Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_

Enviro Sci20: ES1 Nature of ES **My Connection**

**My Connection To The Natural Environment**

Reflect upon how your connection with the environment is influenced. Be sure to consider and include the following:

1. Explore your own personal experiences both OF the natural environment and IN the natural environment. Experiences can be positive and/or negative.
2. How family has influenced your connection with the natural environment?
3. How have friends, neighbors and community influenced your connection with the natural environment?
4. How has your understanding of culture influenced your connection with the environment?
5. How has your understanding of DIFFERENT cultures influenced your connection with the environment?
6. How has mass media influenced your connection with the environment?
7. How has your understanding of global issues/concerns influenced your connection with the environment?

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Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_

Enviro Sci20: ES1 Nature of ES  **Enviro Sci Defined**

**Environmental Science Defined**

This **synthetic** (putting together) exercise will facilitate a deeper understanding of the definition of environmental science. You will need library/textbook resources and internet access to complete this assignment.

1. Find **10 different definitions** of environmental science and write them on the back of this paper. You can use either books or web materials.
2. After reading all 10 of your definitions, **synthesize** the most important features of each into a single definition of environmental science ***in your own words.***

*MY definition of environmental science is…*

1. After creating your own definition, get into a **group of 2-4** and discuss the definitions you have come up with coming up with a single perfect definition.

*Our* *definition of environmental science is…*

1. Write that definition on the board to help create a class discussion
   1. Rooted in numbers – definition of science (empirical, repeatable, falsifiable)
   2. Describes human interaction with the world - how are humans affecting things
   3. Deals with (potential) environmental issues
   4. Used for environmental impact assessments
   5. Multidisciplinary
2. Define Environmentalism –
3. How is Environmental Science different from Environmentalism?

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_

Enviro Sci20: ES1 Nature of ES  **Enviro Sci Defined**

* + - 1. Environmental Science is…

Source:

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# Miss Foley

ESci20: ES1 Nature of ES  **An Interdisciplinary Science**

**Environmental Science =**

**The study of how the natural world works, how our environment**

**affects us, and how we affect our environment.**

The **environment** includes all the living (biotic) and non-living (abiotic) things with which organisms interact. **Organisms** are living things. Our connection with the environment is influenced by personal experiences, family/friends, mass media and cultural understandings. We gain a deeper understanding and appreciation of the environment when we personally experience it actively and directly.

**Environmental science** is an **interdisciplinary** field, one that borrows techniques from numerous disciplines and brings research results from these disciplines together. It is a newly developing field that integrates knowledge, theories, models and processes from other scientific disciplines such as ecology, atmospheric science, biology, chemistry, physics, oceanography, geology and human geography to investigate human impacts on the environment.

**Enviromentalism** is a social movement dedicated to protecting the natural world from undesirable changes brought about by human actions. It is incorrect to confuse Environmental Science with Environmental Studies.

Environmental scientists maintain an objective approach focusing on data avoiding bias and value judgements at all times. **Data** is information that does not change from person to person. A **value judgement**is information that does change from person to person. **Bias** is a preference or viewpoint that is personal, not scientific. Attempting to remain free from bias, open to whatever conclusion the data demands is the ultimate goal of an effective scientist.

Environmental scientists use the **scientific method** – a process made up of asking questions, making a hypothesis, making and testing predictions, making observations, analyzing and interpreting results and making conclusions.

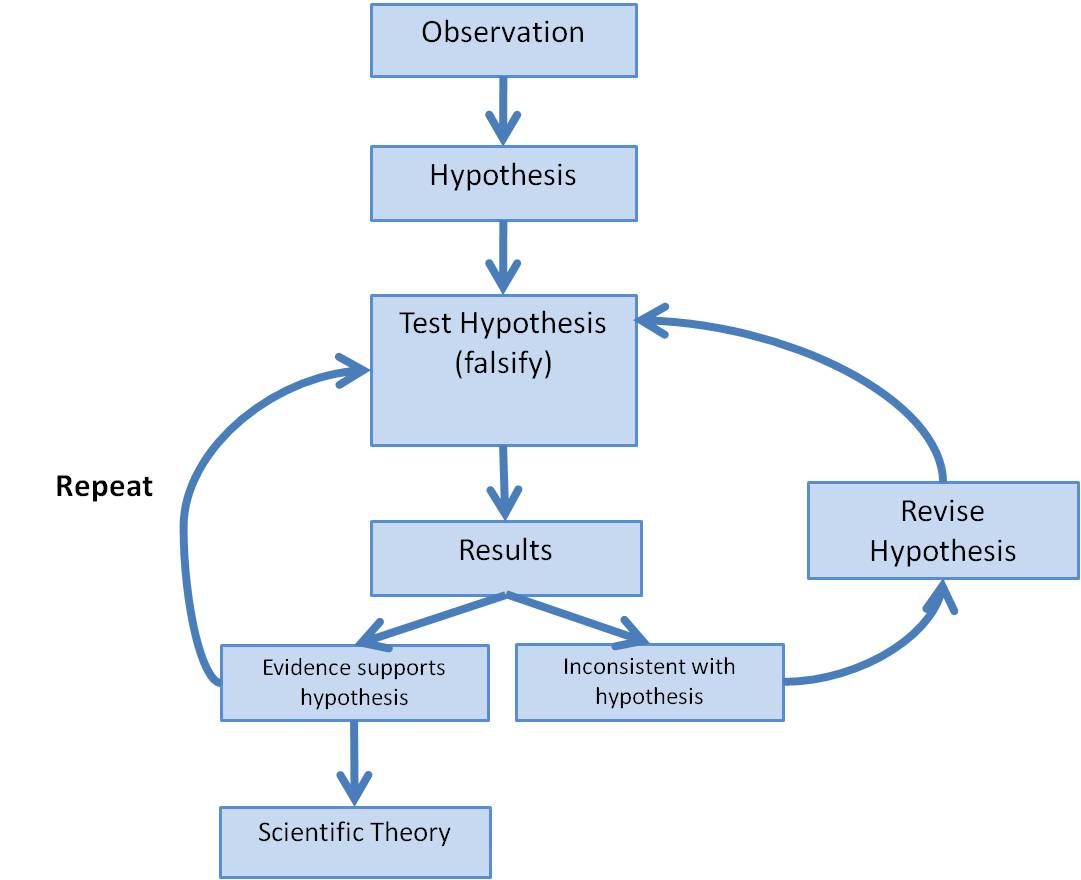
Environmental scientists also use **modelling to generate** **predictions** when they can’t observe a phenomenon directly. Assumptions and approximations that are incorporated into a model of a particular environmental system can influence the reliability and precision of the model.

They use experiments, observational studies and controlled studies to gather data. In **observational studies**, scientists look for evidence in the natural world that would help confirm or contradict the predictions generated by their hypothesis.

**Experiments** are activities designed to test the validity of a prediction or hypothesis. They involve manipulating **variables** (conditions that change) both independent and dependent. **Independent variables** are variables that scientists manipulate while **dependent variables** change in response to the conditions set in an experiment. Environmental scientists particularly value **quantitative data** which is information that does not change from person to person often expressed using numbers.

# Miss Foley

ESci20: ES1 Nature of ES  **The Scientific Method**

****

**Lab Reports document findings from the scientific method.**

The lab write-up should be done as outlined below. The Purpose (objective), Hypothesis, and Procedure should be completed before the lab period. When conducting an experiment using the scientific procedure, some data may be collected in rough form. You may need to transfer this data to a proper data chart in your final write up.

**Title**

**Purpose:** This is the problem you are evaluating. Make a brief statement about what you are trying to discover or find out.

**Hypothesis:** This is a statement of what you think will happen based on your experiences. This should be a tentative answer to the problem posed in the purpose, and will either be proved or disproved by the results of the activity. No marks will be deducted for stating a hypothesis that does not agree with what you will discover in the activity, but they must be statements that make sense.

**Materials:** List of all materials used during the lab.

**Procedure:** This is a description of the steps to be followed to complete the activity. Diagrams of the experimental apparatus (if required) may be included here. If you are given a handout of the procedure, or if the procedure is in the textbook, you may indicate this by writing “see handout” or “see textbook” instead of writing out the procedure.

**Data / Observations:** If measurements or any other kind of quantitative information has been collected, these will be listed here. They are usually in the form of chart or table. Use a ruler to make your tables. If qualitative observations are made, these will also be included under this heading. A single sample calculation must be included for each calculation type when calculations are done, but you do not need to show all work for all values.

