

## Indiana Academic Standards for Environmental Science Standards Resource Guide Document

This Teacher Resource Guide has been developed to provide supporting materials to help educators successfully implement the Indiana Academic Standards for Environmental Science. These resources are provided to help you in your work to ensure all students meet the rigorous learning expectations set by the Academic Standards. Use of these resources is optional – teachers should decide which resource will work best in their school for their students.

This resource document is a living document and will be frequently updated.

Please send any suggested links and report broken links to:

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The resources, clarifying statements, and vocabulary in this document are for illustrative purposes only, to promote a base of clarity and common understanding. Each item illustrates a standard but please note that the resources, clarifying statements, and vocabulary are not intended to limit interpretation or classroom applications of the standards.

Standard 1: Environmental Systems			
Indiana Academic Standard	Clarifying Statement	Highlighted Vocabulary Words from the Standard Defined	Crosscutting Concept

<p>Env.1.1 Understand and explain that ecosystems have <b>cyclic fluctuations</b>, such as <b>seasonal changes</b> or changes in <b>population</b>, as a result of <b>migration</b>, <b>birth</b>, and <b>mortality</b>.</p>	<p>Population data trends</p>	<p>Cyclic fluctuations – recurring in a defined process/cycle  Seasonal changes – division of the year marked by changes in weather, ecology and hours of daylight  Population – a particular section, group, of organism living in an area or country</p> <p>Migration – seasonal movement of animals from one region to another</p> <p>Birth – start of life as a physically separate being.  Addition to a population  Mortality – the state of being subject to death  reduction in population</p>	<p>Patterns</p> <p>Cause and effect</p>
<p>Env.1.2 Understand and explain that human beings are part of Earth’s ecosystems and give examples of how human activities can, deliberately or inadvertently, alter <b>ecosystems</b>.</p>	<p>How humans use the ecosystem for soil, water, air, development. How we destroying it knowingly with the cost benefit analysis and how it happen on accident (dams, biomaginfication) this is a standards that should be laced throughout the whole year</p>	<p>Ecosystems – biological community of interacting organisms and their physical environment.</p>	<p>Cause and effect</p> <p>Systems and system models</p>
<p>Env.1.3 Recognize and describe the difference between systems in <b>equilibrium</b> and systems in <b>disequilibrium</b>. Describe how <b>steady state</b> is achieved through <b>negative</b> and <b>positive feedback loops</b>.</p>	<p>Equilibrium and feedback loops in the ecosystem and in populations.</p>	<p>Equilibrium – state in which opposing forces or influences are balanced  Disequilibrium – loss or lack of equilibrium or stability  Steady state – unvarying condition in a physical process,  Negative feedback loop –  Positive feedback loop –</p>	<p>Patterns</p> <p>Cause and effect</p>
<p>Env.1.4 Diagram the <b>cycling</b> of carbon, nitrogen, phosphorus, and water and describe the human impacts on each.</p>	<p>Each cycle addressed and how humans can interfere with it (water diversion and collection, and carbon dioxide being released)</p>	<p>Cycling – complete round or series of occurrences that repeats or is repeated</p>	<p>Patterns</p> <p>Cause and effect</p>

