Ohio Science - Extended Learning Standards

Environmental Science

Earth Systems: Interconnected Spheres of Earth

1 **Biosphere • Evolution and adaptation in populations • Biodiversity • Ecosystems (equilibrium, species interactions, stability) • Population dynamics** ENV.ES.1

Complexity a

a Predict the effects on the biosphere based on changes in a given population. ENV.ES.1.A

Complexity b

b Identify cause and effect of population change(s) within the biosphere. ENV.ES.1.B

Complexity c

c Recognize that the biosphere is occupied by living organisms. ENV.ES.1.C

Learning Progression

- Predict what will happen if the Asian carp enter the Great Lakes. What may happen to the native fish populations? How does the Asian carp affect the food web of that ecosystem? ENV.ES.1.LP.A
- Examine native fish populations in areas that have been impacted by the invasion of Asian carp. Explore the relationship between the numbers of the native fish and the number of Asian carp after their arrival. Look at this in terms of the first month, six months, a year, several years. ENV.ES.1.LP.B
- Watch how Asian carp have taken over an area. ENV.ES.1.LP.C
- Identify local invasive species and illustrate how they have impacted the ecosystem. ENV.ES.1.LP.D
- List things that could cause the number of a particular type of organism to go up or down (food shortage, more babies born, disaster, organisms move into or out of the area). [Observe a map of the arrival and spread of an invasive species (e.g., kudzu).] ENV.ES.1.LP.E
- Identify that the part of Earth occupied by living things is called the biosphere. ENV.ES.1.LP.F
- Observe the school yard or a video and identify living organisms. ENV.ES.1.LP.G

2 Atmosphere • Atmospheric properties and currents ENV.ES.2

Complexity a

a Analyze how greenhouse gases affect atmospheric properties. ENV.ES.2.A

Complexity b

b Identify atmospheric properties (e.g., temperature, humidity, density and pressure). ENV.ES.2.B

Complexity c

c Recognize air currents on a map. ENV.ES.2.C

Learning Progression

- Raising cattle has had a impact on methane gas in the atmosphere. Observe the increase of methane gas in the atmosphere as the number of cattle has increased. ENV.ES.2.LP.A
- Examine a hundred year cycle of weather data for a region and find the patterns that emerge. ENV.ES.2.LP.B
- Map global temperatures for the last hundred years. ENV.ES.2.LP.C
- Track data for atmospheric gases in a region of the globe and observe the changes of gases that result from natural and human activity. This can be a historic look (e.g., industrial age) or current events. ENV.ES.2.LP.D
- Observe the data from hurricane season in the United States and identify the conditions that existed that generated the storms of that season. ENV.ES.2.LP.E
- Identify climates that exist around the globe. ENV.ES.2.LP.F
- Examine weather patterns in several locations around the globe. Track the temperature range and precipitation that prevails in that area. ENV.ES.2.LP.G
- Identify what causes the climate that exists in a regional area (e.g., use a felt map and arrows to create a map of global wind patterns). ENV.ES.2.LP.H
- Demonstrate how the sun warms the earth.This warming impacts climatic patterns that occur in a particular region. ENV.ES.2.LP.I
- Understand that wind in Ohio often blows from west to east and therefore weather events often arrive from the west. ENV.ES.2.LP.J
- Recognize that air often moves in the same pattern over and over. ENV.ES.2.LP.K
- Experience wind as moving air (blow on face, observe leaves/trees moving, fan, feel wind outside) ENV.ES.2.LP.L

3 Lithosphere • Geologic events and processes ENV.ES.3

Complexity a

a Describe how a geologic event can impact the other spheres (e.g., volcano eruption into the air, mudslide into water, etc.). ENV.ES.3.A

Complexity b

b List events that can occur within the lithosphere. ENV.ES.3.B

Complexity c

c Recognize that the lithosphere is the outer most layer (crust) of the surface of the Earth. ENV.ES.3.C

