Norfolk Public Schools
Science Learning in Place Plan: Science 7 Lessons

Week 4: April 6 – 10, 2020

Monday	Tuesday	Wednesday	Thursday	Friday
Catastrophic Disturbances Assignments: • **Read** the article entitled, "Disturbance Ecology" ○ **Highlight or Underline** key definitions or phrases in the passage ○ **Research and Record** any words you do not know the definitions (dictionary, online, phone, ask family, etc.)	**Catastrophic Disturbances** Assignments: • **Review** the article entitled, "Disturbance Ecology" • **Answer** the "Disturbance Ecology Analysis Questions"	**Catastrophic Disturbances** Assignments: • **Complete** the first 2 columns KWLS activity ("What I Know" and "What I Want to Know") • **Read** the article entitled, "Surtsey Island, Iceland" • **Complete** the last two columns of the KWLS chart.	**Catastrophic Disturbances** Assignments: • **Review** the two articles assigned this week • **Write** an essay using the articles you read this week to explain to your family what you think the best 3 actions humans can take to protect our natural resources. Support your response with specific details from the text.	**Catastrophic Disturbances** Assignments: • **Review** the two articles assigned this week • **Complete** the "Lesson Review" - answer and justify the four 4 questions.

Week 5: April 13 – 17, 2020

Monday	Tuesday	Wednesday	Thursday	Friday
Spring Break				

Week 6: April 20 – 24, 2020

Monday	Tuesday	Wednesday	Thursday	Friday
Food Production Assignments: • **Read** the article entitled, "Crops and Ecology" ○ **Highlight or Underline** key definitions or phrases in the passage ○ **Research and Record** any words you do not know the definitions (dictionary, online, phone, ask family, etc.)	**Food Production** Assignments: • **Review** the article entitled, "Crops and Ecology" • **Create** a 5-question multiple choice quiz and quiz a member of your family after they read the article. ○ It should include: ▪ 4 answer choices for each question with one right answer ▪ A question for each section of the text	**Food Production** Assignments: • **Read** the article entitled, "Environmental Impacts of Agricultural Change" • **Create** a poster using the information form the passage and your own research to make the public aware of how food is connected to issues in our ecosystem. ○ describe the issue, ○ what causes it, ○ and how to stop it.	**Food Production** Assignments: • **Review** the two articles assigned this week • **Write** a claim to support why someone should read one of the two articles from this week. What makes the text worth reading? What will a reader gain or what might a reader do after reading the text? Support your response with specific details from the text.	**Food Production** Assignments: • **Review** the two articles assigned this week • **Complete** the "Lesson Review" - answer and justify the four 4 questions.

Disturbance Ecology

1 Disturbances

Disturbance are ecosystem processes which affect the composition, structure and function within an ecosystem. Their effects include changes to parent material, soil, hydrology and the destruction of biota all of which than lead to alterations in species composition, structure and ecosystem function. Disturbances also promote changes in the mutualistic and competitive nature between organisms which than influences the rate of vegetation change and therefore succession. Natural disturbances such as fire, insects and diseases and wind have shaped the landscapes and vegetation found in all ecosystems. In addition to the natural disturbance factors which shape our ecosystems, we also must consider the disturbances caused by humans. We will discuss the different types of disturbances as they relate to secondary secession later in this lesson.

2 Disturbance as an Ecosystem Process

The term disturbance will be used here to represent any discrete event in time that disrupts ecosystem composition, structure or function (Barnes et al. 1998). Due to the nature of the disturbance process we often associate it with death and destruction; however we must consider the idea that disturbances are in fact natural events in all ecosystems. As we have mentioned disturbances not only effect individual plants and communities but have effects on the physical site as well (Barnes et al. 1998). Disturbances such as glaciation and volcanism have major influences on site development by creating new landforms and rearranging parent material especially at large scales. On smaller scales wind and fire can change the physical site as well. The point to this is that not only do disturbances have direct effects on plants and plant communities but they also have many indirect effects.

3 Types of Disturbance

Disturbances are often times ecosystem specific. So to best understand the different types of disturbances we must always think in terms of specific ecosystems with which they occur. When we view disturbances in this way we see that the frequency and severity of a disturbance is often closely related to the specific site conditions. There are many disturbance agents throughout the world which interact with each other as well as with the environment and the biota to create disturbance regimes. Although we will discuss several specific types of disturbances you should always remember that there are at any one time several different types of disturbances interacting in various ways.