<p>Env.1.5 Identify and measure <b>biological, chemical, and physical</b> (abiotic and biotic) <b>factors</b> within an ecosystem.</p>	<p>Parts of the ecosystem in biomes and in cycles</p>	<p>Biological factors –all living organisms in an area          Chemical factors – non-living chemical parts of the environment that affect living organisms and the functioning of ecosystems          Physical factors – all physical aspects of an area that has an impact on the living organisms and the functioning of ecosystems</p>	<p>Cause and effect          Systems and system models</p>
<p>Env.1.6 Describe the difference between <b>weather</b> and <b>climate</b>. Locate, identify, and describe the major Earth <b>biomes</b>. Explain how biomes are determined by climate (temperature and precipitation patterns) that support specific kinds of plants.</p>	<p>Address all 10 biomes, make sure they can tell them apart with temperature, precipitation and plants (NOT ANIMALS)</p>	<p>Weather – state of the atmosphere at a place and time as regards heat, dryness, sunshine, wind, rain, etc          Climate – weather conditions prevailing in an area in general or over a long period          Biomes – large naturally occurring community of flora and fauna occupying a major habitat</p>	<p>Patterns          Cause and effect</p>
<p>Env.1.7 Identify tools and technologies used to adapt and alter <b>environments</b> and natural resources in order to meet human physical and cultural needs.</p>	<p>Laced throughout all year about the then and now of technology and human improvements and how it affects the environment</p>	<p>Environments – surroundings or conditions in which a person, animal, or plant lives or operates</p>	<p>Cause and effect          Systems and system models</p>
<p>Env.1.8 Explain the factors that influence weather and climate, the action of <b>gravitational forces</b>, and the rotation of the Earth.</p>		<p>Gravitational forces - force that attracts any object with mass</p>	<p>Cause and effect          Energy and matter</p>

<p>Env.1.9 Describe how weather can be influenced by global climatic patterns, such as <b>El Niño</b> and <b>La Niña</b>.</p>		<p>El Niño - irregularly occurring and complex series of climatic changes affecting the equatorial Pacific region and beyond every few years, characterized by the appearance of unusually warm, nutrient-poor water off northern Peru and Ecuador, typically in late December</p> <p>La Niña - cooling of the water in the equatorial Pacific that occurs at irregular intervals and is associated with widespread changes in weather patterns complementary to those of El Niño, but less extensive and damaging in their effects</p>	<p>Patterns Cause and effect</p>
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**Standard 2: Flow of Matter and Energy**

Indiana Academic Standard	Clarifying Statement	Highlighted Vocabulary Words from the Standard Defined	Crosscutting Concept
<p>Env.2.1 Describe how matter cycles through sources and sinks and how energy is transferred. Explain how <b>matter</b> and <b>energy</b> move between and within components of an <b>environmental system</b>.</p>	<p>How carbon can get stuck in the ocean but flow through plants and atmosphere. How this flow can apply to all forms of matter and energy</p>	<p>Matter – physical substance in general that which occupies space and possesses rest mass</p> <p>Energy – power derived from the utilization of physical or chemical resources, especially to provide light and heat or to work machines</p> <p>Environmental system – system where life interacts with the various abiotic components found in the atmosphere, hydrosphere, and lithosphere</p>	<p>Patterns Cause and effect</p> <p>Systems and system models</p>
<p>Env.2.2 Identify the different forms of energy and understand that energy may be converted from one form to another, but cannot be created or destroyed.</p>	<p>Energy transfer not destroyed. Laws of thermodynamics. Energy from coal is burned and gives off heat and light, the heat can be used to boil water to produce steam to turn a turbine (mechanical) to power a generator to turn a light on (electrical)</p>		<p>Systems and system models</p> <p>Energy and matter</p>

<p>Env.2.3 Recognize and explain that the amount of life any environment can support is limited by the available energy, water, oxygen, nutrients and minerals, and by the ability of ecosystems to recycle <b>organic materials</b> from the remains of dead organisms.</p>	<p>Limiting factors of life and natural recycling.</p>	<p>Organic materials – organic compounds that has come from the remains of organisms such as plants and animals and their waste products in the environment</p>	<p>Cause and effect Systems and system models</p>
<p>"Env.2.4 Recognize and describe the different sources of energy, including <b>fossil fuels, nuclear,</b> and alternative sources of energy provided by water, wind, <b>geothermal, biomass/biofuels,</b> and the <b>sun.</b></p>	<p>Be able to tell where it come from and what it is used for and the pros and cons of each.</p>	<p>Fossil fuels – natural fuel such as coal or gas, formed in the geological past from the remains of living organisms. Nuclear – energy released during nuclear fission or fusion, especially when used to generate electricity Geothermal – produced by the internal heat of the earth Biomass – total mass of organisms in a given area or volume Biofuels – fuel derived directly from living matter Sun – star around which the earth orbits</p>	<p>Cause and effect Systems and system models</p>
<p>"Env.2.5 Give examples of the various forms and uses of <b>fossil fuels</b> and <b>nuclear energy</b> in our society.</p>	<p>Be able to tell where it come from and what it is used for and the pros and cons of each.</p>	<p>Fossil fuels – natural fuel such as coal or gas, formed in the geological past from the remains of living organisms. Nuclear energy – energy released during nuclear fission or fusion, especially when used to generate electricity</p>	<p>Cause and effect Energy and matter</p>