Learning Progression

- Watch videos of the volcanic activity of Hawaii and predict how that eruption impacts the environment of the island. ENV.ES.3.LP.A
- List the emissions of a volcanic eruptions (e.g., lava, volcanic gases, ash) and explain how they will impact the environment locally and globally. ENV.ES.3.LP.B
- Identify the outer surface layer of the Earth as the lithosphere; understand that it is made of rock (some of which has weathered into soil and sand). ENV.ES.3.LP.C
- Recognize that the surface of Earth constantly changes. ENV.ES.3.LP.D
- Recognize that humans live on Earth's surface, the lithosphere. ENV.ES.3.LP.E

4 **Hydrosphere • Oceanic currents and patterns (as they relate to climate) • Surface and ground water flow patterns and movement • Cryosphere • AND • ENV.ES.5 Movement of matter and energy through the hydrosphere, lithosphere, atmosphere, and biosphere • Energy transformations on global, regional, and local scales • Biogeochemical cycles • Ecosystems • Weather • Climate** ENV.ES.4

Complexity a

a Describe how ocean currents and patterns relate to climate. ENV.ES.4.A

Complexity b

b Follow surface and ground water flow patterns and movement. ENV.ES.4.B

Complexity c

c Recognize that the hydrosphere is the water portion of Earth. ENV.ES.4.C

Learning Progression

- Trace the hydrologic cycle in different regions around the Earth and show how it impacts climate. ENV.ES.4.LP.A
- Use the National Oceanic and Atmospheric Administration, NOAA, site to track ocean water temperatures around the Earth and demonstrate how this impact ocean currents. ENV.ES.4.LP.B
- Identify the living and nonliving portions of the environment that are impacted by pollution (e.g.,habitat reduction, acid rain, algae blooms, fish kills). ENV.ES.4.LP.C
- Follow the runoff of fertilizer from a farm into a lake and identify the outcomes that may result (e.g., algae blooms, fish kills). ENV.ES.4.LP.D
- Follow the water flow through a region and determine points of contamination and follow where the water goes next. ENV.ES.4.LP.E
- Recognize that groundwater can be contaminated. ENV.ES.4.LP.F
- Use pictures to identify where groundwater is found. ENV.ES.4.LP.G
- Use topographic maps to show how water flows through a region. ENV.ES.4.LP.H
- Identify local bodies of water. ENV.ES.4.LP.I

Earth's Resources

1 Energy resources • Renewable and nonrenewable energy sources and efficiency • Alternate energy sources and efficiency • Resource availability • Mining and resource extraction ENV.ER.1

Complexity a

a Describe the source and benefit of renewable and nonrenewable energy as it relates to resources. ENV.ER.1.A

Complexity b

b Compare renewable and nonrenewable sources of energy (e.g., effectiveness, cost to produce). ENV.ER.1.B

Complexity c

c Sort sources of energy as renewable and nonrenewable. ENV.ER.1.C

Learning Progression

- List the pros and cons for a variety of energy sources. ENV.ER.1.LP.A
- Match pictures of renewable and nonrenewable resources with their origins. ENV.ER.1.LP.B
- Identify where various energy resources originate (e.g., coal, petroleum, wind, water). ENV.ER.1.LP.C
- Understand that renewable means more can be made is a short period of time. ENV.ER.1.LP.D
- Understand that nonrenewable means that once it is used there is no way to get more in a reasonable time frame. ENV.ER.1.LP.E
- List some of Earth's resources as coal, wind, water, petroleum, trees. ENV.ER.1.LP.F
- Recognize that we power our everyday appliances, devices, and cars with energy produced by Earth's resources. ENV.ER.1.LP.G

2 Air and air pollution • Primary and secondary contaminants • Greenhouse gases • Clean Air Act ENV.ER.2

Complexity a

a Identify a consequence and solution to air pollution (e.g., Clean Air Act). ENV.ER.2.A