**Discussion:** In this section, you interpret your results in terms of what you know or what is in the text or other references. In most cases this will take the form of answering questions in the lab material.

**Conclusion:** This is a statement indicating if your hypothesis is correct or incorrect. If your hypothesis is well written, you should have no difficulty in writing a meaningful conclusion. A list of experimental errors is often included in this section.

# Miss Foley

ESci20: ES1 Nature of ES  **Differing Worldviews**

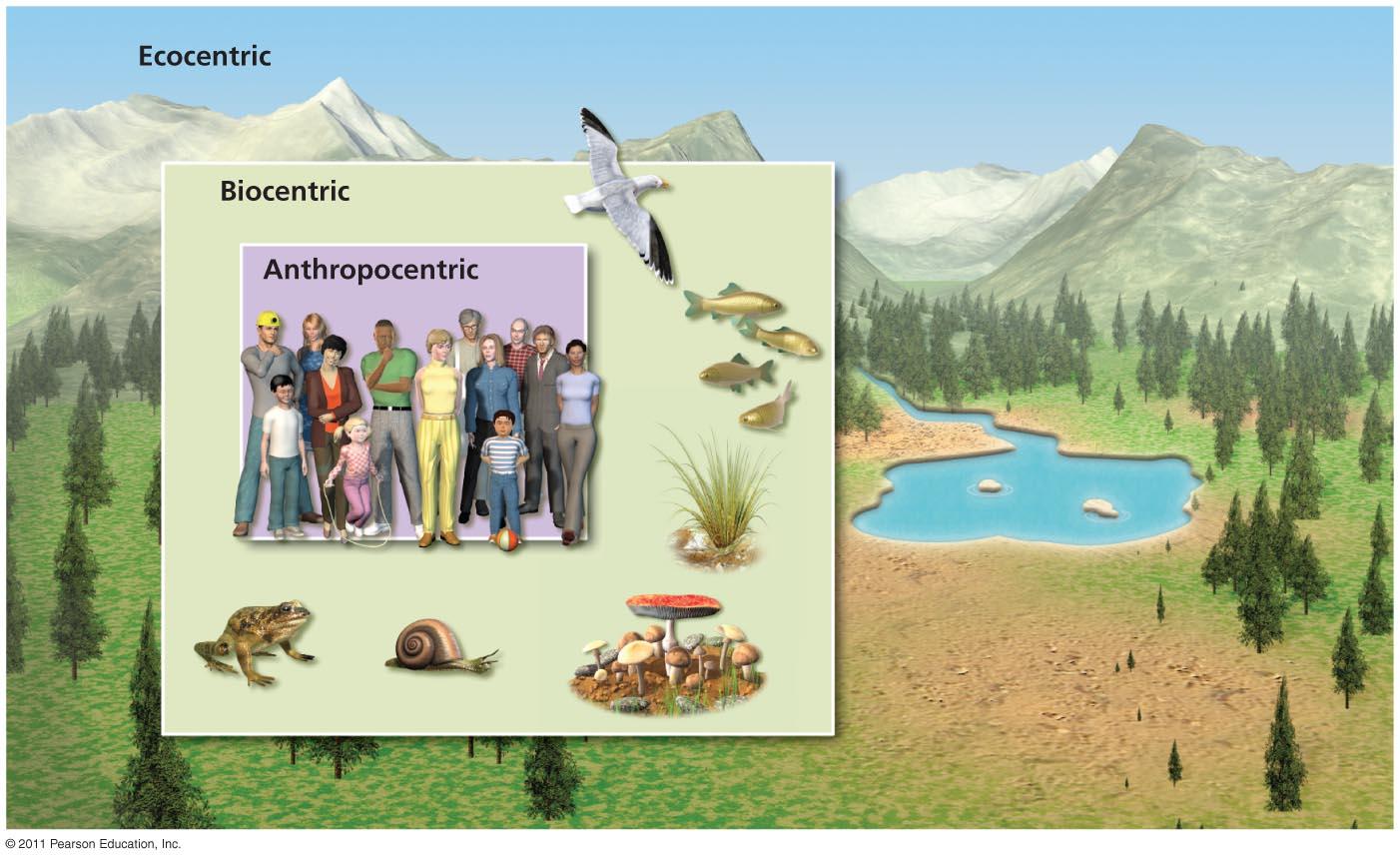
**First Nations and Métis** **=**

provides essential characteristics regarding the environment,

including the importance of the four elements (i.e., earth, water,

wind and fire), a sense of interconnectedness with the

environment and respect for Mother Earth.



**Anthropocentrism =**

a human-centered view of our relationship with the environment placing the highest value on humans and human welfare.

**Biocentrism** **=**

gives value to all living things evaluating the overall

impact on living things, both human and non-human.

**Ecocentrism *=***

judges the overall impact on whole ecological systems, consisting of relationships between both living and non-living elements.

# Miss Foley

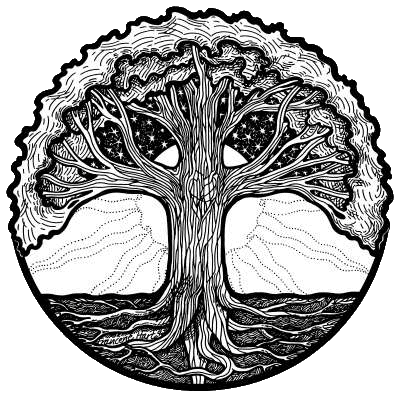
ESci20: ES1 Nature of ES  **First Nations & Metis Worldview**

**The Sacred Tree**

Source: The Sacred Tree: A Reflection On Native American Spirituality © 1985

And Elder Mike Pinay Dec 2015 Visit Notes

For all the people of the earth, the Creator has planted a Sacred Tree under which they may gather, and there find healing, power, wisdom and security. The roots of this tree spread deep into the body of Mother Earth. Its branches reach upward like hands praying to Father Sky. The fruits of this tree are the good things the Creator has given to the people, teachings that show the path to love, compassion, generosity, patience, wisdom, justice, courage, respect, humility and many other wonderful gifts.

The ancient ones taught us that the life of the Tree is the life of the people. If the people wander far away from the protective shadow of the Tree, if they forget to seek the nourishment of its fruit, or if they should turn against the Tree and attempt to destroy it, great sorrow will fall upon the people. Many will become sick at heart. The people will lose their power. They will cease to dream dreams and see visions. They will begin to quarrel among themselves over worthless trifles. They will become unable to tell the truth and to deal with each other honestly. They will forget how to survive in their own land. Their lives will become filled with anger and gloom. Little by little they will poison themselves and all they touch.

It was foretold that these things would come to pass, but that the Tree would never die. And as long as the Tree lives, the people live. It was also foretold that the day would come when the people would awaken, as if from a long, drugged sleep; that they would begin, timidly at first but then with great urgency, to search again for the Sacred Tree.

The knowledge of its whereabouts, and of the fruits that adorn its branches have always been carefully guarded and preserved within the minds and hearts of our wise elders and leaders. These humble, loving and dedicated souls will guide anyone who is honestly and sincerely seeking along the path leading to the protecting shadow of the Sacred Tree.

# Miss Foley

ESci20: ES1 Nature of ES  **First Nations/Metis/Inuit Worldview**

**FNMI Code of Ethics**

In addition to the sacred teachings concerning the nature of things, the teachings of the *Sacred Tree* include a code of ethics to which all should conform their lives if they wish to find happiness and well-being.  This code describes what wisdom means in the relationship between individuals, in family life, and in the life of the community.  These are the sparkling gems of experience practiced by Native peoples everywhere:

* Each morning before rising, and each evening before sleeping, give thanks for the life within you and for all life, for the good things the Creator has given you and others and for the opportunity to grow a little more each day.  Consider your thoughts and actions of the past day and seek for the courage and strength to be a better person.  Seek for the things that will benefit everyone.
* Be truthful at all times, and under all conditions.
* Always treat your guests with honor and consideration.  Give of your best food, your best blankets, the best part of your house, and your best service to your guests.
* The hurt of one is the hurt of all, the honor of one is the honor of all.
* Receive strangers and outsiders with a loving heart and as members of the human family.
* Observe moderation and balance in all things.
* All the races and tribes in the world are like the different colored flowers of one meadow.  All are beautiful.  As children of the Creator they must all be respected.
* To serve others, to be of use to family, community, nation or the world is one of the main purposes for which human beings have been created.  Do not fill yourself with your own affairs and forget your most important task.  True happiness comes only to those who dedicate their lives to the service of others.
* Know those things that lead to your well-being, and those things that lead to your destruction.
* Respect the wisdom of the people in council.  Once you give an idea to a council or a meeting it no longer belongs to you.  It belongs to the people.  Respect demands that you listen intently to the ideas of others in council and that you do not insist that your idea prevail.  Indeed, you should freely support the ideas of others if they are true or good, even if those ideas are quite different from the ones you have contributed.  The clash of ideas brings forth the spark of truth.  Once a council has decided something in unity, respect demands that no one speak secretly against what has been decided.  If the council has made an error, that error will become apparent to everyone in its own time.