<p>"Env.2.6 Understand and describe how layers of energy-rich organic material have been gradually turned into great <b>coal beds</b> and <b>oil pools</b> by the <b>pressure</b> of the overlying earth. Recognize that by burning these fossil fuels, people are passing stored energy back into the environment as heat and releasing large amounts of matter such as carbon dioxide and other <b>air pollutants</b>.</p>	<p>How coal and oil are formed and form different types. As well as which type we use for energy or where new technology is headed</p>	<p>Coal beds – layer or stratum of mineral coal.  Oil pools – petroleum reservoir  Pressure – continuous physical force exerted on or against an object by something in contact with it  Air pollutants – introduction of particulates, biological molecules, or other harmful materials into Earth's atmosphere, causing diseases, death to humans, damage to other living organisms such as animals and food crops, or the natural or built environment.</p>	<p>Cause and effect  Energy and matter</p>
<p>Env.2.7 Differentiate between <b>renewable</b> and <b>nonrenewable resources</b>, and compare and contrast the pros and cons of using nonrenewable resources.</p>	<p>Pros and cons of fossil fuels, nuclear, biomass, solar, wind, hydro, geothermal and the differences in each</p>	<p>Renewable resources – substance of economic value that can be replaced or replenished in the same amount or less time as it takes to draw the supply down  Nonrenewable resources – resource of economic value that cannot be readily replaced by natural means on a level equal to its consumption</p>	<p>Cause and effect  Stability and change</p>
<p>Env.2.8 Cite examples of how all fuels, renewable and nonrenewable, have advantages and disadvantages that society must question when considering the trade-offs among them, such as how energy use contributes to the rising standard of living in the <b>industrially developing nations</b>. However, explain that this energy use also leads to more rapid depletion of Earth's energy resources and to environmental risks associated with the use of fossil and nuclear fuels.</p>	<p>Comparing economy to society to the environment when it comes to energy needs of humans. A cost benefit analysis</p>	<p>Industrially developing nations – less developed industrial base, and a low Human Development Index (HDI) relative to other countries</p>	<p>Cause and effect  Stability and change</p>

<p>Env.2.9 Describe how decisions to slow the depletion of energy sources through efficient technologies can be made at many levels, from personal to national, and these technologies always involve trade-offs of <b>economic costs</b> and <b>social values</b>.</p>	<p>Politics with energy</p>	<p>Economic costs – measuring costs against benefits  Social values – thinking about how scarce resources are allocated and used. It involves looking beyond the price of each individual contract and looking at what the collective benefit to a community is when a public body chooses to award a contract.</p>	<p>Stability and change</p>
<p>Env.2.10 Understand and describe how <b>nuclear reactions</b> release energy without the <b>combustion products</b> of burning fuels, but that the <b>radioactivity</b> of fuels and by-products poses other risks which may last for thousands of years. Understand and assess the uses of nuclear <b>fission</b> and <b>fusion</b>, including the implications for society.</p>	<p>Pros and cons of nuclear and radioactivity issues. Fission and fusion explanations.</p>	<p>Nuclear reactions – change in the identity or characteristics of an atomic nucleus that results when it is bombarded with an energetic particle, as in fission, fusion, or radioactive decay  Combustion products – end product when fuels, such as hydrocarbons, remain after the process of combustion. Thus, these are released and scattered into the atmosphere  Radioactivity – emission of ionizing radiation or particles caused by the spontaneous disintegration of atomic nuclei.  Fission – action of dividing or splitting something into two or more parts  Fusion – process or result of joining two or more things together to form a single entity</p>	<p>Stability and change</p>

