



# APES in a BOX: The Review Sessions

## **Agriculture and Food Resources**

### **Soil and Agriculture**

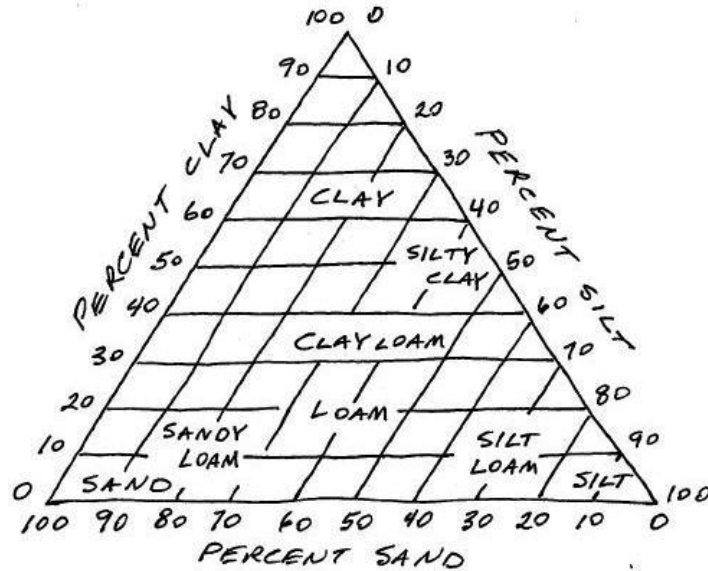
Throughout most of our relatively short human history, we have survived as **hunter-gatherers**. Approximately 10,000-12,000 years ago, we began to practice early forms of agriculture. This was the beginning of the **Agricultural Revolution**. Humans began to increase food production through advanced cultivation techniques and selective breeding. Throughout most of the agricultural revolution, humans have practiced subsistence farming. This mainly involved family farms that existed for the purpose of feeding the family. Subsistence farmers may also sell, or barter, surplus crops. During the **Industrial Revolution** fossil fuels and machinery were applied in the pursuit of expanding world food production. These advances marked the beginning of the end for family farms. It became much more cost effective to produce food on large farms using these modern farming techniques. The **Green Revolution**, beginning in the 1940s, saw an even greater increase in food production with genetically altered crops, improved fertilizers, pesticides, and cultivation techniques. We are currently enjoying the successes of the Green Revolution, and trying to figure out how to deal with the negative impacts of it. There appears to be a resurgence of interest in more traditional farming techniques and organic farming. The challenge for the future will be to meet the increasing demand for food while practicing environmentally sustainable agriculture.

With the history lesson out of the way, let's take a quick look at what makes agriculture tick. Soil is often underappreciated. But it serves as the anchor and nutrient source for the plants that feed us, give us oxygen, and help to filter our land and water. Soil is composed of both inorganic and organic components. The particles that make up soil in order of decreasing size are: gravel, sand, silt, or clay.

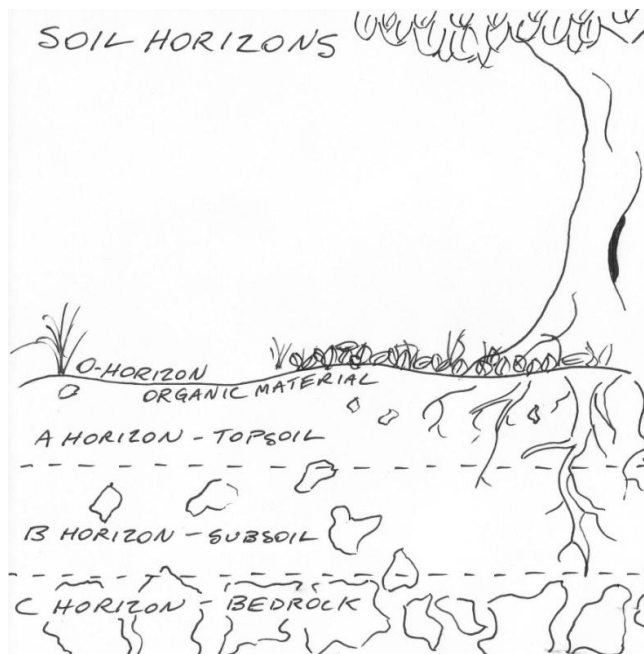


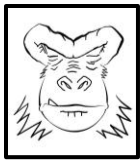
# APES in a BOX: The Review Sessions

In the **Soil Triangle** below, see how the ratio of sand, silt, and clay determines the type of soil.



