Oakwood City School District
Environmental Science Standards

One goal of science education is to help students become scientifically literate citizens able to use science as a way of knowing about the natural and material world. All students should have sufficient understanding of scientific knowledge and scientific processes to enable them to distinguish what is science from what is not science and to make informed decisions about career choices, health maintenance, quality of life, community and other decisions that impact both themselves and others.

Environmental science is a high school level course, which satisfies the Ohio Core science graduation requirements of Ohio Revised Code Section 3313.603. This section of Ohio law requires three units of science. Each course should include inquiry-based laboratory experience that engages students in asking valid scientific questions and gathering and analyzing information.

Environmental science incorporates biology, chemistry, physics and physical geology and introduces students to key concepts, principles and theories within environmental science.

Investigations are used to understand and explain the behavior of nature in a variety of inquiry and design scenarios that incorporate scientific reasoning, analysis, communication skills and real-world applications.

Environmental Standards

Earth Systems: Interconnected Spheres of Earth

A. Biosphere
    a. Determine the carrying capacity of an ecosystem using historical or current data (e.g., Moose on Isle Royale, Kaibab Deer in Arizona).
    b. Graph survivorship curves to make judgements about environmental and health conditions in various habitats/ecosystems.
    c. Evaluate current protection and management laws pertaining to endangered species and their habitats.
    d. Collect data on species diversity and abundance. Compare and contrast data using Simpson's Diversity Index or Shannon-Wiener Index to measure species diversity/abundance and compare the relative health of the two habitats.
    e. Identify an instance of biomagnification or bioaccumulation within a specific ecosystem and propose possible solutions.
    f. Model and describe how toxins enter and accumulate in a food chain. Find and paraphrase laws/regulations which attempt to regulate use of potential contaminants (e.g., DDT, BPA, pharmaceuticals, lead).
B. Atmosphere
    a. Differentiate between the layers of the Earth's atmosphere, complete with description and chemical composition.
    b. Explain the effects and causes of El Niño/La Niña weather patterns on Earth's spheres, biogeochemical cycles and biodiversity. Include regional comparisons of the effects of these events.
    c. Explore the major types and sources of air pollution. Compare the main types and illustrate ways to prevent air pollution.
    d. Distinguish between primary and secondary contaminants.
    e. Analyze the Clean Air Act and explore the historical context for the development of the Clean Air Act.
    f. Examine the Paris Agreement within the United Nations Framework Convention on Climate Change, dealing with greenhouse-gas-emissions mitigation, adaptation, and finance. Contrast national legislation to international legislation.
    g. Analyze ice core models and/or datasets, and graphically represent how elements in the atmosphere can change over time. Interpret and extrapolate into the future potential atmospheric conditions.
    h. Illustrate the process of how acid rain is created and describe its effects on each component of the environment.
C. Lithosphere

a. Differentiate between the layers of the Earth in order to identify and describe the components and their role.
b. Examine human impacts on the lithosphere (e.g., hydraulic fracturing, surface mining, urbanization) and hypothesize possible consequences.
c. Identify at least two examples of modern desertification, one in the United States and one in another country. Determine impact on the ecosystem.

D. Hydrosphere
a. Analyze watershed maps and identify watershed boundaries, water movement/ direction, and geological features that impact water behavior in the region.
b. Examine the factors that lead to changing oceanic currents (both deep and shallow).
c. Examine the city's water delivery system including where your drinking water comes from and where your waste water goes as well as the treatment process utilized in your city.
d. Analyze excerpts or summaries of literature (e.g. Rachel Carson's Silent Spring) and create scenarios which model the effects of toxins introduced into a water system. Examine the actions that resulted from the publication of the literature.
e. Research water as a resource. Identify areas of concern and classify various sources (e.g., fresh, salt, ground, surface, glacier).
f. Analyze the Clean Water Act and propose an amendment to address increases in populations and changes to ecosystems.
g. Conduct a water quality tests of various local bodies of water, and determine how the results (e.g., dissolved oxygen content, phosphates, nitrates/nitrites, pH, fecal coliform) could impact aquatic ecosystems.
h. Examine point source versus nonpoint source contamination and apply differences to interpret a water pollution scenario.