# Miss Foley

ESci20: ES1 Nature of ES  **First Nations/Metis/Inuit Worldview**

* Respect.  Respect means “to feel or show honor or esteem for someone or something; to consider the well-being of, or to treat someone or something with deference or courtesy”.  Showing respect is a basic law of life.
  1. Treat every person, from the tiniest child to the oldest elder with respect at all times.
  2. Special respect should be given to elders, parents, teachers, and community members.
  3. No person should be made to feel “put down” by you; avoid hurting other hearts as you would avoid a deadly poison.
  4. Touch nothing that belongs to someone else without permission, or an understanding between you.
  5. Respect the privacy of every person.  Never intrude on a person’s quiet moments or personal space.
  6. Never walk between people that are conversing.
  7. Never interrupt people that are conversing.
  8. Speak in a soft voice, especially when you are in the presence of elders, strangers, or others to whom special respect is due.
  9. Do not speak unless invited to do so at gatherings where elders are present.
  10. Never speak about others in a negative way, whether they are present or not.
  11. Treat the earth and all of her aspects as your mother.  Show deep respect for the mineral world, the plant world, and the animal world.  Do nothing to pollute the air or the soil.  If others would destroy our mother, rise up with wisdom to defend her.
  12. Show deep respect for the beliefs and religions of others.
  13. Listen with courtesy to what others say, even if you feel that what they are saying is worthless.
  14. Listen with your heart.



# Miss Foley

ESci20: ES1 Nature of ES  **Elder Wisdom**

**Elder Mike Pinay Visit Notes (Dec 2015)**

Need to finish!!!!

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_

ESci20: ES1 Nature of ES  **Impact of Revolutions**

**“FedEx” Day – Delivering Overnight**

1. Individually research one of the following revolutions and their contribution to the overall impact on human population growth and the natural environment:

* Green/Agricultural
* Industrial
* Medical
* Environmental

1. Gather with your presentation group to combine research and strategize how you will orally present your compiled research.
2. Be prepared to orally share your findings with the class and hand in your research notes following your presentation.

*Reminder: Place a star (*🞳*) at the end of your individual research notes before handing in.*

**Research and Presentation Notes:**

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# Miss Foley

ESci20: ES1 Nature of ES  **Revolutions Timeline**

**Medical Revolution** ❑ Anthropocentrism ❑ Biocentrism ❑ Ecocentrism

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**Industrial Revolution** ❑ Anthropocentrism ❑ Biocentrism ❑ Ecocentrism

*Impact on Environment: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

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**Agriculture/Green Revolution** ❑ Anthropocentrism ❑ Biocentrism ❑ Ecocentrism

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**Environmental Revolution** ❑ Anthropocentrism ❑ Biocentrism ❑ Ecocentrism

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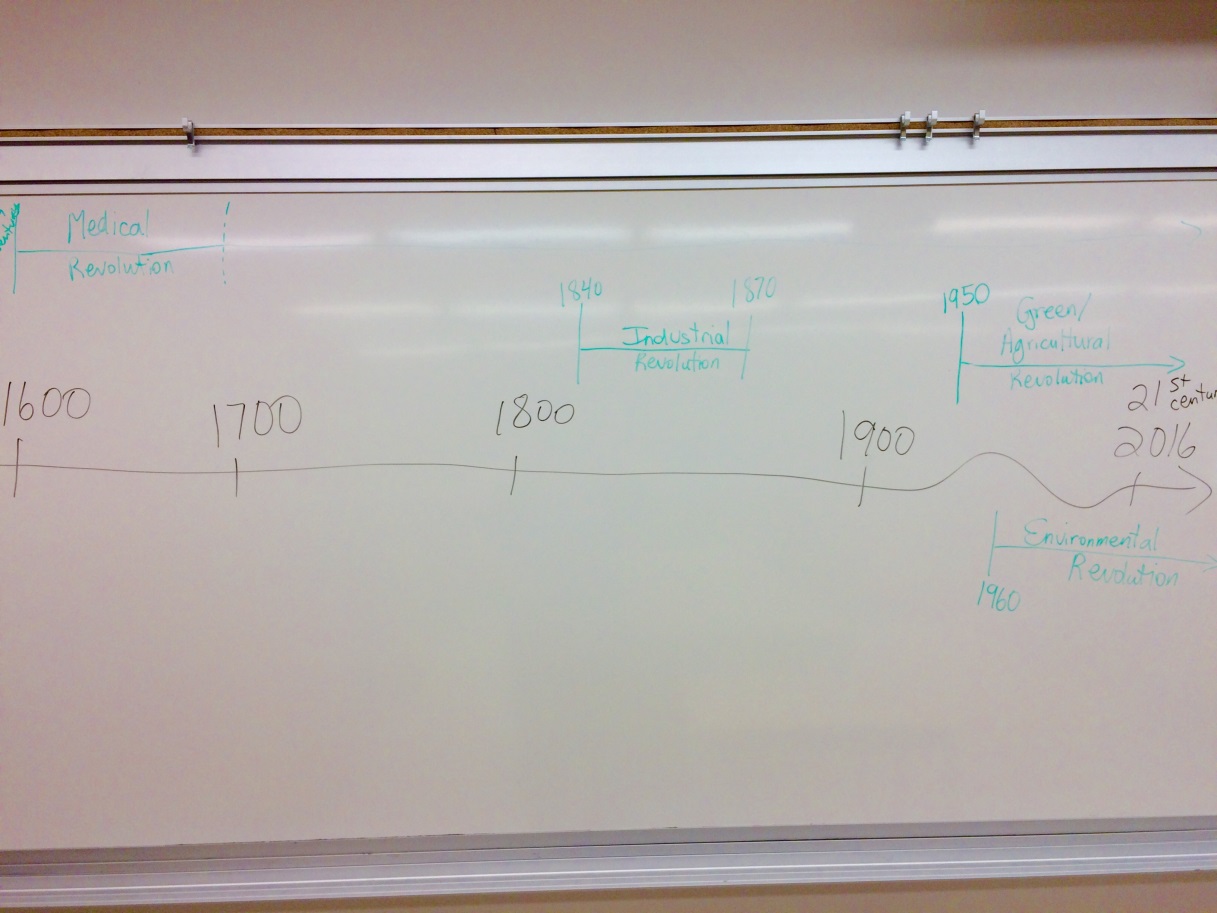
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# Miss Foley

ESci20: ES1 Nature of ES  **Revolutions Timeline**

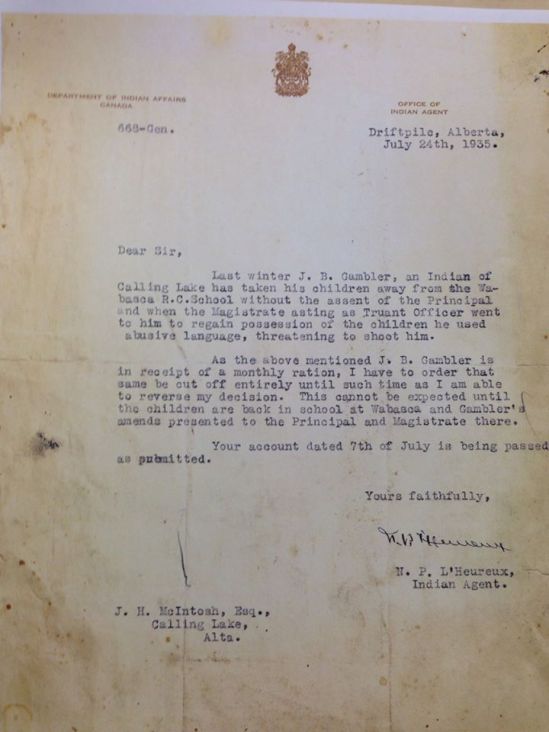
**TEACHER COPY**



The *agricultural revolution* was the transition around 10,000 years ago from a nomadic hunter-gatherer lifestyle to growing crops, raising animals and living in villages making it easier to meet nutritional needs. As a result, they began to live longer life spans and had the ability to produce more children who survived to adulthood. The *industrial revolution* around 300 years ago was the shift from rural life, with animal-powered agriculture and hand-made manufacturing, to an urban society powered by non-renewable energy sources such as coal, oil and natural gas. The agricultural and industrial revolutions are responsible for remarkable increases in human population size.

