscopic organisms, dead organisms, decaying plants). Top soil is the darkest colored and most fertile layer of soil. The depth of this horizon can be a few inches in dry soils or more than 20 in the Willamette Valley. This is the layer of soil where gardeners and farmers plant gardens and crops which provide an idea environment for the growth of roots.



## ***O Horizon- Organic***

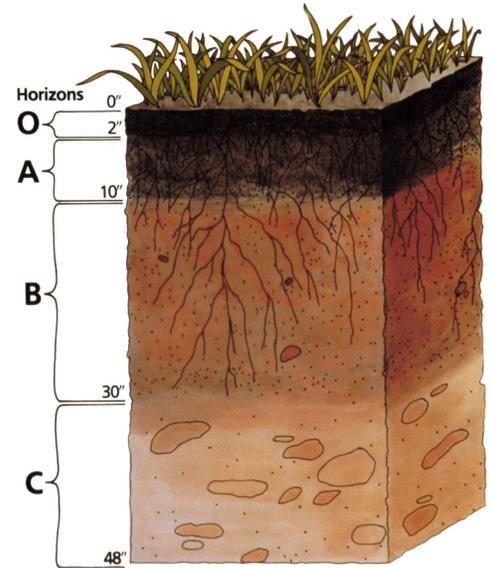
The O horizon is made up of nearly 100 percent of organic material consisting of decaying leaves, twigs, or peat. O horizons usually appear in forest soils or in wet bog and swamp soils such as in Lake Labish, Waldo Lake and Lower Klamath Lake. There are very few Oregon agricultural lands that have an O horizon.



## ***E Horizon- Eluviation Layer***

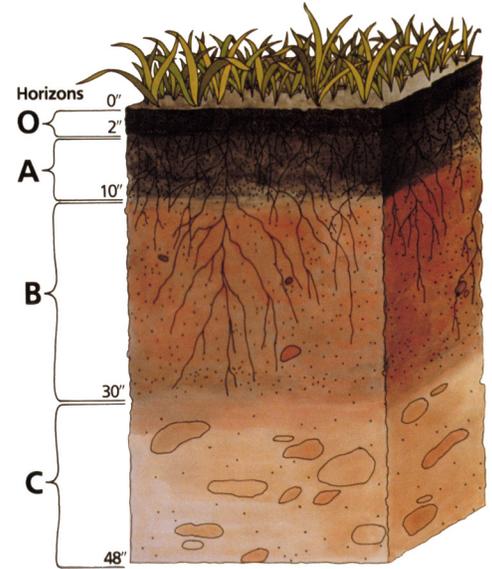
The E horizon appears light gray or white due to the leaching of iron and organic material. When present, the E horizon is below the O horizon or the A horizon.

E horizons appear in many of the sandy soils on Oregon's coast and in some wet silty soils.



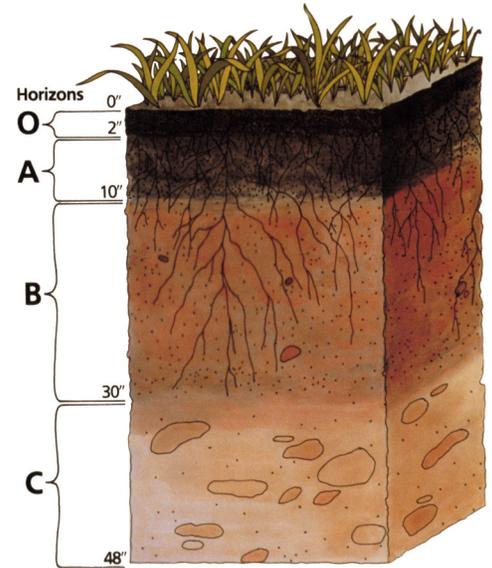
## ***B Horizon- Subsoil***

The B horizon is usually yellowish brown or reddish brown in color and doesn't contain as much organic matter. This layer contains clay, nitrogen, minerals and salts which have leached from the surface layer. Although it can be rich in minerals, this layer isn't good for growing plants because it lacks organic matter.



