Unit: OTP 11 - Environmental Science

Content Area: **Science**
Course(s): **OTP Science**
Time Period: **year**
Length: **40 Weeks**
Status: **Published**

Unit Overview

Environmental Science is a multidisciplinary science that draws from all sciences to help us better understand the relationship between humans and the world in which we live. The following topics will be covered:

-How the scientific method can be used for the identification and investigation of major environmental issues.

-Earth's surface is a complex and dynamic set of interconnected systems that involve the geosphere, hydrosphere, atmosphere, and biosphere. Within these systems the 4 main cycles (water, oxygen, carbon and nitrogen) are used and recycled to allow the systems to be interconnected.

-Ecosystems and biomes are complex, interactive systems that include both biological communities (biotic/living) and physical (abiotic/nonliving) components of the environment. A change in the physical environment over time, can ultimately affects the stability of the entire system.

-Living organisms have the capacity to produce populations of infinite size, but resources environmental factors have limits which hinder the populations growth.

-The Earth doesn't have infinite resources and with the increase of human consumption, this places severe stress on the natural and non-natural resources. How humans use resources, such as land for agriculture, affects whether human sustainability can be maintained. Waste disposal and recycling are key points to preserve the resources humans need to live.

-Plants are a vital components of the natural world . Without plants, animals could not survive. Plants use photosynthesis as a process to make their own food.

Transfer

Students will be able to independently use their learning to...

-Use and practice the scientific method to solve everyday problems.

-Identify how human activities affect the atmosphere, geosphere, hydrosphere, atmosphere, and biosphere.

-Understand the difference between living and nonliving factors in an ecosystem.

-Explain the flow of energy through an ecosystem/biome.

-Identify how changes (growing or shrinking) of a population can cause stress on the environment.

-Develop ways to reduce the stress that the growing human population has put of the Earth. Ex: trash, water/air pollution

-Explain the steps of photosynthesis in order to care for plants.

Meaning

Understandings

Students will understand that...

- Recognizing the importance of repeating experiments to get valid test results.
- Composing a hypothesis that is testable is critical to an experiment.
- Identifying there are more than one answer or solution to a problem.
- The six steps of the scientific method don't have to follow a particular order.

- Earth's four systems are integrated and can have an effect on each other.
- The atmosphere is composed almost entirely of nitrogen and oxygen and it is divided into 4 layers based on changes in temperature and altitudes
- The hydrosphere includes all the water on or near Earth surface
- The biosphere is the narrow layer at the Earth's surface where life can exist.
- The solid parts of Earth, the geosphere, is constantly being acted on by other forces.

- Abiotic and biotic factors are the specific makeup of an ecosystem.
- Protecting a habitat as a whole is more important than protecting singular organisms.
- Using chemicals, such as pesticides, can cause problems in the environment for many years
- All organisms within an environment rely on one another to maintain life and balance.
- Biomes are classified by latitude, altitude, and organisms that live there.
- Organisms in each biome are adapted to live in that biome.
- Water biomes are an important aspects of the Earth's biosphere.

- All populations can be increased or decreased as a result of environmental factors such as disease, resource limitations and natural disturbances
- Interactions between species can be categorized based the benefit or harm that one species to causes another.

- Human population growth has expanded due to improvements in living conditions and crop production.
- When growing populations use resources faster than they can be renewed, the most critically used are fuel/wood, water and arable land.
- Most of the worlds energy needs are met by fossil fuels, which are nonrenewable resources.
- The extraction of fossil fuels has cause many environmental problems that has had long lasting impacts on the Earth.
- Renewable energy is energy from sources that are constantly being formed.
- Biodegradable materials can be broken down by biological processes, while non- biodegradable materials cannot.
- Recycling is a process of reusing materials or recovering valuable materials from waste or scrap.
- Activities at home can create hazardous waste, which can be harmful to the Earth.

- Biological molecules are recycled within ecosystems.
- Energy flows through trophic levels in an ecosystem.

Essential Questions

Students will keep considering...