**A Letter from an Indian Agent to cut off Rations for J.B Gambler: Calling Lake Alberta 1935**

[*July 31, 2014*](https://redpowermedia.wordpress.com/2014/07/31/a-letter-from-an-indian-agent-to-cut-off-rations-for-j-b-gambler-calling-lake-alberta-1935/)*by*[*Red Power Media, Staff*](https://redpowermedia.wordpress.com/author/redpowermedia/)

[](https://redpowermedia.files.wordpress.com/2014/07/10301930_713059502091333_2955817261194183136_n1.jpg)

*Letter from an Indian agent to a store clerk – Calling Lake Alberta 1935*

When residential schools were established for Native people in Canada by the government of Sir John A. MacDonald, there were resisters.

This is a letter from an Indian agent to a store clerk in Calling Lake Alberta in 1935.

It was a request to have monthly rations for J.B Gambler cut off as punishment for removing his children from the Wabasca residential school.

Gambler refused to send his children back.

“When the Magistrate acting as Truant Officer went to him to regain possession of the children he used abusive language and threatened to shoot him,” says the letter signed W.P. L’Heureux.

“As the above mentioned J.B. Gambler is in receipt of a monthly ration, I have to order that the same be cut off entirely until such time as I am able to reverse my decision,” L’Heureux wrote to the store owner.

“This cannot be expected until the children are back at school at Wabasca and Gambler’s amends presented to the Principal and Magistrate there.”

At the time Native people were not allowed to leave the reserves without the permission of the local Indian Agent.

Unable to leave the reserve, rations were a heavy hammer to wield, forcing people to send their children to the residential schools so they were fed.

The letter is a stark evidence of the price paid by Native parents who did not comply with the residential school system.

[Curtis Cardinal](https://www.facebook.com/curtis.cardinal.9?lst=100000274282448%3A100001618700871%3A1505510388) posted the letter from his great-great-great grandfather Jean-Baptiste Gambler on his Facebook page. He also gave permission to Red Power Media to post it.

The letter was found in a shed by Gwen Schmidt in July 2014.

*By: Black Powder*

# Miss Foley

ESci20: ES1 Nature of ES  **Sustainability & CEAA**

**Sustainability =**

**Our ability to meet current demand for resources**

**without depleting future supply**

Principles of sustainability, such as environmental justice, environmental economics and social justice, are integral to environmental science. The question revolves around how we go about making sustainability possible.

***Environmental justice*** promotes the fair and equitable treatment of all people with respect to environmental policy and practice, regardless of income, race or ethnicity.

***Environmental economics*** refers to the field of economics that links environmental and economic costs.

***Environmental ethics and social justice*** are the application of ethical standards to relationships between humans and their environment.

***Ecological footprints*** are used to express the environmental impact of an individual or population in terms of the total amount of land and water required to provide raw materials consumed and to dispose of or recycle the waste the individual or population produces. Every organism and natural/synthetic object has a footprint.

**Canadian Environmental Assessment Agency (CEAA)**

Data produced through environmental science can be used in environmental impact assessments, such as those outlined in the **Canadian Environmental Assessment Act (CEAA) 2012**, guiding projects or policies. Under CEAA 2012, an environmental assessment focuses on potential adverse environmental effects that are within federal jurisdiction, including:

* fish and fish habitat
* other aquatic species
* migratory birds
* federal lands
* effects that cross provincial or international boundaries
* effects that impact on Aboriginal peoples, such as their use of lands and resources for traditional purposes
* changes to the environment that are directly linked to or necessarily incidental to any federal decisions about a project

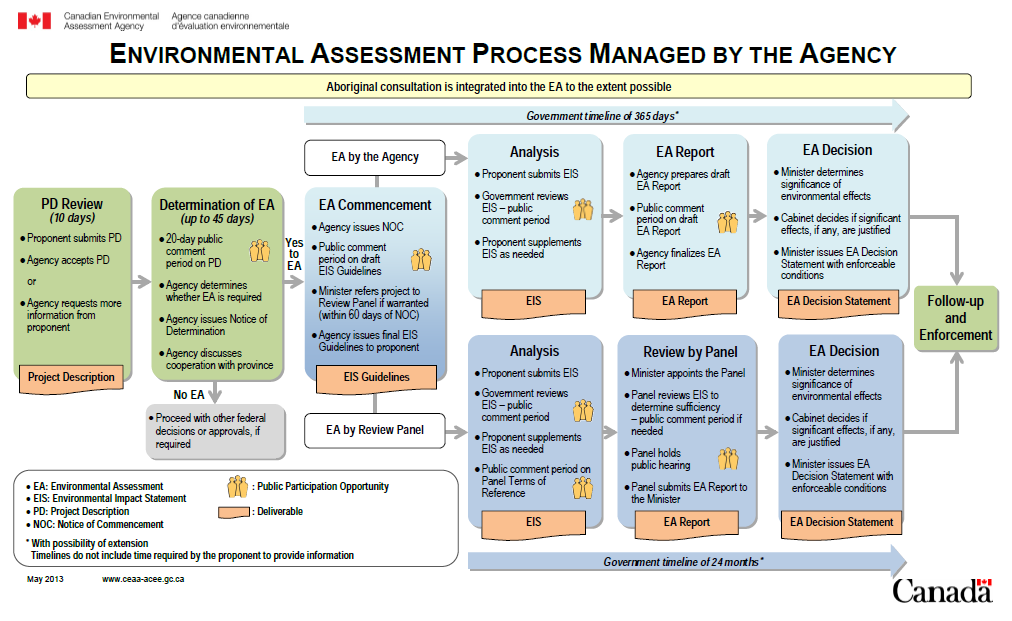
An **environmental assessment will consider** a comprehensive set of factors that include **cumulative effects, mitigation measures** and **comments received from the public.**

The following **timelines** have been set by the CEAA 2012 for the government to complete its work:

* **365 days** from the commencement of an environmental assessment by the Agency to the final environmental assessment decision
* **24 months** for an assessment by review panel from the time of referral to the final environmental assessment decision.
* Designated projects that are regulated by the Canadian Nuclear Safety Commission or the National Energy Board **automatically** require an environmental assessment by those regulators.

# Miss Foley

ESci20: ES1 Nature of ES  **CEAA (cont’d)**



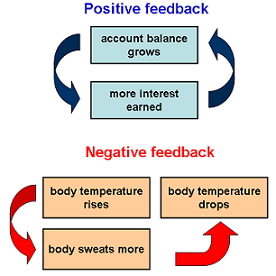
# Miss Foley

ESci20: ES1 Nature of ES  **Systems**

**System =**

**A network of relationships among parts, elements, or components that interact with and influence one another through the exchange of energy, matter or information**

The earth’s environment consists of complex systems that receive inputs of energy, matter, or information; process these inputs; and produce outputs of energy, matter or information. Systems seldom have well-defined boundaries making it harder to decide where one ends and another begins.

**Feedback loops =**

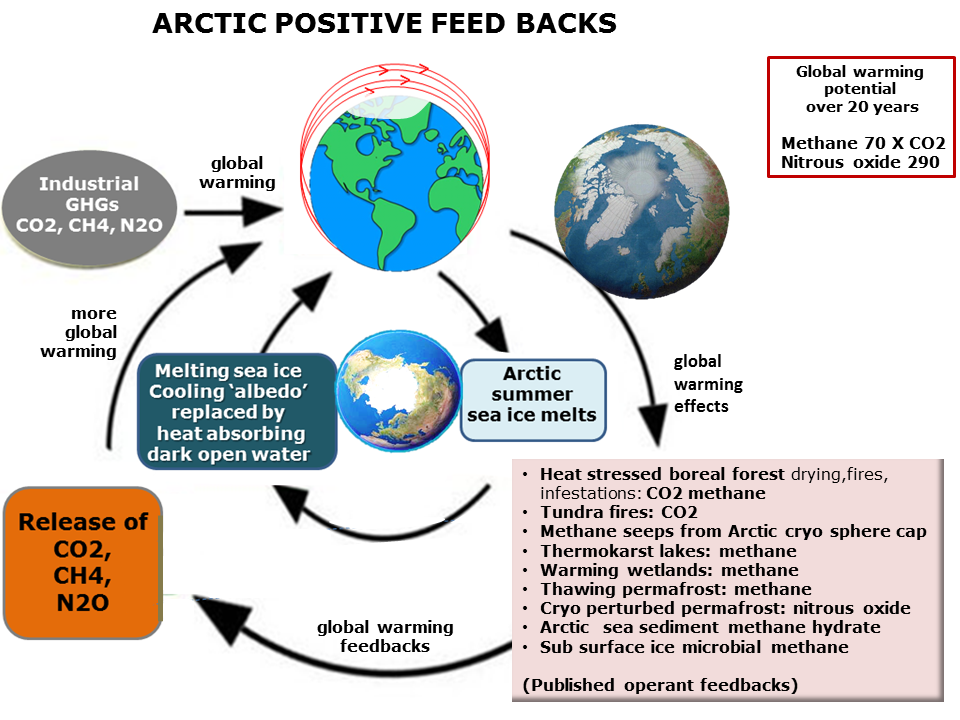
**Cyclical processes that describe how an event is both a cause & an effect in the same system**

In **negative feedback loops**, the output of a system moving in one direction acts as input that causes the system to **move in the other direction**. Negative feedback loops **stabilize a system**.