E. Movement of matter and energy through the hydrosphere, lithosphere, atmosphere and biosphere
a. Distinguish between climate and weather.
b. Analyze an actual environmental or geologic event (e.g., release of a toxin/contaminant, hurricane, earthquake, volcano, flood, fire, landslide) and determine how each of Earth's spheres was impacted. Include long-term and short-term impacts. Trace the movement of contamination or energy through each sphere. Provide scientific evidence and data to support conclusions.
c. Describe the relationship between ocean surface temperature and hurricane intensity, using the NOAA database. Map the most vulnerable areas and use it to identify highly populated areas that could be affected.
d. Explore, analyze and interpret past and current climate patterns for 10 different cities around the world. Analyze differences between climate patterns and make predictions of future patterns.
e. Explain the steps and reservoir interactions in the phosphorus cycle, carbon cycle, nitrogen cycle and hydrologic cycle.
f. Compare and contrast components of different ecosystems.

Earth's Resources

A. Wildlife and wilderness
   a. Research an Ohio wilderness or water ecosystem and identify threats to each species, including human impacts.
   b. Discuss the process of biomagnification and the ramifications if a primary consumer or a producer is removed or too many consumers or producers are introduced.
   c. Examine the hazards of invasive species. Identify invasive species in the community and describe their impacts on the local food web.
   d. Evaluate current practices to conserve or recover native species that are currently endangered.
   e. Compare the biodiversity of two natural areas, including richness and distribution. Draw conclusions, including how the biodiversity is relevant toward mitigating the impact of invasive species
   f. Make assessments about the introduction of species. Identify ways that it boosts endangered species populations and potential negative impacts.
   g. Research the requirements for listing a species as a species of concern, threatened or endangered on the state or federal level. Identify a species on one of these lists and research its life history, specifically the impacts leading to its decline.
   h. Research the effect that climate change is having or has had on a specific living or extinct species (e.g., harp seal, polar bear, dinosaur, elkhorn coral) or on an ecosystem (e.g., the Great Barrier Reef, the Arctic Circle).
   i. Research an endangered species, including information on the organism's ecosystem and its role within the ecosystem, its value (ecologically and commercially), reasons for endangerment and possible solutions or interventions.

Global Environmental Problems and Issues

A. Human Population
   a. Interpret population demographic curves, graphs or pyramids (e.g., from US Census Bureau, the UN Census, World Factbook) and discuss differences in population growth rates among several different countries (developing vs. developed).
   b. Compare developing and developed countries, identifying the factors that separate the two types of countries.
   c. Compare local fertility rates to national and international rates. Consider environmental and societal factors contributing to differences.
   d. Relative to resource availability and rates of consumption, assess the scope of human population growth and potential limits to its growth (e.g., Tragedy of the Commons, Hans Rosling and Gapminder Foundation)

e. Use data on birth rates, death rates, life expectancy, average income and literacy rates of various countries to develop a plan that could contribute to a change in the fertility and death rates
f. Use an online ecological footprint calculator (e.g., Earth Day Network) to compare how many Earths it would take to sustain the world population for various lifestyles.

B. Climate change
   a. Explain the correlation between historical carbon dioxide concentration data and historical global temperature data.
   b. Research monthly average precipitation data in different areas to strengthen conclusions about periods of drought or abnormal rainfall as they relate to climate change.
   c. Compare the effects of El Niño and La Niña at two different longitudinal locations, but at the same latitude, using sea surface temperature and precipitation from real satellite data.
   d. Examine the history of climate science and policy initiatives over the past two centuries in developing and non developing countries. Include global data and compare different nations.
   e. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
   f. Describe how the atmosphere and the oceans interact to sequester atmospheric carbon.
   g. Describe positive and negative feedback loops that impact the greenhouse effect and climate change.