4 Land Movement

Events such as earthquakes, landslides, and volcanoes are all major disturbance agents which can create new ecosystems with extremely different biota. In many parts of the world landslides have been linked to drastic changes in vegetation. Just like landslides volcanic eruptions are also present in many parts of the world and may be responsible for large scale vegetation changes. Recent events such as the eruption of Mt. St. Helens are one example of how volcanic activity has shaped many ecosystems around the world.

5 Fire

Fire may be one of the most dominate disturbance agents world wide. A large number of forested and non forested ecosystems for example have been burned over at more or less frequent intervals for the last several thousand years. In many of these ecosystems fire plays an important role in reproduction and regeneration, reduction of competition, nutrient cycling and forest succession.

6 Wind

The effects of wind on ecosystems can be found at regional and local scales, from hurricanes which may affect a large portion of the east coast to down bursts which may only affect a few trees in a forested stand. In either case the effects of wind as a disturbance agent can not be ignored.

7 Insects and Disease

Insects and pathogens are major regulators of forest in many ecosystems, each year there are millions of hectors affected by insects and pathogens throughout North America. Although the visual effect of insects and pathogens is less dramatic than that of fire or mass land movements their ability to kill either individual trees or small groups of trees in a forest has a major influence in controlling forest succession. However recent outbreaks of bark beetles and the introduction of invasive pathogens have greatly influenced forest succession on large scales. There ability to have dramatic influences on forest succession is even more pronounced due to the fact that many insects and pathogens attack only one species. Insects and diseases like all other disturbance agents tend to work together this is particularly true with respect to fire, although little information is available about this relationship.

8 Human Disturbances

Human disturbances have probably had the most drastic effects on succession in both forested and non-forested lands. Activities ranging from over grazing, to land clearing and logging have dramatically changed the composition, structure and function of ecosystems around the world. In the western United States fire prevention is one of the most ecologically damaging practices humans have introduced. Other issues such as fragmentation may have greatly disturbed large scale ecosystem processes. Other human caused disturbances include the introduction of non-native species, the elimination of species and climate change. The effects of these and other human caused disturbances has had dramatic effects on ecosystems on both local and landscape scales, and as with global warming the effects on vegetation and secession will be seen across the world.

9 Water

Water quality can decline due chemical contaminants, raw sewage, trash, hear and other waste products from institutional or residential uses. Agriculture can also cause water pollution. Animal waste and fertilizer from farms contain nutrients that can ender ponds and lakes as runoff. An increase in the amount of nutrients, such as nitrates, in aquatic ecosystem is call eutrophication. Algae rely on the excess minerals and it can cause algae to grow and die rapidly. As a result the oxygen in the pond is dissolved. As dissolved oxygen levels decrease, fish begin to die. If eutrophication continues, the pond ecosystem may not recover.

Disturbance Ecology Analysis Questions

1. How does human activity affect climate change?_____
   _____
   _____
2. Why does the increase in human population affect biodiversity? _____
   _____
   _____
3. List and describe three types of biodiversity loss by humans? _____
   _____
   _____

Surtsey Island, Iceland

KWLS (Know-Want-Learn-Still Learn)

Directions: Complete this activity using the article "Surtsey Island, Iceland"

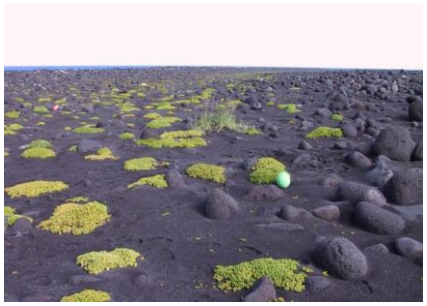
The K-W-L-S strategy provides a structure for organizing information that you know about a topic, noting what you want to know, and listing what has been learned and is yet to be learned.

1. Fold a sheet of paper into four columns. Label the columns K, W, L, and S.
2. Preview the text, surveying the title, section headings, pictures, captions, etc. to familiarize yourself with the topic.
3. In the first column (K), list what you already know or think you know about the topic.
4. In the second column (W), list questions about what you want to know or want to learn from the text.
5. After reading the text, write the answers to your questions in the third column (L).
6. Not all of your questions may be answered in the text. If that happens, state a standard response, i.e., "The text did not provide the answer," or "The reading/graph/diagram did not provide enough information." Use the fourth column (S) to list these items.

KWLS

What I Know	What I Want to Know	What I Learned	What I Still Want to Learn

Surtsey Island, Iceland



In 1963, an underwater volcano erupted off of the southern coast of Iceland. Subsequent eruptions continued for several years, eventually creating a new **volcanic island** that is approximately 500 feet above sea level. As the magma from the eruption cooled and solidified, the new island developed a barren, rocky terrain.