*Examples:* thermostats, predator-prey, body temperature

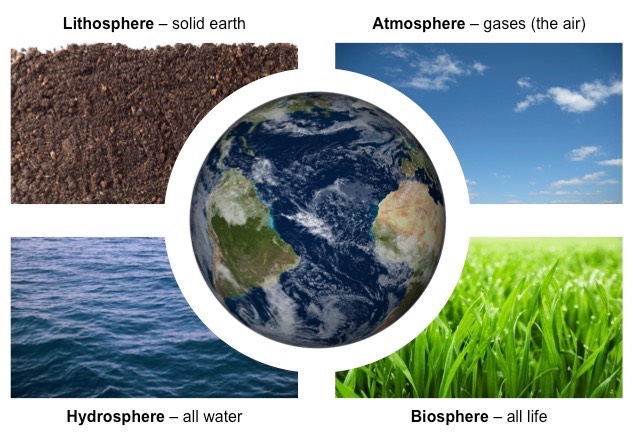
In **positive feedback loops**, the output of a system moving in one direction acts as an input that causes the system to continue **moving in the same direction**. Positive feedback loops **destabilize systems** driving them towards the extreme.

*Examples:* erosion, mental health disorders, fevers



# Miss Foley

ESci20: ES1 Nature of ES  **Spheres**

The earth is made up of several unique properties, characteristics, composition and they all affect the processes of the earth differently. Every of these properties and elements in Earth’s system are largely categorized into one of the four major subsystems including water, living things, land, and the air. These are regarded as the four interlocking “wonders” that create the earth’s diversity. Cumulatively, they are primarily grouped into biological (a.k.a. **biotic** = living things) and physical (a.k.a. **abiotic** = non-living things).

These four “wonders” of the earth are dependent upon each other and have been used to make the study of biological and physical components of the earth easily comprehendible. They are scientifically called the biophysical elements namely the **hydrosphere** (‘hydro’ for water), **biosphere** (‘bio’ for living things), **lithosphere** (‘litho’ for land), and **atmosphere** (‘atmo’ for air). These spheres are further divided into various sub-spheres.

**Hydrosphere = WATER**

The hydrosphere includes all the gaseous, liquid, and solid water of the planet earth. The hydrosphere stretches all the way from the Earth’s surface downward numerous miles into the lithosphere and high above the crust into the atmosphere. Most of the water in the atmosphere is in gaseous form and as it rises higher into the atmosphere it condenses to form clouds which fall back on earth as precipitation.

Water in the hydrosphere is always in motion just like the atmospheric gases. The natural earth features depicting the hydrosphere are the rivers, streams, lakes, seas, oceans and the water vapor. Glaciers, which are the slowly moving masses of ice, are also part of the hydrosphere. 97% of all earth’s water is salty. Oceans carry most of the salty water while the majority of lakes and rivers carry fresh water. The earth’s temperature is highly influenced by the hydrosphere.

Very low temperatures are associated with icebergs, glaciers or icecaps; low to moderate temperatures are associated with the common types of precipitation like snow, rain, drizzle, sleet or hails; and high temperatures are tied to dry and hot conditions and evaporation. The glaciers, icebergs, and icecaps are also categorically called the *cryosphere*.

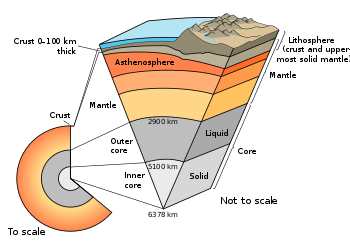
**Biosphere = LIVING THINGS**

All the living things in the planet are categorized under the biosphere. The biosphere includes all of the animals, plants, and microorganisms of earth, including humans. These ecological communities interact together with the physical aspects of the earth including the hydrosphere, lithosphere, and the atmosphere.

Collectively, these ecological communities are made reference to as **biomes**. Deserts, forests, grasslands, aquatic, tundra, and chaparral are the main biomes present in the biosphere. The living things on earth interact with each other in various ways, which is well elaborated under the **trophic levels** of food chains and food webs – how energy is transferred in ecological systems.

# Miss Foley

ESci20: ES1 Nature of ES  **Spheres**

**Lithosphere = LAND**

The lithosphere is made up of all the hard and solid land mass on the earth’s surface, the semi-solid rocks (molten materials) underneath the earth crust, and the liquid rocks in the inner core of the earth. The surface of the lithosphere is uneven as it is characterized by various landform features. Some of the landforms include mountains like the Mount Fuji in Japan and Mount Vesuvius in Italy, deep valleys within the mountain ranges, huge plains like the ones in Texas and Brazil, extensive plateaus like Bolivian plateau in South America and the Colorado plateau of the United States, and hills like the black hills.

The liquid, semi-solid, and solid land components of the lithosphere form layers that are chemically and physically different. This is why the lithosphere is further divided into sub-spheres namely the crust, the mantle, the outer core, and the inner core. The crust is made of loose soil and rocks. The mantle is made of dense rock made up of nickel and iron in the form of silicate rocks and its lower part is semi-solid (partially molten) rocks.

The outer core is made up of liquid (purely molten) rock materials. The inner core is the center of the earth which is purely made of very hot and liquid iron and nickel. The rock materials are divided into three primary categories based on how they are formed namely igneous rocks, sedimentary rocks, and metamorphic rocks.

**Atmosphere = AIR**

All the air in the atmosphere makes up the atmosphere. The atmosphere is a mixture of **nitrogen** (about 78%), **oxygen** (about 21%), and other gasses (about 1%) such as **carbon dioxide** (0.039%), **argon** (0.93%) and the rest are **trace gases** (krypton, neon, helium , and xenon). The higher the atmosphere, the thinner it becomes gradually moving towards space. The atmosphere extends all the way from the earth’s crust to more than 6200 miles (10,000 kilometers) above the earth’s surface into space. The atmosphere is divided into several layers: **stratosphere,** **troposphere, mesosphere, thermosphere, and the exosphere.** These atmospheric layers exhibit different chemical compositions and temperatures, and the temperatures and chemical compositions widely vary within the different layers.

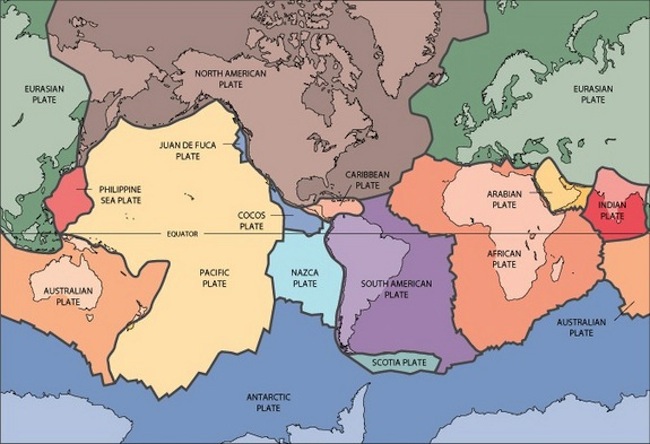
The **troposphere** is where most of the weather happens and it becomes colder with altitude. The air is in constant motion around the planet and it is normally responsible for some natural events in the planet such as local breeze, winds, tornado, and tropical cyclones. The atmosphere is always in constant interaction with the hydrosphere, giving rise to the planets weather conditions.