Complexity b

b Identify a greenhouse gas and how humans have impacted the level of greenhouse gases. ENV.ER.2.B

Complexity c

c Identify types of air pollution. ENV.ER.2.C

Learning Progression

- Use Google Earth to view a local area to determine what exists in an area and what products are produced and how that impacts an area (e.g., farms, housing developments, industries, nature reserves). ENV.ER.2.LP.A
- Identify sources of pollution. ENV.ER.2.LP.B
- Identify greenhouse gases (e.g., carbon dioxide, water vapor) and how they can impact the atmosphere and environment. ENV.ER.2.LP.C
- Recognize that excess natural materials can be considered pollution. ENV.ER.2.LP.D
- Recognize that human activities create pollution. ENV.ER.2.LP.E

3 **Water and water pollution • Potable water and water quality • Hypoxia, eutrophication • Clean Water Act • Point source and non-point source contamination** ENV.ER.3

Complexity a

a Identify a consequence and solution to water pollution (e.g., Clean Water Act). ENV.ER.3.A

Complexity b

b Identify ways that humans have changed the global water supply (e.g., water quality). ENV.ER.3.B

Complexity c

c Identify types of water pollution. ENV.ER.3.C

Learning Progression

- Use Flint Michigan to illustrate how pollution can impact human water consumption and use. ENV.ER.3.LP.A
- Identify where contaminants from a stream originate in the area. ENV.ER.3.LP.B
- Match pictures to point and non-point sources of contamination. ENV.ER.3.LP.C
- Observe data from a local stream to see what contaminants are present. ENV.ER.3.LP.D
- Recognize that human activities create pollution. ENV.ER.3.LP.E
- Recognize that the water used for drinking has to be processed to be used. ENV.ER.3.LP.F
- Identify what surrounds the water source and how it could impact it. ENV.ER.3.LP.G
- In your region, identify where your water travels. ENV.ER.3.LP.H
- In your region, identify where your water originates. ENV.ER.3.LP.I

4 **Soil and land • Desertification • Mass movement and erosion • Sediment contamination • Land use and land management (including food production, agriculture, and zoning) • Solid and hazardous waste** ENV.ER.4

Complexity a

a Identify a consequence and solution of soil pollution (e.g., land use, zoning). ENV.ER.4.A

Complexity b

b Identify ways that humans have contributed to changes in the land (e.g., deforestation, strip mining, waste, etc.). ENV.ER.4.B

Complexity c

c Identify types of soil pollution. ENV.ER.4.C

Learning Progression

- Explore mitigation projects for reclaiming mining areas (e.g., the Wilds). ENV.ER.4.LP.A
- Discuss ways that a deforested area can be restored. ENV.ER.4.LP.B
- Show pictures of how the logging industry has changed an area. ENV.ER.4.LP.C
- Look at a series of pictures of an area before, during and after a major development project (e.g., riverfront project, building a housing development, stripmine). How has the area changed? What organisms have been impacted? What pollutants were introduced or eliminated? ENV.ER.4.LP.D
- Recognize that land can be used for a variety of purposes and that use in turn impacts the environment. ENV.ER.4.LP.E

5 Wildlife and wilderness • Wildlife and wilderness management • Endangered species • Invasive species • Introduced species ENV.ER.5

Complexity a

a Explain how a species can become endangered (e.g., deforestation, invasive species). ENV.ER.5.A

Complexity b

b Categorize species as “endangered” or “nonendangered.” ENV.ER.5.B

Complexity c

c Identify the meaning of “endangered.” species. ENV.ER.5.C

Learning Progression

- Observe data of endangered populations and examine efforts to restore those populations. ENV.ER.5.LP.A
- Examine the laws of the nation or local area to protect endangered species. ENV.ER.5.LP.B
- Use data for the Ohio Department of Natural Resources to monitor that status of a particular species. ENV.ER.5.LP.C
- Recognize that as organisms’ death rate exceeds its birth rate they areconsidered endangered and may become extinct if the conditions do not change. ENV.ER.5.LP.D
- Recognize that as an environment changes the conditions may become unfavorable for the survival of some organisms. ENV.ER.5.LP.E