This new island, called Surtsey, was at first lifeless. Plants could not grow on the bare rock, thus limiting habitat for new animals that found their way to the island. One of the first **colonizers** of Surtsey were phytoplankton that sounded the edges of the island. These phytoplankton attracted fish and eventually birds to begin visiting the outskirts of this new land mass found 32 kilometers of the southern coast of Iceland.

Eventually, visiting birds, marine mammals, and wind brought seeds to Surtsey Island. However, without soil, most of these seeds failed to **germinate**. About five years after the formation of the island, organisms called **lichen** and some mosses began to grow on the rocky surface. Lichen are formed from a **symbiotic** relationship between a fungus and an algae. Although lichens are not plants, they are able to produce their own food through photosynthesis. Lichen have root-like filaments that are able to attach to, and break down, bare rock to extract nutrients. Over time, the action of the lichen on Surtsey created a thin layer of soil.

As soil began to accumulate on the island, small grass-like plants started to grow providing some shelter for nesting birds. Additionally, grasses and plants provided habitat for insects, which began to establish themselves after being brought to the island through the action of waves, wind, and birds. As the small plants and lichen died and **decomposed**, the amount and quality of the soil on the island began to increase.

Approximately thirty years after the formation of Surtsey, the first bush was seen growing on the island, a tea-leaved willow. As the grasses and small bushes continued to grow, they often **out-competed** the founding lichen and dominated some areas of the island. As these plants lived and eventually died, they also decomposed contributing to the developing soil. By 2008, almost seventy species of plants were found on Surtsey, along with thriving insect populations (including spiders) and several colonies of nesting seabirds. The emergence of Surtsey island has provided a unique opportunity for scientists to observe how ecosystems develop and change over time.

Lesson Review

Directions: Please justify your answers by providing the specific details from the passages you read this week.

1. While a water system is undergoing eutrophication, there is an extremely high increase in phytoplankton. Why does phytoplankton organisms increase during this process? A. phytoplankton live on the bottom level of a water system B. phytoplankton reply on the minerals found in sewage and fertilizer C. phytoplankton need the increase oxygen that is produced D. phytoplankton enjoy living in cloudy water areas	**3. An increase in carbon dioxide in the atmosphere is partially responsible for global warming. This constitutes what kind of change?** A. precipitation change B. temperature change C. climate change D. weather change
2. Which of the following factors would have the LEAST effect on the life processes of a species? A. scientists are studying the habits of the species B. fire wipes out an organism's habitat C. a non-native species in accidentally introduced into the species' area D. humans move into the organism's habitat	**4. Run off from a chicken farm added excessive amounts of nutrients to a lake causing an abundance of algae to grow and choke out other organisms This process is called --** A. lake aging B. deforestation C. eutrophication D. riparian buffer

Crops and Ecology

Agriculture is built upon fertile soil, a favorable climate, ample freshwater, a diversity of plant and animal species, and the skills and labor of farmers and farm workers. These are the ecological foundations of our food system. They are also endangered by depletion, disruption, or disease. Finding ways to better preserve the health of agricultural ecosystems is key to the long-term sustainability of our food supply.

Most of the challenges described here relate most directly to crop production, but because crops are grown in large part to feed livestock, the production of meat, milk, and eggs is also heavily implicated. In North America, for example, only 40 percent of cropland is used to feed people directly; most of the remainder is used to grow feed for animals.[2]

SOIL

Almost everything we eat can be traced back to soil. Far from being lifeless dirt, fertile soil is teeming with organisms, including worms, arthropods, bacteria, fungi, and plant life. The decaying (and fully decayed) remains of these and other organisms, and their excrement, make up the part of soil called organic matter. The remaining mineral fraction of soil is composed of sand, silt, and clay.

Organic matter and the organisms that inhabit it are a large part of what makes soil fertile. Organic matter soaks up water and nutrients like a sponge, helping plant roots to access them.