<p>Env.2.11 Recognize and describe the role of <b>natural resources</b> in providing the <b>raw materials</b> for an <b>industrial society</b>.</p>	<p>Why humans need these resources</p>	<p>Natural resources – materials or substances such as minerals, forests, water, and fertile land that occur in nature and can be used for economic gain.</p> <p>Raw materials – basic material from which a product is made  Industrial society – society driven by the use of technology to enable mass production, supporting a large population with a high capacity for division of labor.</p>	<p>Cause and effect</p> <p>Stability and change</p>
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**Standard 3: Natural Disasters**

Indiana Academic Standard	Clarifying Statement	Highlighted Vocabulary Words from the Standard Defined	Crosscutting Concept
<p>Env.3.1 Identify and describe <b>geomorphic processes</b> controlled by tectonics (i.e. <b>volcanic activity</b>, <b>uplift</b>, and shaping of <b>landforms</b>)</p>		<p>Geomorphic processes – natural mechanisms of weathering, erosion and deposition that result in the modification of the surficial materials and landforms at the earth's surface</p> <p>Volcanic activity – rupture in the Earth's crust where molten lava, hot ash, and gases from below the Earth's crust escape into the air</p> <p>Uplift – raising of a geographical area as a consequence of plate tectonics</p> <p>Landforms – natural feature of the earth's surface.</p>	<p>Cause and effect</p> <p>Systems and system models</p>
<p>Env.3.2 Identify and describe <b>tornado</b> formation with the use of a <b>weather map</b>.</p>		<p>Tornado – mobile, destructive vortex of violently rotating winds having the appearance of a funnel-shaped cloud and advancing beneath a large storm system</p> <p>Weather map – map showing the state of the weather over a large area</p>	<p>Patterns</p> <p>Systems and system models</p>

Env.3.3 Read and describe a weather map in terms of <b>pressure systems</b> , fronts, and changing weather patterns		Pressure system – relative peak or lull in the sea level pressure distribution	Patterns  Systems and system models
"Env.3.4 Identify natural Earth hazards, such as <b>earthquakes</b> and <b>hurricanes</b> , and identify the regions in which they occur as well as the short-term and long-term effects on the environment and on people.		Earthquakes – sudden and violent shaking of the ground, sometimes causing great destruction, as a result of movements within the earth's crust or volcanic action  Hurricanes – large tropical storm system with high-powered circular winds.	Cause and effect  Systems and system models

#### Standard 4: Environmental Policy

Indiana Academic Standard	Clarifying Statement	Highlighted Vocabulary Words from the Standard Defined	Crosscutting Concept
Env.4.1 Explain <b>environmental policies</b> /organizations (Clean Water Act, Clean Air Act, Endangered Species Act, Species Survival Plan, Resource Conservation and Recovery Act, Department of Energy, and the World Health Organization) and identify their impact.		Environmental policies – commitment of an organization to the laws, regulations, and other policy mechanisms concerning environmental issues	Cause and effect  Stability and change
Env.4.2 Understand that environmental policies/decisions have negative and positive impacts on people, societies, and the environment	Human health, society, environment, and economics trend that these laws change and adjust		Stability and change

#### Standard 5: Biodiversity

Indiana Academic Standard	Clarifying Statement	Highlighted Vocabulary Words from the Standard Defined	Crosscutting Concept