Global Environment Problems and Issues

1 Human population ENV.GP.1

Complexity a

a Describe how the size of the human population can have harmful effects on the environment. ENV.GP.1.A

Complexity b

b Identify how the human population has changed over time. ENV.GP.1.B

Complexity c

c Recognize that humans can change their environment globally. ENV.GP.1.C

Learning Progression

- At the rate of change what could the human population be in the next 100 years. ENV.GP.1.LP.A
- Use data to show how the human population has change in the last 100 years. ENV.GP.1.LP.B
- Match events to their outcomes in an environment (e.g., fertilizer runoff causes algae blooms which contaminates water supply). ENV.GP.1.LP.C
- Identify how humans can impact an area and provide examples. ENV.GP.1.LP.D
- Identify what caused the biggest changes in that area. ENV.GP.1.LP.E
- Show a map or pictures of an area that documents the changes over the last 100 years. ENV.GP.1.LP.F

2 Potable water quality, use, and availability ENV.GP.2

Complexity a

a Describe a way to preserve potable water on Earth. ENV.GP.2.A

Complexity b

b Identify a way humans have changed the global water quality ENV.GP.2.B

Complexity c

c Identify a fresh water source. ENV.GP.2.C

Learning Progression

- Use an aquarium to show how water can be contaminated and determine how to clean it up. ENV.GP.2.LP.A
- Show a chart that compares the total amount of water available on the Earth to the amount of freshwater that is available. ENV.GP.2.LP.B
- Identify activities that impact the water supply (e.g., pollution or remediation). ENV.GP.2.LP.C
- Recognize that water is processed for human consumption. ENV.GP.2.LP.D
- Recognize that water is necessary for survival. ENV.GP.2.LP.E
- Show a picture or map of your local water source. ENV.GP.2.LP.F

3 Climate change ENV.GP.3

Complexity a

a Describe a way to preserve our global climates. ENV.GP.3.A

Complexity b

b Identify a possible factor of climate change. ENV.GP.3.B

Complexity c

c Recognize the characteristics of a climate change (e.g., melting glaciers). ENV.GP.3.C

Learning Progression

- Relate how the polar icecap reduction has impacted populations of organisms that live in that region. ENV.GP.3.LP.A
- Watch a video of the change in the polar icecaps for the last 25 years. ENV.GP.3.LP.B
- Recognize ways that can reduce greenhouse gases. ENV.GP.3.LP.C
- Recognize that climate changes impact the survival rates of organisms. ENV.GP.3.LP.D
- Recognize that human activity can impact the climate (e.g., increase global temperatures). ENV.GP.3.LP.E

4 Sustainability ENV.GP.4

Complexity a

a Explain how resources can be sustained to reduce the impact on Earth (e.g., planting new trees after chopping down others). ENV.GP.4.A

Complexity b

b Identify a resource that should be sustained to positively affect Earth. ENV.GP.4.B

Complexity c

c Sort resources into renewable or non-renewable categories. ENV.GP.4.C

Learning Progression

- Share the story of the development of the Wilds in Ohio. Guernsey county was used for strip mining and the land was reclaimed and used as a wildlife conservatory. ENV.GP.4.LP.A
- Discuss how to reduce resource exploitation (renew, reuse, recycle). ENV.GP.4.LP.B
- Identify ways to protect our valuable resources such as water and air. ENV.GP.4.LP.C
- Categorize renewable and non-renewable resources. ENV.GP.4.LP.D