# Miss Foley

ESci20: ES1 Nature of ES  **Plate Tectonics**

**Plate tectonics =**

**The theory that Earth's outer shell is divided into**

**several plates that glide over the mantle**

The plates act like a hard and rigid shell compared to Earth's mantle. This strong outer layer is called the lithosphere.

Developed from the 1950s through the 1970s, plate tectonics is the **modern version** of **continental drift**, a theory first proposed by scientist Alfred Wegener in 1912. Wegener didn't have an explanation for how continents could move around the planet, but researchers do now. Plate tectonics is thought to be the unifying theory of geology.

The driving force behind plate tectonics is **convection in the mantle**. Hot material near the Earth's core rises and colder mantle rock sinks. It is like a pot boiling on a stove. The convection drive plates tectonics through a combination of pushing and spreading apart at mid-ocean ridges and pulling and sinking downward at subduction zones, researchers think. Scientists continue to study and debate the mechanisms that move the plates.

**Mid-ocean ridges** are gaps between tectonic plates like seams on a baseball. Churning currents in the molten rocks below propel them along like a jumble of conveyor belts in disrepair. Hot magma wells up at the ridges, forming new ocean crust and shoving the plates apart. Most geologic activity stems from the interplay where the plates meet or divide. They move at a rate of **one to two inches** **(3-5 cm) per year**.

The movement of the plates creates three types of tectonic plate boundaries:

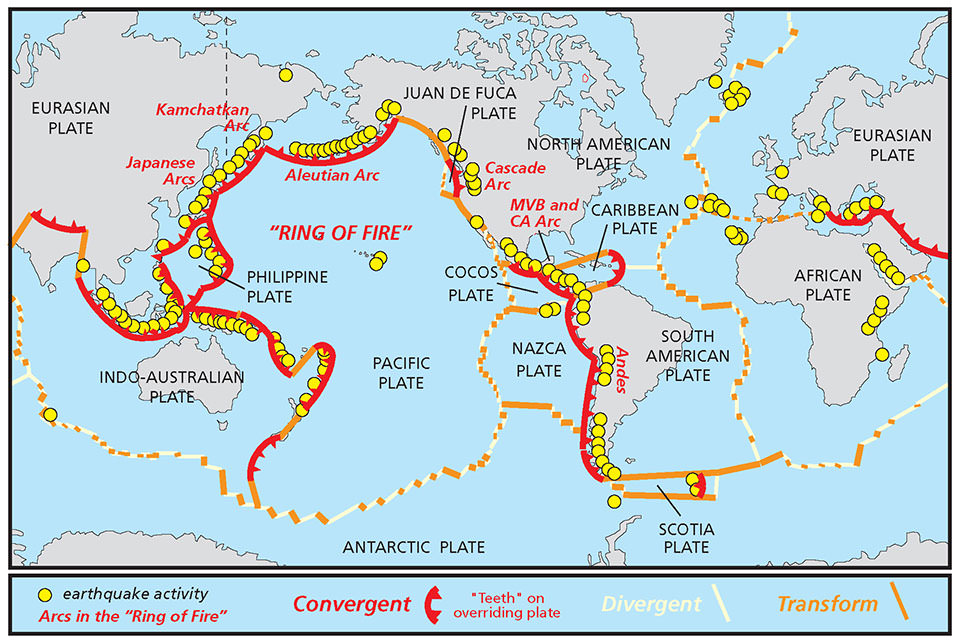
* **Divergent** - two **plates are** **spreading apart**, as at seafloor-spreading ridges or continental rift zones such as the East Africa Rift
* **Convergent** - two **plates meet and one slides beneath** the other back into the mantle. The cold, sinking plate pulls the crust behind it downward.
* **Transform** - **plates move sideways** and are slip-sliding in relation to each.

# Miss Foley

ESci20: ES1 Nature of ES  **Plate Tectonics**

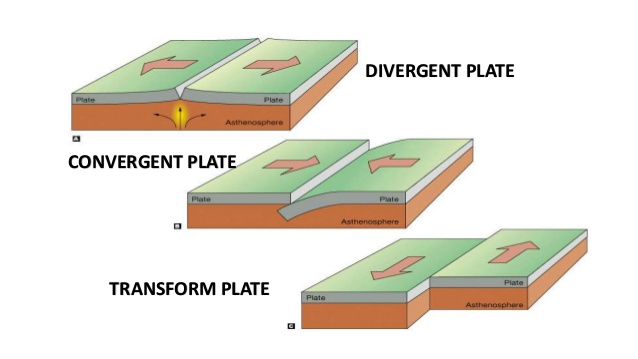
**Convergent Boundaries**

Where plates serving landmasses collide, the crust crumples and buckles into mountain ranges. India and Asia crashed about 55 million years ago, slowly giving rise to the Himalaya, the highest mountain system on Earth. As the mash-up continues, the mountains get higher. Mount Everest, the highest point on Earth, may be getting taller.

These convergent boundaries also occur where a plate of ocean dives, in a process called **subduction**, under a landmass. As the overlying plate lifts up, it also forms mountain ranges. In addition, the diving plate melts and is often spewed out in volcanic eruptions such as those that formed some of the mountains in the Andes of South America. Many spectacular volcanoes are found along subduction zones, such as the **"Ring of Fire"** that surrounds the Pacific Ocean.

At ocean-ocean convergences, one plate usually dives beneath the other, forming deep trenches like the Mariana Trench in the North Pacific Ocean, the deepest point on Earth. These types of collisions can also lead to underwater volcanoes that eventually build up into island arcs like Japan.

**Divergent Boundaries**

****At divergent boundaries in the oceans, magma from deep in the Earth's mantle rises toward the surface and pushes apart two or more plates. Mountains and volcanoes rise along the seam. The process renews the ocean floor and widens the giant basins. A single mid-ocean ridge system connects the world's oceans, making the ridge the longest mountain range in the world.

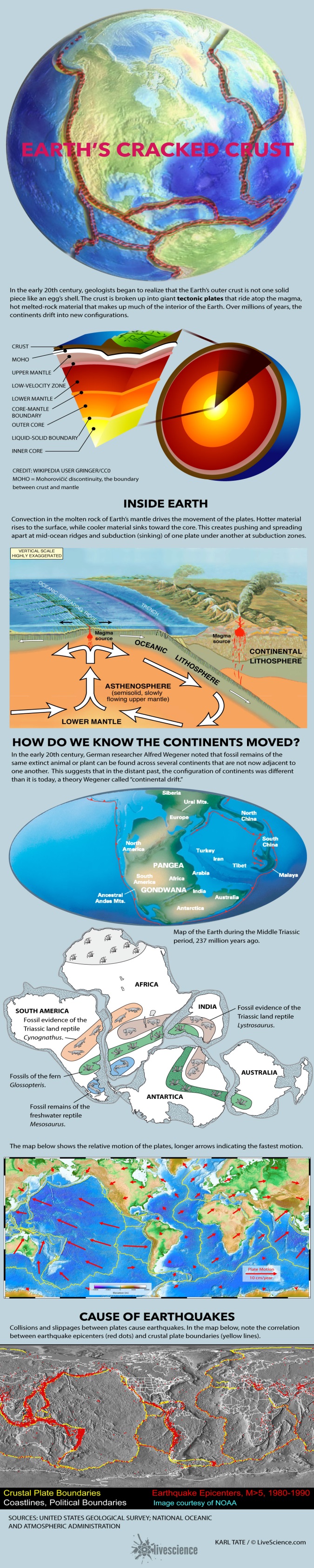
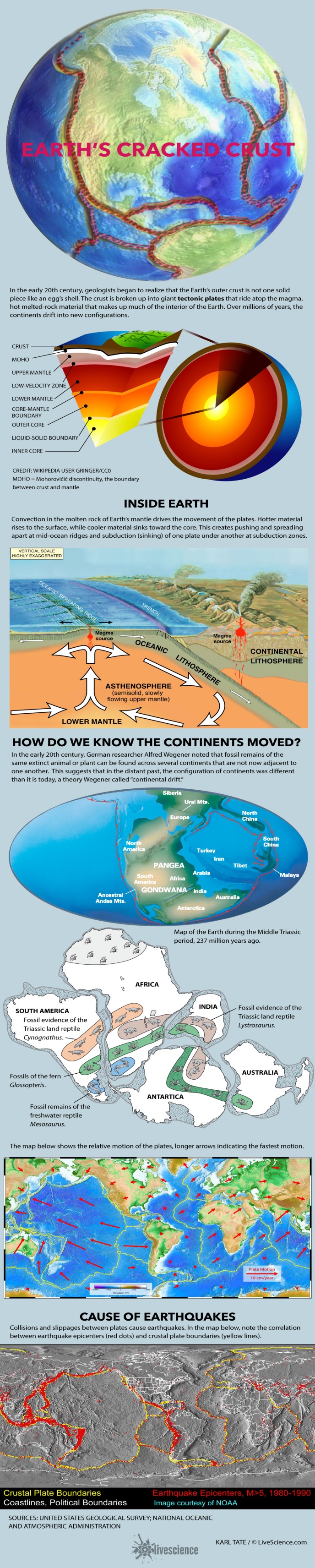
On land, giant troughs such as the Great Rift Valley in Africa form where plates are tugged apart. If the plates there continue to diverge, millions of years from now eastern Africa will split from the continent to form a new landmass. A mid-ocean ridge would then mark the boundary between the plates.