- Where can human error occur in an experiment?
- How to improve an experimental techniques?
- How to improve an experiment after resulting in a rejected hypothesis?
- How can the scientific method be useful in my own life?
- How do the different variables (control groups and experimental groups) relate to one another and how does a change in one variable effect the other variables?
- How observations can provide new insights to an experiment?

- What is the basic composition of Earth's atmosphere?
- How is heat transferred in the atmosphere?
- What is the composition and structure of the physical Earth?
- What factors contribute to the support of life in the biosphere?
- How elements (ex: oxygen, water, carbon and nitrogen) moved between the four systems?

- How are ecosystems interconnected?
- How are biomes classified?
- Why is natural selection the driving force behind evolution?
- How are aquatic ecosystems classified?
- What are threats to the marine and freshwater ecosystem?

- What is ecological succession and how does that affect the environment?
- What are humans doing that affects the cycling of materials in an ecosystem?
- Populations are dependent on the changes and pressures in the environment?
- Why are carrying capacities different for each species?
- How is the human population changing currently and what affects this rate?
- Why does it matter how humans use land?
- In what ways can deforestation have negative effects on the environment?
- How does soil conservation provide a greater amount of fertile soil?

- How does photosynthesis harvest energy that is used for all life on Earth?
- How do organisms obtain and use energy they need to live and grow?
- How do matter and energy move through ecosystems?

Application of Knowledge and Skill

Students will know...

Students will know...

- How to identify problems by using observations.
- That lab reports help explain findings to the problem/solution, hypothesis, results, and conclusions in an experiment.
- Graphs and tables are great way to relay information about findings of an experiment.
- The six steps of the scientific method (identify a problem or question, make observations, form a hypothesis, experiment, record and organize data and make conclusions.)

- that the four systems (hydrosphere, biosphere , atmosphere and geosphere) interact and rely on each other to function as a whole.
- how elements (oxygen, water, carbon and nitrogen) are reused and recycle between the four systems.
- that the greenhouse affect the Earth's climate.

- that all organisms are interconnected and they rely on each other.
- Evolution is a slow change that takes over thousands of years.

- Small ecosystems are an important part of biome
- Threats to the marine and freshwater ecosystems can have long reaching effects.

- That wind and water can alter the Earth's surface.
- That ecological succession happens slowly and at different rates.
- Humans are affecting the materials that the Earth has.
- The change in the human population is putting many pressures on the environment.
- The carrying capacity of an area is always fluctuating.
- That soil conservation is an importance part of land conservation.

- Photosynthesis produces carbohydrates and releases oxygen into the atmosphere.
- Carbohydrates are broken down into their atoms to recombine to form other carbon molecules.

Students will be skilled at...

Students will be skilled at...

- making predictions based on reasoning from prior knowledge.
- be able to test a hypothesis through experimental design.
- interpret graphs and tables.

- labeling the different Earth's systems.
- constructing experiments to show how the Earth's systems are interconnected.
- identifying how the different elements(oxygen, water, carbon and nitrogen) are used and recycled.

- comparing and identifying land biomes
- comparing and identifying water biomes
- construct food webs and food chains
- demonstrate how removing one organism can affect the whole ecosystem dramatically.
- compare the different types of relationships that organisms can have with each other.

- labeling key parts on a population graph
- describe the key components of land conservation
- conduct experiments to see how pollutants can affect the Earth

- Describing the relationship between photosynthesis and cellular respiration.

- Record and report the growth of plants.
- demonstrate how to take care of plants

Academic Vocabulary

- Abiotic Factor
- age structure
- Bedrock
- biodegradable
- biodiversity
- Biotic Factor
- Birth Rate
- carnivore
- CFC
- Clear-cutting
- Community
- Competition
- composting
- Condensation
- consumer
- Death Rate
- decomposer
- Development
- Dispersion
- Drought
- ecosystem
- Emigration
- Erosion
- evaporation
- Fertilizer
- Food chain
- Food wed
- Global warming
- Green house effect
- Habitat

- hazardous waste
- herbivore
- Immigration
- Litter
- Mutualism
- Niche
- Nitrogen cycle
- Nitrogen fixation
- nonrenewable resource
- omnivore
- Ozone layer
- Parasitism
- Photosynthesis
- Pioneer species
- pollution
- Population
- precipitation
- Predator
- Prey
- Primary succession
- producer
- Radiation
- recycling
- Renewable resource
- scavenger
- Secondary succession
- Selective cutting
- Stability
- Topsoil
- Water cycle

Learning Goal 1

Science is a process by which we learn about the world around us. Science progresses mainly by the experimental method.