Throughout history, farmers have mismanaged this essential resource, sometimes with catastrophic results. Plowing soil and compacting it (e.g., by driving over it with heavy machinery), for example, can make soil more prone to erosion—the removal of soil by wind, rain, and other forces. Erosion is particularly damaging because the top layer of soil (topsoil) is richest in organic matter. Erosion can also contribute to water pollution by transporting pesticides and excess nutrients into nearby streams and rivers. On much of the world's agricultural land, fertile soil is still being eroded much faster than it can be restored by natural processes.[3,4]

FRESHWATER

Growing crops and raising animals for food depend on a reliable supply of freshwater. This resource is surprisingly scarce: of all the water on Earth, only 2.5 percent is freshwater; the rest is salty. The vast majority (99 percent) of freshwater is locked in glaciers, icecaps, or below ground, and is mostly unavailable. The remaining amount—a tiny fraction of all the water on Earth—is responsible for serving most of our water needs.[7,8]

Where rainfall is inadequate, farmers draw from rivers, lakes, reservoirs, wetlands, and groundwater to supply crop fields with freshwater. An estimated 17 percent of global agricultural lands are irrigated, and crop irrigation accounts for an estimated 90 percent of global freshwater consumption. In many parts of the world, freshwater supplies are being depleted much faster than natural processes can restore them.

PESTICIDE USE

Pesticides are used with the intent of killing a target organism (pest), such as an insect, plant, or fungus that interferes with a food crop. Pesticides often have unintended effects on other, non-target organisms. Some pesticides are non-toxic to humans, while others are highly toxic. Some pesticides persist (do not break down) in the environment, remaining toxic to people and wildlife for many years.

Depending on the pesticide, exposure may increase people's risk for certain cancers and problems with their reproductive, immune, endocrine, and nervous systems. Pesticide use has also been implicated in sex reversals in amphibians;[20] weakened immune systems in dolphins, seals, and whales;[16] declining populations of beneficial organisms (e.g., pollinators and predators of pests); and other harms to wildlife. Many studies suggest insecticides are contributing to recent and dramatic declines in honey bee populations—a global phenomenon called colony collapse disorder (CCD).[23–27] Recent surveys indicate that roughly 30 percent of U.S. honey bee colonies are lost each winter, in part due to CCD.

Over time, pests may develop resistance to the chemicals used against them. When this happens, farmers may apply more (or different) pesticides to achieve the desired result,[30,31] worsening the potential dangers posed by their use.

NUTRIENT POLLUTION

To provide crops with nutrients for growth, farmers often apply fertilizers such as synthetic nitrogen, minerals, animal manure, or human sewage. The use of human and animal excrement as fertilizer is an ancient method of recycling organic matter, transforming waste into food. But when more fertilizer or manure is applied than plants can use, the excess nutrients become "too much of a good thing," seeping down into groundwater or being carried into nearby waterways by runoff (the flow of water, e.g., rain or irrigation water, over land).

Nutrient pollution in aquatic ecosystems can stimulate algal blooms—rapid accumulations of algae. After the algae die, bacteria feed on the decomposing remains, using up oxygen from the water. This process can create dead zones—underwater regions where oxygen levels are too low for most plants and animals to survive.[41] Dead zones have become common in U.S. coastal regions, such as the Chesapeake Bay. Globally, the number of dead zones has roughly doubled every decade since the 1960s.[42] A dead zone in the Gulf of Mexico, largely a result of fertilizer and manure runoff from corn and soy fields in the Midwestern United States,, reaches the size of the state of New Jersey at times of the year.[42,43]

CROP BREEDING AND GENETIC ENGINEERING

Over centuries, farmers and plant breeders have transformed agricultural crops by making them more productive, safer to eat, or better adapted to certain growing conditions. Traditionally, this has been achieved by selectively interbreeding plants to accentuate desirable traits, such as size or sweetness.

Introduced in 1996, GE crops are now grown on more than 400 million acres—an area roughly the size of Alaska. Nearly two-thirds of GE acreage is in the U.S. and Brazil.[52] Most GE crops are engineered either to resist the herbicide Roundup, allowing farmers to spray it without affecting their crops (Roundup is sold by the same company that markets "Roundup Ready" seeds); or to exude a chemical that is toxic to insects using a gene from the bacterium *Bacillus thuringiensis* (*Bt*).

After over 20 years of research, thousands of trials, and promises of "feeding the world," GE's potential to boost the food supply remains uncertain. Most GE crops have shown little or no increase in yields,[53] while the widespread use of Roundup on "Roundup Ready" crops has led numerous weed species to develop a resistance to it.[54] According to one survey, nearly half of U.S. farmers reported Roundup-resistant weeds on their farm in 2012.[55]

While genetically engineered organisms may hold promise, their pervasiveness in agriculture—and our food supply—raises unanswered questions about their potential effects on public health and ecosystems.

Environmental Impacts of Agricultural Change

Agricultural, or farming, methods have intensified continuously since the 18th century. The Industrial Revolution brought new equipment and farming methods that increased food production. In the mid-20th century, scientists discovered ways to produce stronger crops that produce more food, which increased crop harvests even further.