5 Species depletion and extinction ENV.GP.5

Complexity a

a Describe why species extinction is harmful to Earth. ENV.GP.5.A

Complexity b

b Identify the cause of a species extinction. ENV.GP.5.B

Complexity c

c Identify a species that has become extinct. ENV.GP.5.C

Learning Progression

- Watch videos of how Lake Erie water snakes (LEWS) were removed from the endangered species list. This has changed due to public awareness and the introduction of goby fish to the Great Lakes. ENV.GP.5.LP.A
- Identify an organism within an ecosystem and predict what happens to other parts of the ecosystem with the removal of that organism. (Use the story and data of the moose and wolf populations of Isle Royale to illustrate the codependency of organisms.) ENV.GP.5.LP.B

6 Air quality ENV.GP.6

Complexity a

a Describe the effect of air quality on humans. ENV.GP.6.A

Complexity b

b Describe the effect of a pollutant on air quality ENV.GP.6.B

Complexity c

c Identify a type of air pollution. ENV.GP.6.C

Learning Progression

- Look at pictures of pollution sources (eg., factories, crowded highways, dust storms) and identify how these sources make air contaminated ENV.GP.6.LP.A
- Watch videos that show the effects of pollutants on humans (e.g., COPD, asthma); discuss why it is important to keep our air clean ENV.GP.6.LP.B
- Identify ways that people can reduce air pollution (e.g., drive less, filter factory emissions, use modern farming technique such as no till, purchase local products). ENV.GP.6.LP.C
- List some things that are not be pleasant to breathe (e.g., dust, cigarette smoke, car exhaust). ENV.GP.6.LP.D
- Breathe in and out to recognize that fresh air is important to keep us alive and healthy. ENV.GP.6.LP.E

7 Food production and availability ENV.GP.7

Complexity a

a Describe how a factor could limit the availability of food. ENV.GP.7.A

Complexity b

b Describe a factor that can affect food production (e.g., early frost, drought, etc.). ENV.GP.7.B

Complexity c

c Identify oane food production method (e.g., farming, manufacturing). ENV.GP.7.C

Learning Progression

- Identify events that can damage crops or decrease food production (drought, wind storms, flooding, late frost, insect damage). ENV.GP.7.LP.A
- Look at population maps or videos to understand how the rapidly increasing human population leads to food scarcity. ENV.GP.7.LP.B
- Recognize that some food crops are genetically modified to enhance production (e.g., increase yield, internal protection from weeds and insects). ENV.GP.7.LP.C
- Farmers plant their crops at the same time every year. Predict what would happen if the weather prevented those crops from being planted on time due to flooding or cold temperatures. ENV.GP.7.LP.D

8 Deforestation and loss of biodiversity ENV.GP.8

Complexity a

a Identify an effect of deforestation on an ecosystem. ENV.GP.8.A

Complexity b

b Describe the importance of a forest ecosystem. ENV.GP.8.B

Complexity c

c Recognize that having many different organisms in an ecosystem generally leads to a healthier ecosystem. ENV.GP.8.C

Learning Progression

- Show before and after pictures of an area that has been deforested and discuss what was being harvested and why. ENV.GP.8.LP.A
- Look at population maps or videos to show how human populations have changed and how this impacts the ecosystem (https://www.youtube.com/watch?v=khFjdmp9sZk). ENV.GP.8.LP.B

9 Waste management (solid and hazardous) ENV.GP.9

Complexity a

a Describe a way to reduce solid and hazardous waste. ENV.GP.9.A

Complexity b

b Describe an effect of waste on the environment. ENV.GP.9.B

Complexity c

c Sort types of waste into solid or hazardous waste. ENV.GP.9.C

Learning Progression

- Show pictures of a landfill and discuss the contents. ENV.GP.9.LP.A
- Interview the school's custodian and find out what happens to waste produced in the school. ENV.GP.9.LP.B
- Match pictures of waste materials and their method of removal. ENV.GP.9.LP.C
- Explore how waste could be reduced. ENV.GP.9.LP.D
- Identify what makes waste and how it is classified. ENV.GP.9.LP.E