Life on earth is interdependent. Learning how to take care of personal needs can enhance independence. Learning how to care for other living things can increase selfconfidence and develop responsibility.

Science and technology are interdependent. Technology can assist students in learning how to complete everyday tasks. Students need to know the range of technological tools available and how to use them to improve the quality of life and enhance independence.

Target 1

SWBAT: Investigate why the experimental method involves making observations, forming a hypothesis, performing an experiment, interpreting data, and communicating results.

Target 2

SWBAT: Use models, including conceptual and mathematical models, to understand the systems they study.

Learning Goal 2

Making environmental decisions involves gathering information, considering values, and exploring consequences.

SCI.K-12.5.6	All students will gain an understanding of the structure, characteristics, and basic needs of organisms. Science and technology are interdependent. Technology can assist students in learning how to complete everyday tasks. Students need to know the range of technological tools available and how to use them to improve the quality of life and enhance independence.

Target 1

SWBAT: Compare and contrast decisions about the environment and how they should be made thoughtfully. Using a decision-making model will provide you with a systematic process for making knowledgeable decisions.

Learning Goal 3

The geosphere is the solid part of the Earth that consists of all rock, and the soils and sediments on the Earth's

surface.

9-12.HS-ESS1-5	Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
9-12.HS-ESS1-6	Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.
9-12.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
9-12.HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
9-12.HS-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

Target 1

SWBAT to able to label and recall the three main parts of the geosphere.

Learning Goal 4

The atmosphere is the mixture of gases that surrounds the Earth.

9-12.HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
9-12.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
9-12.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

Target 1

SWBAT describe the layers and composition of the Earth's atmosphere.

Target 2

SWBAT explain the difference between conduction, convection and radiation.

Learning Goal 5

The hydrosphere includes all of the water at or near the surface of the Earth.

9-12.HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
9-12.HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
9-12.HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
9-12.HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
9-12.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
9-12.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

Target 1

SWBAT describe the properties of ocean water and explain how the ocean regulates the temperature of the atmosphere.

Learning Goal 6

The biosphere is the narrow layer at the surface of the Earth where life can exist.

9-12.HS-ESS1	Earth's Place in the Universe
9-12.HS-ESS2	Earth's Systems
9-12.HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
9-12.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
9-12.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere,

	atmosphere, geosphere, and biosphere.
9-12.HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.

Learning Goal 7

In Ecosystems, the biotic (living) and abiotic (nonliving) components interact to form an interconnected system. Species adapt to their environment through the process of evolution by natural selection. The six kingdom system of organization helps scientists to classify organisms and study their differences.

9-12.HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
9-12.HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
9-12.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
9-12.HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Target 1

SWBAT distinguish between abiotic and biotic factors, describe how a population differs from a species and explain how habitats are important for organisms.

Target 2

SWBAT explain the difference between an open and closed system.

Learning Goal 8

Organisms need energy to stay alive. Some organisms, such as plants, can directly convert usable energy from the Sun. The cycling of materials such as carbon, nitrogen and phosphorous is essential to keep nutrients balanced in ecosystems. Human activities can affect these cycles. Through ecological succession, ecosystems can change over time.

9-12.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
9-12.HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

9-12.HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Target 1

SWBAT describe how energy is transferred from the Sun to producers and then to consumers, explain how energy transfer in a food web is more complex than energy transfer in a food chain and how energy pyramids represent trophic levels.