<p>Env.5.1 Explain how <b>variation</b> within a species increases the chances of <b>survival</b> of the species under changing environmental conditions.</p>		<p>Variation – change or difference in condition, amount, or level, typically with certain limits Survival – state or fact of continuing to live or exist, typically in spite of an accident, ordeal, or difficult circumstances.</p>	<p>Stability and change</p>
<p>Env.5.2 Explain how the great <b>diversity</b> of species increases the chance that at least some living organisms will survive in the event of <b>major global changes</b>.</p>		<p>Diversity – range of different things Major global changes – planetary-scale changes in the Earth system</p>	<p>Cause and effect  Stability and change</p>
<p>Env.5.3 Explain <b>genetic engineering</b> and identify implications on the environment and society.</p>		<p>Genetic engineering – deliberate modification of the characteristics of an organism by manipulating its genetic material.</p>	<p>Stability and change</p>
<p>Env.5.4 Describe, provide examples, and contrast <b>GMO products, organic products, and conventional products</b>. Describe and explain the environmental concerns associated with GMOs</p>		<p>GMO products – Genetically modified organisms (GMOs) can be defined as organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination Organic products – grown without the use of pesticides, synthetic fertilizers, sewage sludge, genetically modified organisms, or ionizing radiation Conventional products – grown with the use of pesticides, synthetic fertilizers, sewage sludge, genetically modified organisms, or ionizing radiation</p>	<p>Cause and effect</p>

Env.5.5 Identify the indirect and direct threats to <b>biodiversity</b> (e.g. habitat lose and destruction, invasion by exotic species, commercial overfishing and hunting, pollution, climate change, and bioaccumulation and biomagnification of toxins)		Biodiversity – variety of life in the world or in a particular habitat or ecosystem.	Cause and effect
Env.5.7 Identify and explain the three levels of biodiversity: <b>genetic</b> , <b>species</b> , and <b>ecosystem</b>		Genetic- total number of genetic characteristics in the genetic makeup of a species Species – measure of diversity in an ecological community Ecosystem – variety of ecosystems in a given place	Energy and matter

### Standard 6: Population

Indiana Academic Standard	Clarifying Statement	Highlighted Vocabulary Words from the Standard Defined	Crosscutting Concept
"Env.6.1 Demonstrate, calculate, and explain how factors such as <b>birth rate</b> , <b>death rate</b> , and <b>migration rate</b> determine <b>growth rates</b> of populations.		Birth rate – number of live births per thousand of population per year Death rate – ratio of deaths to the population of a particular area during a particular period of time, usually calculated as the number of deaths per one thousand people per year Migration rate – difference of immigrants and emigrants of an area in a period of time, divided (usually) per 1,000 inhabitants Growth rate- increase in a country's population during a period of time	Patterns  Cause and effect  Systems and system models

"Env.6.2 Explain how the size and rate of growth of the human population in any location is affected by economic, political, religious, technological, and environmental (resource availability) factors	Pro and cons to population size in reference to economic, political, religious, technological, and environmental factors.		Systems and system models
"Env.6.3 Describe and give examples about how the decisions of one <b>generation</b> both provide and limit the range of possibilities open to the next generation.		Generation – a body of living beings constituting a single step in the line of descent	Cause and effect Energy and matter
Env.6.4 Explain how the <b>carrying capacity</b> of an ecosystem may change as availability of resources changes.		Carrying capacity – the number of people, other living organisms, or crops that a region can support without environmental degradation	Cause and effect

Standard 7: Pollution			
Indiana Academic Standard	Clarifying Statement	Highlighted Vocabulary Words from the Standard Defined	Crosscutting Concept
Env.7.1 Identify evidence, consequences, and prevention for <b>climate change</b> produced by <b>anthropogenic sources</b> .		Climate change – change in global or regional climate patterns Anthropogenic sources – Caused or influenced by humans	Cause and effect Energy and matter
Env.7.2 Differentiate between <b>natural pollution</b> and <b>pollution</b> caused by humans.		Natural pollution – pollutant created by substances of natural origin such as volcanic dust, sea salt particles, photochemically formed ozone, and products of forest fibers, among others Pollution – presence in or introduction into the environment of a substance or thing that has harmful or poisonous effects	Cause and effect Energy and matter