The increases in food production allowed the global population to grow quickly. In fact, it quadrupled in the past century. As the human population grew, so did the amount of space dedicated to feeding it. In 2016, more than 7 million square kilometers (2.7 million square miles) were devoted to growing corn, wheat, rice and other grains. That's nearly half of all cropland on the planet.
In the coming decades, however, feeding a growing population will likely be more difficult. Changing climates linked to Earth's warming are altering many of the natural processes that make modern agriculture possible.

Modern agriculture itself is also partly responsible for its problems. Farmers rely on many methods that are not sustainable. Farming sustainably means meeting the current needs without compromising the ability for future generations to meet their needs. Farmers often boost productivity in ways that also cause harmful effects on the environment. Below are brief descriptions of three ways intensive agriculture threatens ecosystems.

Irrigation

Agriculture accounts for 70 percent of freshwater use worldwide. Much of this water is used for irrigation, or the practice of watering crops through pipes, canals and sprinklers. Irrigation is needed to support large harvests. Experts predict that agricultural water use may need to increase 15 percent or more by 2050 to feed the growing population.

Researchers and farmers are becoming more aware of the consequences of irrigation. One major consequence is the depletion of rivers and underground water systems; however, there are a number of other effects. When irrigation floods a particular area, the soil changes. It also creates conditions that poison plant roots. When there is too little water in area, soils can become too salty, which also harms plant growth.

In addition, irrigation causes increases in water evaporation. This affects air temperature and pressure, as well as moisture conditions. Recent studies have confirmed that cropland irrigation can influence rainfall patterns -- not only over irrigated areas but also thousands of miles away. Irrigation has also been connected to the erosion of coastlines.

Livestock Grazing

A huge amount of agricultural land is used for cattle and other livestock. In the western United States, hundreds of millions of acres are set aside for livestock grazing, which is when animals eat grass in pastures.

Livestock are responsible for a large proportion of global greenhouse gas emissions. Greenhouse gases trap heat in Earth's atmosphere, causing the Earth to warm. Methane and carbon dioxide are two major greenhouse gases. Cows and their manure are responsible for

releasing huge amounts of methane. Land use and destruction also lead to the release of carbon dioxide into the atmosphere.
In addition, overgrazing is a major problem for environmental sustainability. In some places, land is grazed so heavily that grasses are unable to grow back, and some native plants are so damaged that the species dies off. Cattle often concentrate near streams and other water ways. The combination of overgrazing and animal waste can pollute water sources. Cattle and other large grazing animals can even damage soil by trampling on it, destroying the top layer of soil and causing erosion.

Chemical Fertilizers

Modern agriculture has become heavily dependent on chemical fertilizers, which can help plants grow. The fertilizers usually contain nitrogen and phosphorus. They are particularly effective on corn, wheat and rice crops. In large part, they are responsible for the explosive growth of grain cultivation in recent decades. China, with its rapidly growing population, has become the world's leading producer of nitrogen fertilizers.

Chemical fertilizers have helped double the rate of food production. They have also helped bring about a gigantic increase in nitrogen and phosphorus levels throughout the environment. These nutrients have become pollutants. Roughly half the nitrogen in chemical fertilizers escapes from the fields where it is applied. It finds its way into the soil, air and water.

Large amounts of nitrogen and phosphorus harm ecosystems. Ecosystems can become loaded with too many nutrients -- this process is called eutrophication. In water bodies, eutrophication can cause toxic algae, or water plants, to grow. When the algae decay, they consume oxygen in the water. This leaves very little oxygen for other plants and animals in the water. These areas of little to no oxygen are called "dead zones" because organisms die without oxygen. Dead zones often occur in parts of the Gulf of Mexico.
As the population continues to grow, agricultural productivity and environmental health will clash. We will have to find ways to feed people without harming the ecosystems that we need for growing food.

Lesson Review

Directions: Please justify your answers by providing the specific details from the passages you read this week.

1. Which human activity can often cause the following environmental effects? Deforestation, soil degradation and erosion, genetically engineered products used, chemical pollutant runoff A. Mining B. Farming C. Fishing D. Hunting	**3. What best describes how a farmer could threaten the local ecosystem and species survival?** A. Fertilizing a field that runs off to a stream B. collecting his crop a week early C. using aging equipment D. sharing a field with a neighboring farmer
2. Deforestation can affect other ecosystems by directly causing A. Acid rain B. Increased biodiversity C. Soil erosion D. Ozone destruction	**4. What is the largest driver of deforestation?** A. Forest Fires B. Urban development C. Agriculture D. Logging Industry