Target 2

SWBAT list two types of ecological succession, explain pioneer species and describe how lichens contribute to primary succession.

Learning Goal 9

Biomes are described by their vegetation, temperature and precipitation. The terrestrial biomes of the world include tropical rain forest, temperate forest, taiga, temperate grassland, desert, tundra, chaparral and savanna. There are biome specific threats to each.

9-12.HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
9-12.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

Target 1

SWBAT describe why vegetation is used to name a biome and explain how latitude and altitude affect which plants grow in an area.

Learning Goal 10

Freshwater ecosystems are made up of lakes, rivers, and wetlands. Marine ecosystems include estuaries, coral reefs and oceans. Aquatic ecosystems perform many environmental functions and support many plant and animal species. Pollution, development and overuse threaten many of these ecosystems.

9-12.HS-LS1-5.2.1	Use a model based on evidence to illustrate the relationships between systems or between components of a system.

Target 1

SWBAT describe the factors that determine where an organism lives in an aquatic ecosystem and describe two environmental functions of wetlands. List the different threats against aquatic ecosystems.

Learning Goal 11

Populations can increase or decrease in response to their environment.

9-12.HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
9-12.HS-LS2-8	Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.
9-12.HS-LS2-6.7	Engaging in Argument from Evidence
9-12.HS-LS4-6.LS4.D.1	Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

Target 1

SWBAT describe the three main properties of populations and explain how population sizes are regulated by reproductive behaviors.

Target 2

SWBAT Explain the difference between niche and habitat and describe the five major types of interactions between species.

Learning Goal 12

Humans use land for many purposes, including farmland to grow crops, rangeland to feed livestock, forest land for wood, cities to live and conduct business, and parks for recreational enjoyment. Understanding these

uses and implications can make us better stewards of our environment.

9-12.HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
9-12.HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
9-12.HS-LS4-6	Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
9-12.HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
9-12.HS-LS2-8	Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.
9-12.HS-LS2-6	Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

Target 1

SWBAT explain the benefits of preserving farmland and managing rangeland sustainably. Describe the effects of deforestation on habitats and ecosystems.

Target 2

SWBAT distinguish between traditional and modern farming techniques, the importance of fertile soil conservation and explain what is involved in integrated pest management and genetic engineering.

Target 3

SWBAT explain the effects of overharvesting, the importance of aquaculture and livestock in providing food and other human used product.

Learning Goal 13

Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

9-12.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

Target 1

Describe the structure of a chloroplast and identify the products and reactants of photosynthesis.

Summative Assessment

http://www.edudemic.com/summative-and-formative-assessments/

https://sites.educ.ualberta.ca/staff/olenka.bilash/Best%20of%20Bilash/summativeassess.html

- End of semester exam
- End of unit or chapter test
- Essay or report
- Oral examination
- Participation in lecture, discussion or group work
- Performance in task with rubric or checklist
- Presentation
- Projects
- Structured observation

21st Century Life and Careers

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP6.1	Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

Formative Assessment and Performance Opportunities

http://www.edudemic.com/summative-and-formative-assessments/

https://www.nwea.org/blog/2016/take-three-55-digital-tools-and-apps-for-formative-assessment-success/

https://docs.google.com/presentation/d/1nzhdnyMQmio5lNT75ITB45rHyLISHEEHZlHTWJRqLmQ/pub?start=false&loop=false&delayms=3000#slide=id.gb49e70aa_370

- Do now
- Exit ticket
- Graphic organizer
- Questioning/ discussion
- Role play
- Simulation
- Task analysis
- Task rubric
- Teacher observation
- Think-pair-share
- Visual representation
- Weekly quiz
- Work product

Accommodations/Modifications

Lessons and accompanying activities will be presented verbally, in writing and with visual examples of varying complexity to accommodate unique learning styles. Extra staff will be available to students to provide prompting and support.

- 1:1 instruction
- Community-based instruction
- Cueing/ prompting
- Reinforcement activities
- Role playing/ simulation
- Small group instruction
- Visual supports

Unit Resources

Prentice Hall: Science Explorer- Environmental science green book