<p>Env.7.3 Compare and contrast the effects of <b>environmental stressors</b> (i.e. herbicides, pesticides) on plants and animals. Give examples of secondary effects on other environmental components.</p>		<p>Environmental stressors – Pressure on the environment caused by human activities (such as generation of pollution) or by natural events (such as occurrence of a drought).</p>	<p>Cause and effect</p>
<p>Env.7.4 Explain what common household <b>toxins</b> are, what to do in an emergency, and what proper <b>disposal</b> is.</p>		<p>Toxins – antigenic poison or venom of plant or animal origin, especially one produced by or derived from microorganisms and causing disease when present at low concentration in the body Disposal – action or process of throwing away or getting rid of something</p>	<p>Cause and effect Energy and matter</p>
<p>Env.7.5 Identify and describe the major <b>air pollutants</b> and their sources and impacts on the environment and human health</p>		<p>Air pollutants – air contains gases, dust, fumes or odor in harmful amounts. That is, amounts which could be harmful to the health or comfort of humans and animals or which could cause damage to plants and materials</p>	<p>Cause and effect Energy and matter</p>
<p>Env.7.6 Understand and explain how the burning of fossil fuels releases energy, waste <b>heat</b> and <b>matter</b> (air pollutants)</p>		<p>Heat – form of energy associated with the movement of atoms and molecules in any material. Matter – that which occupies space and possesses rest mass</p>	<p>Cause and effect Energy and matter</p>

<p>Env.7.7 Describe and explain the <b>product life cycle</b> and <b>waste stream</b> and its implications to <b>waste management</b>. Explain the difference between <b>reduce</b>, <b>reuse</b>, and <b>recycle</b></p>		<p>Product life cycle – the time of creation of a product, sale, use, and where it eventually gets disposed</p> <p>Waste stream – total flow of solid waste from homes, businesses, institutions, and manufacturing plants that is recycled, burned, or disposed of in landfills, or segments</p> <p>Waste management – collection, transportation, and disposal of garbage, sewage and other waste products</p> <p>Reduce – make smaller or less in amount, degree, or size</p> <p>Reuse – use again or more than once</p> <p>Recycle – convert (waste) into reusable material</p>	<p>Cause and effect</p> <p>Systems and system models</p>
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Standard 8: Natural and Anthropogenic Resource Cycles			
Indiana Academic Standard	Clarifying Statement	Highlighted Vocabulary Words from the Standard Defined	Crosscutting Concept
<p>Env.8.1 Demonstrate a knowledge of the distribution of natural resources in the U.S. and the world, and explain how natural resources influence relationships among <b>nations</b>.</p>		<p>Nations – large aggregate of people united by common descent, history, culture, or language, inhabiting a particular country or territory</p>	<p>Cause and effect</p>
<p>Env.8.2 Understand and describe the concept of integrated <b>natural resource management</b> and the values of managing natural resources as an ecological unit.</p>		<p>Natural resource management – management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations</p>	<p>Cause and effect</p> <p>Systems and system models</p>

Env.8.3 Recognize and explain that in <b>evolutionary change</b> , the present arises from the materials of the past and in ways that can be explained, such as the formation of soil from rocks and dead organic matter.		Evolutionary change – gradual change in the characteristics of a population of animals or plants over successive generations	Stability and change
Env.8.4 Describe how <b>agricultural technology</b> requires trade-offs between increased production and environmental harm and between efficient production and social values.		Agricultural technology – application of techniques to control the growth and harvesting of animal and vegetable products	Cause and effect
Env.8.5 Describe and examine how water is controlled in developed and undeveloped nations.			Energy and matter
Env.8.6 Understand and describe the concept and the importance of natural and human recycling in conserving our natural resources.			Cause and effect Energy and matter
Env. 8.7 Understand and explain that waste management includes considerations of <b>quantity, safety, degradability</b> , and <b>cost</b> . Also understand that waste management requires social and technological innovations because waste-disposal problems are political and economic as well as technical.		Quantity – amount or number of a material or immaterial thing not usually estimated by spatial measurement Safety – condition of being protected from or unlikely to cause danger, risk, or injury Degradability – compound that breaks down into simpler compounds by stages Cost – amount that has to be paid or spent to buy or obtain something	Cause and effect Systems and system models

Crosscutting Concepts

1. Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
2. Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
3. Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
4. Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.
5. Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.
6. Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.