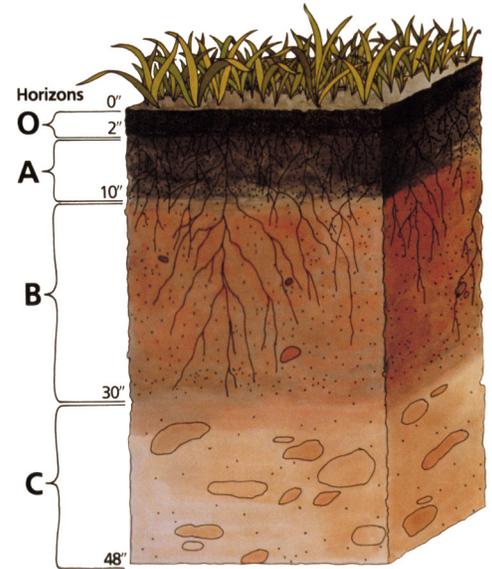
## ***C Horizon- Parent Material or Regolith***

The C Horizon is the substratum layer and has less change than the layers above it. This layer has large deposits of sand, gravel pebbles, rocks, and even boulders. This layer would support very little plant growth.



## ***R Horizon- Bedrock***

The R horizon is 100 percent made up of rock fragments that you cannot dig into because of the coarse structure.



# ***What is Soil?***

“A living, dynamic system at the interface between air and rock. Soil forms in response to forces of climate and organisms that act on parent material in a specific landscape over a long period of time.”



*Huddleston, J., & Kling, G. F. (1996). Manual for Judging Oregon Soils (6th ed., p. 3). Corvallis, OR: Oregon State Extension Service.*



# *How does Soil form?*

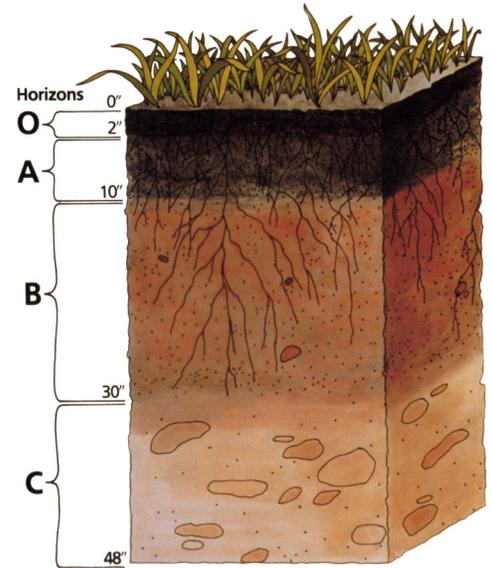
There are five soil forming factors that play an important part in determining the type of soil that can be found in an area. We use the word CLORPT to help us remember them!

CL-Climate

OR- Organisms

P- Parent Material

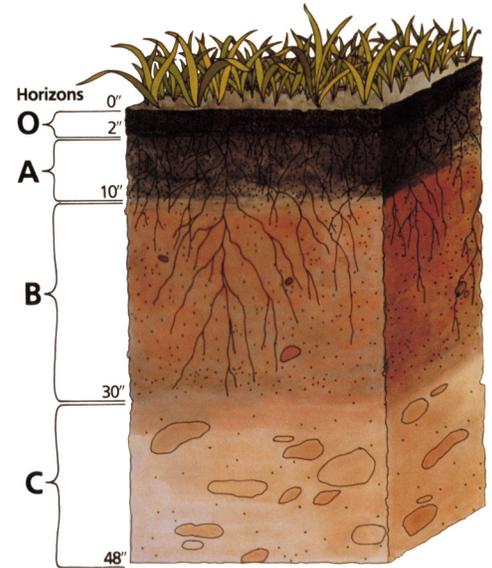
T-Time and Topography



## ***A Soil Profile is.....***

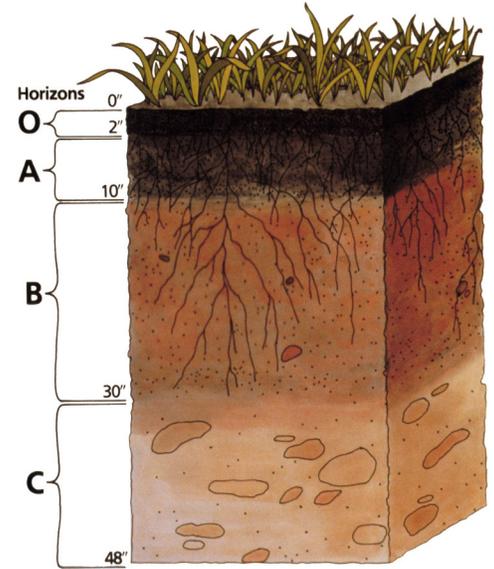
A vertical view of the soil that displays the divided layers or horizons. Soil profiles tell the stories about the area and are different from place to place.