The organic portion of soil includes living organisms and humus. Humus is partially decomposed organic material. Some of the living organisms that can be found in soil include plants, nematodes, arthropods, fungi, bacteria, annelids, and gastropods. In the diagram below, you can see the different layers of soil that can generally be found.





# APES in a BOX: The Review Sessions

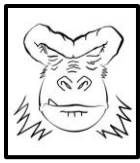
## Soil Degradation

Soil quality can be degraded by erosion, salinization, intensive agriculture, overgrazing, and development. Generally speaking, any activity that removes natural plant cover can result in soil degradation.

**Soil erosion** is simply the movement of soil from one place to another by wind or water. Erosion can be very costly to Farmer Brown as wind and water can remove precious topsoil from his farm. On the flipside, the soil is carried somewhere. If you happen to live downstream from Farmer Brown, his loss may be your gain if the rich topsoil happens to be **deposited** on your land! Be sure to read about ways to combat erosion in the agriculture section of this book. The main culprit in soil erosion is the removal of plant cover from the land. When plants are removed, the root systems are no longer in place to hold the soil together. Plants also play a crucial role as windbreaks, naturally reducing wind erosion. During the 1930s, drought, overgrazing, and over cultivation in the Southern Great Plains led to the historical period now referred to as the **Dust Bowl**. These conditions led to rapid erosion of topsoil which drastically decreased the productivity of the land and the ability of people to survive in the region.

Soil erosion can lead to major societal problems if it decreases crop yield. Haiti is currently undergoing a food shortage caused primarily by erosion. Years of deforestation have led to decreased plant cover, which has increased erosion. As the rate of erosion has increased, the productivity of Haiti's croplands has decreased. Some residents have resorted to eating a cake made of clay, salt, and lard in order to supplement their diets. Deforestation, overgrazing, and intensive cultivation reduce natural plant cover, and therefore contribute to soil erosion. Soil erosion is the main cause of soil degradation worldwide. Extreme soil erosion is a contributing factor in **desertification**. Desertification is simply the development of desert where there was not one before. Erosion contributes to this process by washing away precious topsoil, making it more difficult for plants to thrive. As fewer plants grow, more soil is washed away.

Soil erosion due to agriculture can be prevented by no-till farming, contour plowing, using shelterbelts, terracing, planting cover crops, and reforestation efforts.



## APES in a BOX: The Review Sessions

**No-till farming** involves the use of special equipment to plant crop seeds directly into untilled soil. This practice drastically reduces the impact of soil erosion as there is very little soil that is disturbed. The process requires an initial investment in new agricultural equipment. No-till farming also requires greater application of herbicides to control weeds that would have otherwise been tilled into the soil.

**Contour Plowing** and planting involves planting crops perpendicular to the slope of the land. This allows each row of plants to serve as a barrier to erosion instead of an alley for erosion.

**Shelterbelts** or windbreaks are trees that are planted around the perimeter of cropland, or even in rows in between crops (**agroforestry**). The trees help to block wind, which prevents wind erosion. The roots of the trees help hold soil in place and further help prevent erosion.

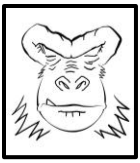
**Terracing** allows farmers to plant crops on steep slopes. Terraces are essentially shelves that are built perpendicular to the slope of the hill. The crops are grown on these shelves, which also serve to trap precious soil as it erodes down the slope.

**Cover Crops** can be planted during the offseason to help hold soil in place. This can include planting a crop that can be sold, and crops, like legumes, that return certain nutrients to the soil.

**Soil Salinization** is another cause of soil degradation. Continual irrigation of land can contribute to soil salinization. When a field is irrigated the water leaves dissolved salts on the surface of the soil. Rapid evaporation can also pull water, and its associated salts, from lower layers to the soil surface. Ultimately, the higher salt levels make it difficult for many plant species to thrive. Potential methods of dealing with salinization include the planting of salt tolerant plants, flushing the soil with water that has a low salt content, or letting the land rest while rainfall flushes out the excess salt. Salinization is a major contributor to crop loss in the United States.

Sometimes soil can be over-irrigated to the point that water in the soil prohibits proper gas exchange in the roots of plants. This condition is called **water-logging** and can result in crop loss.