**Transform Boundaries**

The San Andreas Fault in California is a transform boundary, where two plates grind past each other along what are called **strike-slip faults**. These boundaries don't produce spectacular features like mountains or oceans, but the halting motion often triggers large earthquakes.

# Miss Foley

ESci20: ES1 Nature of ES  **Plate Tectonics**

The Earth is 4.54 billion years old with the oldest seafloor only about 200 million years old because the oceanic crust is constantly recycled at subduction zones. As the continents jostle around the Earth, they occasionally come together to form giant supercontinents, a single landmass. A more recent supercontinent called Pangaea formed about 300 million years ago. Africa, South America, North America and Europe nestled closely together, leaving a characteristic pattern of fossils and rocks for geologists to decipher once Pangaea broke apart. The puzzle pieces left behind by Pangaea, from fossils to the matching shorelines along the Atlantic Ocean, provided the first hints that the Earth's continents move.

# Miss Foley

ESci20: ES1 Nature of ES  **Biogeochemical Cycles**

**Biogeochemical Cycle =**

**How an element/compound moves between various living/nonliving forms & locations in the biosphere**

Energy flows directionally through Earth’s ecosystems, typically entering in the form of sunlight and exiting in the form of heat. However, the chemical components that make up living organisms are different: they get recycled.

The atoms in your body are not brand new. Instead, they've been cycling through the biosphere for a long, long time, and they've been part of many organisms and nonliving compounds along the way.

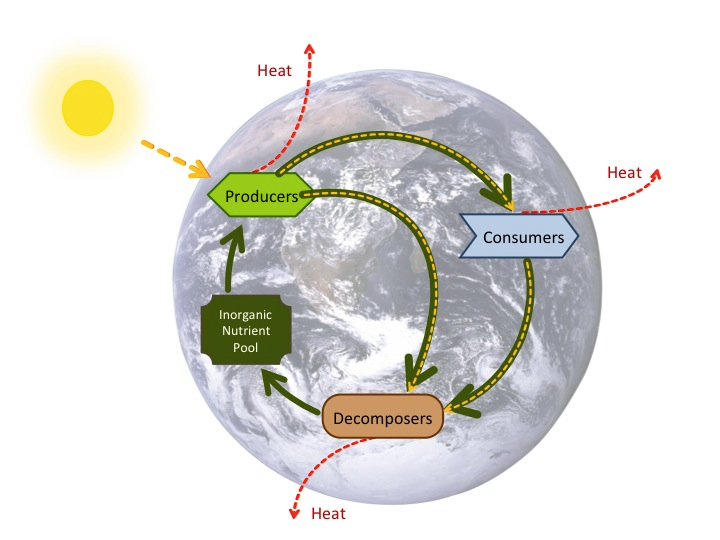


Figure 1 Image credit:

Eva Horne and Robert A. Bear

In this image, the flow of energy is shown with yellow and red arrows. Yellow indicates usable energy and red indicates energy lost in the unusable form of heat. Green arrows show the continual recycling of chemical nutrients.

The six most common elements in organic molecules — **carbon, nitrogen, hydrogen, oxygen, phosphorus, and sulfur** — take a variety of chemical forms. They may be stored for long or short periods in the atmosphere, on land, in water, or beneath the Earth’s surface, as well as in the bodies of living organisms. **Geologic processes** - such as weathering of rocks, erosion, water drainage, and the subduction of continental plates - all play a role in this recycling of materials, as do interactions among organisms.

Water, which contains hydrogen and oxygen, is essential for living organisms. That places the water cycle pretty high on the list of cycles we care about!

Water makes up more than half of our bodies, but humans cannot live by water alone. Instead, there are some other key elements that keep our bodies running and are part of biogeochemical cycles:

* Carbon is found in all organic macromolecules and is also a key component of fossil fuels.
* Nitrogen is needed for our DNA, RNA and proteins and is critical to human agriculture.
* Phosphorus is a key component of DNA and RNA and is one of the main ingredients—along with nitrogen—in artificial fertilizers used in agriculture.
* Sulfur is key to protein structure and is released to the atmosphere by the burning of fossil fuels.

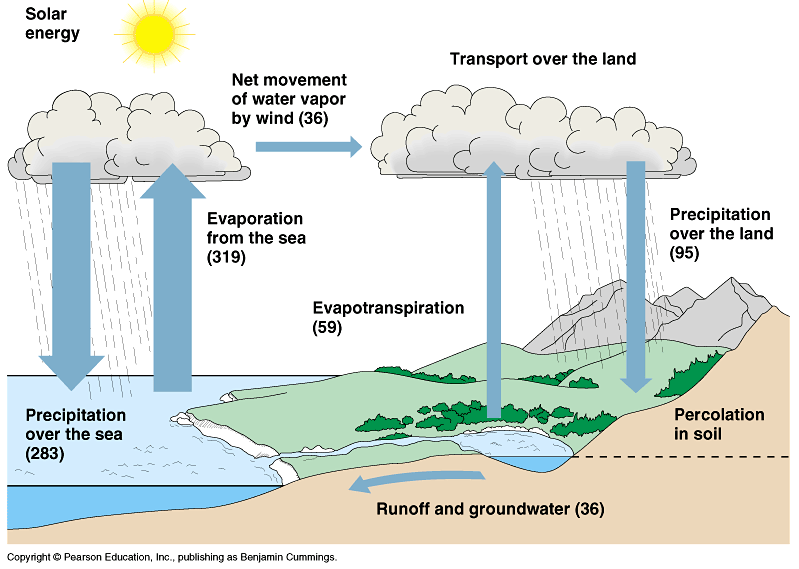
These cycles don't happen in isolation, and the water cycle is a particularly important driver of other biogeochemical cycles. For example, the movement of water is critical for the leaching of nitrogen and phosphate into rivers, lakes, and oceans. The ocean is also a major reservoir—holding tank—for carbon.

Though each element or compound takes its own route, all of these key chemical nutrients cycle through the biosphere, moving between the biotic—living—and abiotic—nonliving—worlds and from one living organism to another.