*(See example of soil profile in picture on the right)*



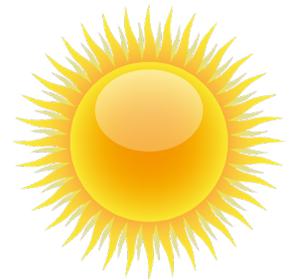
## ***What is a Soil Horizon?***

A layer of soil that forms from physical, chemical and biological properties resulting from soil forming processes. Each is distinguishable by certain characteristics which you will learn more about as you read each horizon card. You can see the horizons labeled in the picture to the right as O, A, B and C.



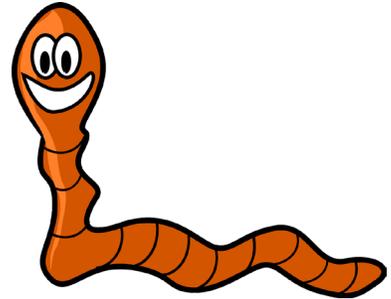
## ***CLORPT- Climate***

Temperature and rainfall affects the color of the soil, acidity levels and presence of organic matter. Leaching or the removal of soil materials occurs during high rainfall by water that is flowing through the soil. In Western Oregon, lime is completely leached out of the soil but in Eastern Oregon due to low rainfall soils still have lime present. Soils in climates that are warm and moist have lots of organic matter and support plant growth, opposite of hot and dry climates.



# ***CLORPT-Organisms***

Organisms in the soils such as plants and animals play an important role in increasing organic matter and humus in the soil providing nutrients to the soil. Roots on plants help to mix soil particles and break up large rocks in the soil providing channels for movement of water and air. The foliage of the plant decays and adds organic matter to the soil. Animals within the soil such as earthworms, insects and burrowing animals help in continued mixing of the soil and carries plant debris down to the topsoil.



## ***CLORPT- Parent Material***

Parent material is weathered geological matter that has formed the soil that we see. Most parent material are a type of bedrock such as sandstone or basalt. Sediments that are translocated by water, wind or ice such as volcanic ash, lake laid silts, dune sand, and glacial gravels are other parent material types.



## ***CLORPT- Time and Topography***

Young soils share similar characteristics and properties as their parent matter. As soil get older the inherited properties become less and less evident as new characteristics are forming.

The position of the landscape causes soils to change in moisture, temperature, and parent material. Slopes can cause collection of water at the bottom and have little to no collection at the top. The bottom of the slope can also collect transported materials that the top of the slop may not. Directional slopes can also have different temperatures, a north facing slope could be cooler than a south facing slope.



# ***What is Soil?***

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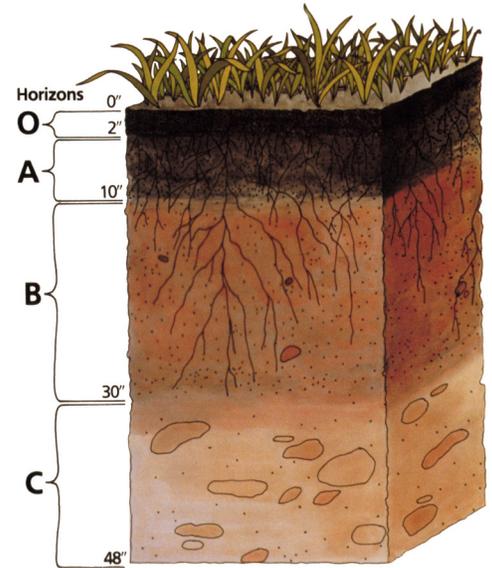


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## ***What is a Soil Horizon?***

A layer of soil that forms from physical, chemical and biological properties resulting from soil forming processes. Each is distinguishable by certain characteristics which you will learn more about as you read each horizon card. You can see the horizons labeled in the picture to the right as O, A, B and C.



## ***A Soil Profile is.....***

A vertical view of the soil that displays the divided layers or horizons. Soil profiles tell the stories about the area and are different from place to place.

*(See example of soil profile in picture on the right)*