Soil can be remediated by using organic fertilizers such as compost, **manure**, or **green manure**. This increases the organic material in the soil, decreases soil compaction, and increases the water holding capacity of the soil. All of these things will favor increased plant growth. **Inorganic fertilizers** are frequently used in soil remediation, but actually increase soil compaction, decrease the water holding



# APES in a BOX: The Review Sessions

capacity of soil, and generally only provide nitrogen, potassium, and phosphorus. Inorganic fertilizers are not ideal, but are inexpensive, easy to transport, and have drastically increased the world's food production.

**Genetically modified organisms**, or GMO's, have played a major role in the Green Revolution. GMO technology involves taking beneficial genes from a plant and inserting that beneficial gene into the genome of a crop species. This may include the insertion of genes for drought resistance, pest resistance, the need for less fertilizer, or even genes that produce extra nutritional value in the crop. The potential for GMO's is great as they have led to an increase in food production, particularly in areas that have struggled to produce enough food. They generally grow faster and have higher crop yields. Some suspect that GMO crops may have lower nutritional value, create new food allergens, and lead to the development of new plant toxins. GMO crops definitely lead to lower biodiversity in croplands.

Due to population growth and industrialization of developing countries, deforestation of tropical rainforests is occurring at an alarming rate. **Subsistence agriculture**, where families produce enough food for themselves, accounts for the majority of the destruction. Farmers cut the trees down, burn them, and then plant crops in the ashes. This practice is referred to as **slash-and-burn agriculture**. Commercial logging and cattle-ranching for exports are also threatening the remaining rainforest.

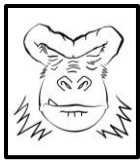
## **Meat production**

Globally the consumption of animal products is on the rise. This includes an increase in the consumption of meat, eggs, and milk. This increased production has required an increase in cropland in order to supply the grain to feed the livestock. A large percentage of meat is produced on large factory farms. On these farms, chickens, pigs, or cattle are often crammed into small spaces where they are fed grain, which requires a significant amount of cropland to grow, and held until they are ready for processing. The main advantage of "factory farming" is the increase in yield and decrease in cost of the animal products that we consume. On a positive note, industrialized meat production has provided high quality protein at reasonable prices to millions of people.

## **Disadvantages of Factory Farms and Feedlots**

Concentrating so many animals in one place can lead to contamination of groundwater when runoff, containing fecal coliform bacteria, reaches the water.

Animal waste can be a great source of fertilizer, but contributes to cultural eutrophication when runoff from feedlots enters lakes and streams.



# APES in a BOX: The Review Sessions

Some techniques that are used to increase yield of meat, such as using antibiotics and hormones, pose potential health risks to consumers.

Some contend that animals, on industrialized farms, are treated poorly prior to processing.

Meat production also poses a resource problem. When we consider the pyramid of energy, and the fact that approximately 90% of energy is lost as heat as you move from one trophic level to the next, we must consider that it is more efficient to eat plant products than animal products. It takes a tremendous amount of grain to produce a small amount of meat. Beef is the most resource-intensive meat while chicken and fish use significantly less grain to produce the same amount of meat.

## **Fisheries and Aquaculture**

Fish and seafood consumption has risen dramatically since the 1950s. As larger percentages of the world's population have developed a taste for seafood, the commercial fishing industry has continually developed new ways to increase its harvest. This has negatively impacted the ocean's fisheries. When a common public resource is exploited it is sometimes referred to as **The Tragedy of the Commons**.

## **Commercial Fishing Techniques**

**Trawling** involves dragging a net across the ocean floor in an effort to catch bottom-dwelling species such as shrimp, flounder, and cod. Unfortunately the net has the potential to destroy just about anything on the ocean floor, including coral reefs, as it is pulled behind the boat. The main problem with trawling is by-catch.

**By-catch** refers to the non-target species that are caught accidentally in the pursuit of the target species. For example, many pounds of crab, fish, and other species are caught, killed, and thrown overboard for every pound of shrimp that reaches the consumer. New technology has produced nets that significantly reduce by-catch by allowing juvenile fish to pass through the nets unharmed.

**Long line fishing** is used to target fish like tuna. The fisherman drags a "long line" with several thousand baited hooks attached to it. Longlines can accidentally snag turtles, and seabirds, as the line is pulled through the ocean.



# APES in a BOX: The Review Sessions

**Driftnetting** is a practice that involves setting large drift nets that can be several miles long. Fish swim into the net and become entangled. However, drift nets can also snag turtles and seabirds.