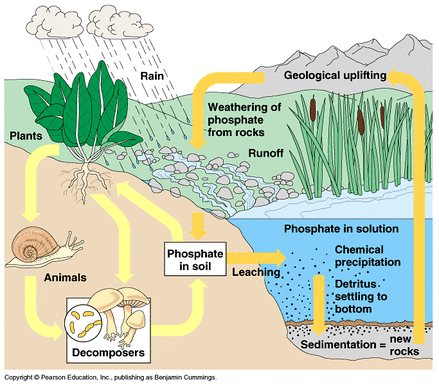
# Miss Foley

ESci20: ES1 Nature of ES  **Biogeochemical Cycles**

**The Water Cycle**

****

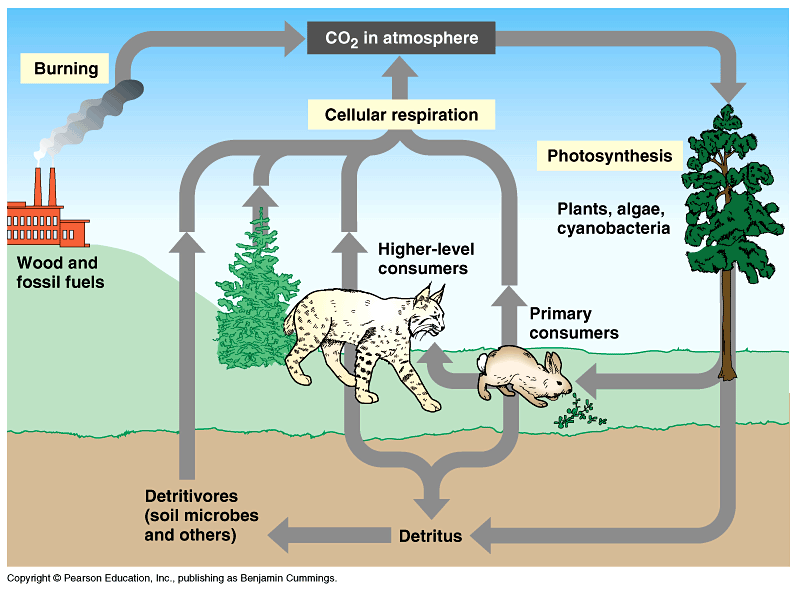
**The Phosphorous Cycle**

****

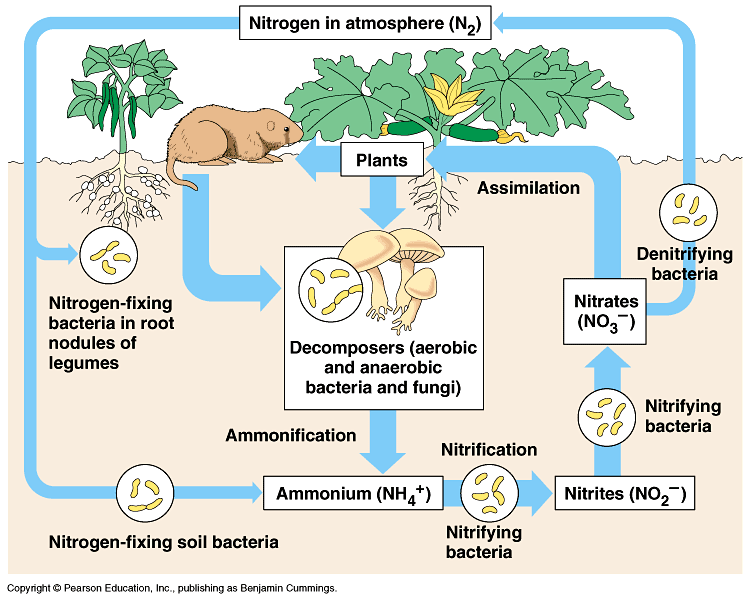
# Miss Foley

ESci20: ES1 Nature of ES  **Biogeochemical Cycles**

**The Carbon Cycle**



**The Nitrogen Cycle**



Miss Foley

ESci20: ES1 Nature of ES  **Case Study**

**Case Study: Cattle Feedlot**

(Designed By Brent Larwood – Sunwest SD)

**The Problem:**

You and your team are a group of scientists hired by the Government of Saskatchewan. Your team is made up of specialists hired by the Government of Saskatchewan to review a new feedlot proposed to be opened in 3 years’ time. Beef Specialty Enterprises has purchased 6 quarters of land in a Rural Municipality (R.M.) of Sasky and looking to start a with a 12,000 cattle operation. It is your team’s job to make sure that the feedlot will be a sustainable decision that helps the community and has a minimal impact the environment. It is ultimately up to you whether or not this feedlot will become a reality.

You will be presenting your findings at a community meeting outlining what your team has discovered, and also sharing the policies and protocols that would have to be following if this feedlot was to open.

**Disclosure 1:**

It is time for your team to take on some titles. Looking at the RM map provided, you see that you are going to need environmental science specialists in the following areas: Soil Science, Hydrology, Agronomy, Environmental Engineering, and Animal Science

Research these areas to find a career that you think will be beneficial to your team.

|  |  |  |
| --- | --- | --- |
| Joe Roky  1 quarter = 168 acres  4 quarters = 1 section  1 section = 1 mile squared  1 mile = 1600 m | Joe Roky | Pete Peters |
| Irene and Jeff Winters | Beef Specialty Enterprises | Beef Specialty Enterprises |
| Hay Incorporated | Beef Specialty Enterprises | Beef Specialty Enterprises |

# Miss Foley

ESci20: ES1 Nature of ES **Case Study (cont’d)**

**Disclosure 2:**

Now that your team is formed, it is time to get to work. The Government of Saskatchewan and Beef Specialty Enterprises want to get answers right away. It is important that your team works efficiently to gather and analyze your results that will either support or deny production to begin. The public are nervous about how this might affect their watershed and air quality. Other community members are excited about applying for a new job because they were told over 100 people are going to be employed.

Your team decides to look at a pros and cons list of this project created by the R.M. Viewing the list below, create a definition and explanation of each point and how this will affect the community and/or environment.

|  |  |
| --- | --- |
| Pro’s | Con’s |
| Employment | Public perception |
| Increased Food Production | Air Quality |
| Local Business Sales | Water Quality |
| Town/School Population Increase | Soil Damage |
| Tax Benefits to RM and Community |  |

**Disclosure 3:**

Your team sees how the R.M is most concerned of the Con’s list. Begin researching how your team plans to create legislation to monitor air, water and soil quality that will minimally affect the environment. Begin by researching how feedlots affect it then research a process how they can be controlled. This will be the deciding factor whether or not production will begin.

**Disclosure 4:**

Your team arrives at the proposed land for the feedlot to find a group of protestors has formed on the access road to the land. You see there are two teams of for and against trying to prove each other wrong. You can tell by reading the protest both teams protest signs that anthropocentric, bio-centric eco-centric, techno-centric and eco-feminist views are all present. Your team drives away but notes that these concerns will need to be addressed in the public meeting.

**Disclosure 5:**

After your team completes your research, you decide that the feedlot will be approved. Create a presentation that will show how the feedlot will only benefit the community and how water, air and soil will be continually monitored to make sure environmental damage is minimal. You must be sure to create this presentation that is geared to the community members. They must understand how and why this decision was made.

# Miss Foley

ESci20: ES1 Nature of ES **Case Study (cont’d)**

**Cattle Feedlot:**

**Things To Consider When Researching:**

1. What is a feedlot?
2. Operations
   1. Daily
   2. Employees vs employers
   3. Business wise
   4. Equipment required
   5. Supplies & storage of supplies
   6. Waste processing
3. Financial
   1. Financing
   2. Salaries
   3. Cost to run and build
   4. Tax/business benefits
   5. Business plan
4. Impact
   1. On environment (watershed, air quality, soil, etc.)
   2. Community and neighbors
   3. On employment rates
   4. Of Facility
5. Facility
   1. Square footage needed for 12,000 head
   2. Design elements
6. Supply & Demand

# Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ESci20: ES1 Nature of ES**

\_\_\_\_\_\_ =

100

**Feedlot Case Study:**

**Open Book Individual Assessment**

1. Where did you decide the best location was to build the feedlot? Explain why while focusing on the multiple factors considered when making the decision.

(5 marks)

1. Explain **what and how** each career could contribute to the feedlot decision making process. (10 marks)

Soil Science –

Hydrology –

Agronomy –

Environmental Engineer –

Animal Science -

1. Complete the following table: (9 marks)

|  |  |
| --- | --- |
| **Communities Pros/Cons** | **Worldview**  (Biocentric, Anthrocentric, Ecocentric) |
| Impact on watershed |  |
| Impact on air quality |  |
| Soil damage |  |
| Public perception |  |
| Employment |  |
| Increased food production |  |
| Local business sales |  |
| Town/School population increases |  |
| Tax benefits to RM and community |  |

1. Complete the following **research notes & solutions table** supporting the community identified pros and cons of building the feedlot. Be sure to add two (2) additional researched areas of your choosing to each side of the chart and **provide possible solutions** **to any cons discussed**. (70 marks – 5 marks each)

|  |  |
| --- | --- |
| **PROS** | **CONS** |
| **Employment** | **Impact on Watershed** |
|  |  |

|  |  |
| --- | --- |
| **PROS** | **CONS** |
| **Increased Food Production** | **Impact on Air Quality** |
|  |  |
| **Local Business Sales** | **Soil Damage** |
|  |  |

|  |  |
| --- | --- |
| **PROS** | **CONS** |
| **Town/School Population** | **Public Perception** |
|  |  |
| **Tax Benefits to RM and Community** | **Additional Notes:** |
|  |  |

|  |  |
| --- | --- |
| **PROS** | **CONS** |
| **Addition #1:** | **Addition #1:** |
|  |  |
| **Addition #2:** | **Addition #2:** |
|  |  |

1. In your educated opinion, should this 12,000 head feedlot be built or not?

What arguments, research, or main points would you focus on to convince someone else to agree with you? (6 marks)

# Miss Foley

ESci20: ES1 Nature of ES  **Bloom’s Taxonomy**