In **purse-seine fishing**, the fisherman use a large net to scoop up large schools of fish, such as yellow fin tuna, as they feed near the surface. Sometimes a spotter airplane is used to locate the fish for the boat. Dolphins will often swim above schools of tuna, and are inadvertently trapped by the net.

Most of the modern commercial fishing methods can be quite destructive, but the fact remains that we need food and the ocean provides a great deal of it. **Aquaculture**, or fish farming, is one possible way to meet the demand for seafood without many of the negative impacts of the commercial fishing process. Aquaculture involves raising fish, or other seafood, in nets that are either floating in open water, enclosing areas along a coast, or in inland ponds.

## **Advantages of Aquaculture**

Fish farming reduces the pressure that is placed on fisheries by traditional commercial fishing methods.

Aquaculture does not use the vast quantity of fossil fuels that traditional fishing methods use.

Aquaculture produces a great deal of seafood in a small amount of space resulting in higher profits.

## **The Downside of Aquaculture**

When high volumes of fish are concentrated in one area, they are more susceptible to disease. Fish farms produce a high volume of waste, and water pollution, due to the high density of organisms confined to a small space.

Fish farms are often built in coastal areas which can disrupt mangrove forests and important breeding grounds for many species. The destruction of mangroves also makes the coastline vulnerable to hurricanes, tsunamis, and storm surges.

Fish farms often use grain to feed their fish which places further stress on the agricultural system.



# APES in a BOX: The Review Sessions

## Food Resources Review Questions

### Multiple Choice

1. Which of the following are characteristics of hunter-gatherers?

I. Relatively short life-span

II. Highly mobile lifestyle

III. Expert farmers

A) I only

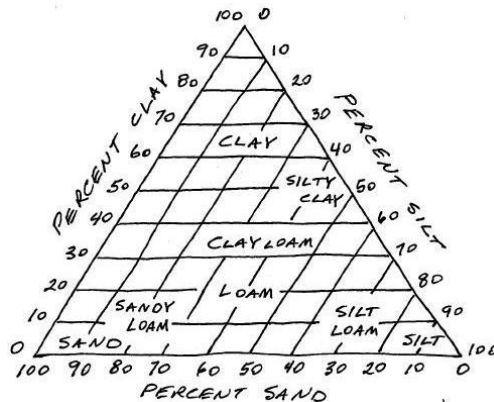
B) II only

C) I and II only

D) I and III only

E) I, II, and III

Use the diagram below to answer question 2



2. What is the name of a soil that is 10% clay, 70% silt, and 20% sand?

A) Clay loam

B) Silt loam

C) Silt

D) Sandy loam

E) Silty clay





## APES in a BOX: The Review Sessions

3. Which of the following is an agricultural practice in which crops are planted on steep slopes to maximize land use, and minimize erosion.

- A) Contour plowing
- B) Terracing
- C) Agroforestry
- D) No-till agriculture
- E) Desertification

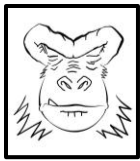
### **Free Response**

1. Over the last 15,000 years human beings have drastically changed the way that we live, eat, and interact with the environment. Throughout this period of time there have been several distinct periods of time or revolutions that have characterized these changes.

A. Identify and describe two major revolutions that humans have gone through during the last 15,000 years.

B. Describe one negative environmental impact and one positive environmental impact of one of the revolutions that you identified in part A.

C. For one of the revolutions identified above, describe one impact that this revolution has had on human health.



# APES in a BOX: The Review Sessions

## Multiple Choice Scoring Guidelines

1. C	3. B	
2. B		

## Free Response Scoring Guidelines

**1.A.(4 points total) 1 point each for correct identification and description of two revolutions.** Possible answers include:

Agricultural Revolution	The development of agriculture including selective breeding and the development of plant cultivation techniques.
Industrial Revolution	Characterized by the development of mass assembly, and the use of fossil fuels to power industry.
Green Revolution	Characterized by the application of machinery, inorganic fertilizers, pesticides, and the genetic modification of crops in agriculture.
Information Revolution	Characterized by globalization, the proliferation of computers and information technology.

**1.B. (2pts total) 1 point each for an accurate description of one positive and one negative environmental impact of one of the revolutions described in part A. The impacts must be linked to the students answer, and must be an environmental impact.**

**1.C. (1pt total) 1 point for a correct description of a human health impact related to one of the revolutions given in part A.**

Multiple choice points earned + Free response points earned/10\*100 = Quiz average

( \_\_\_\_\_ + \_\_\_\_\_ )/10 \* 100= \_\_\_\_\_ Quiz grade