Integrated Teacher Resource Package (ITRP)
Environmental Science 11

Examining the Anthropogenic Effects to Environmental, Social, and Personal Spheres of Sustainability from a Macroscopic and Holistic Systems Perspective.

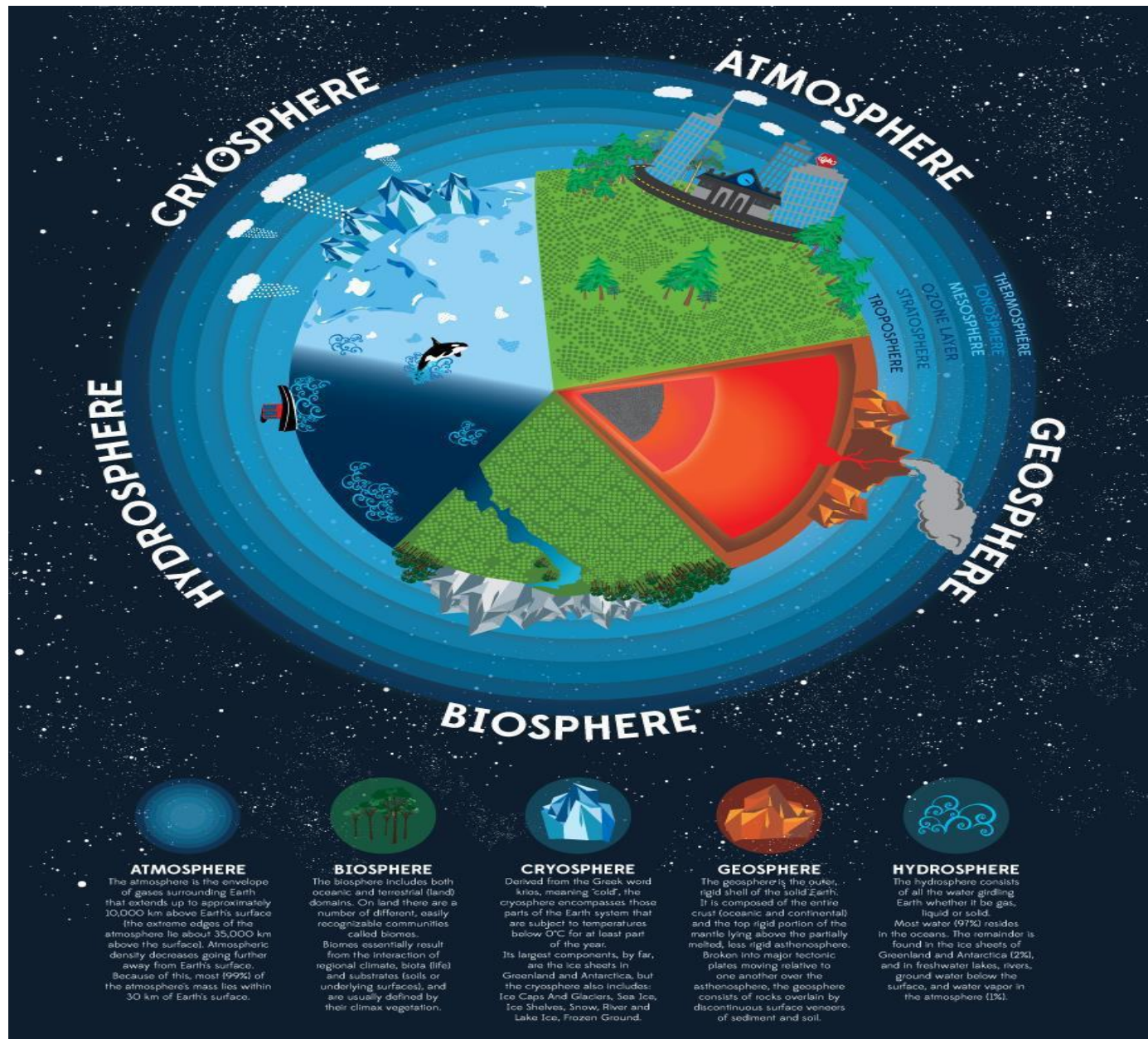Michael X. Yue, Ken Marquart, & Joshua Carr
10.24.2018

Figure 1. An infographic earth science poster, portraying the five domains of Earth's environmental spheres: atmosphere, biosphere, cryosphere, geosphere, and hydrosphere. This poster is attributed and created by Kenneth W. Baldwin for the Earth Science Educational Kit in 2002. The integration and contribution of this illustration follows and abides by the Creative Commons: Attribution-Non-Commercial 4.0 International (CC BY-NC 4.0) [LINK A]

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1.0 INTEGRATED, HOLISTIC, PEDAGOGICAL PRINCIPLES OF INQUIRY

Pedagogical frameworks of studential inquiry will focus on ecological epistemology. In this Integrated Teacher Resource Package (ITRP), three main principles (Social Ecology Model of Sustainability, Herman Daly's Sustainability Principles, and RMIT Sustainability Principles) will be examined from Mulligan's (2018) textbook publication (Introduction into Sustainability – 2nd Ed.) will be holistically tied into pedagogical development of assessments and rationale from a Backwards Design Model (BDM) for the Environmental Science 11 curriculum.

Social Ecology Model of Sustainability (SEMS)

Contemporary SEMS are based on three central dogmas of sustainable considerations: environmental, social, and personal. In the figure below, the graphic presentation displays a paradigm shift of economic influence as a main driver for holistic sustainability.

Environmental: Natural Biotic, abiotic, and edaphic ecological considerations
Social: Anthropogenic sociality to sustainability and natural connectivity
Personal: Reflective and reflexive epistemology and introspection
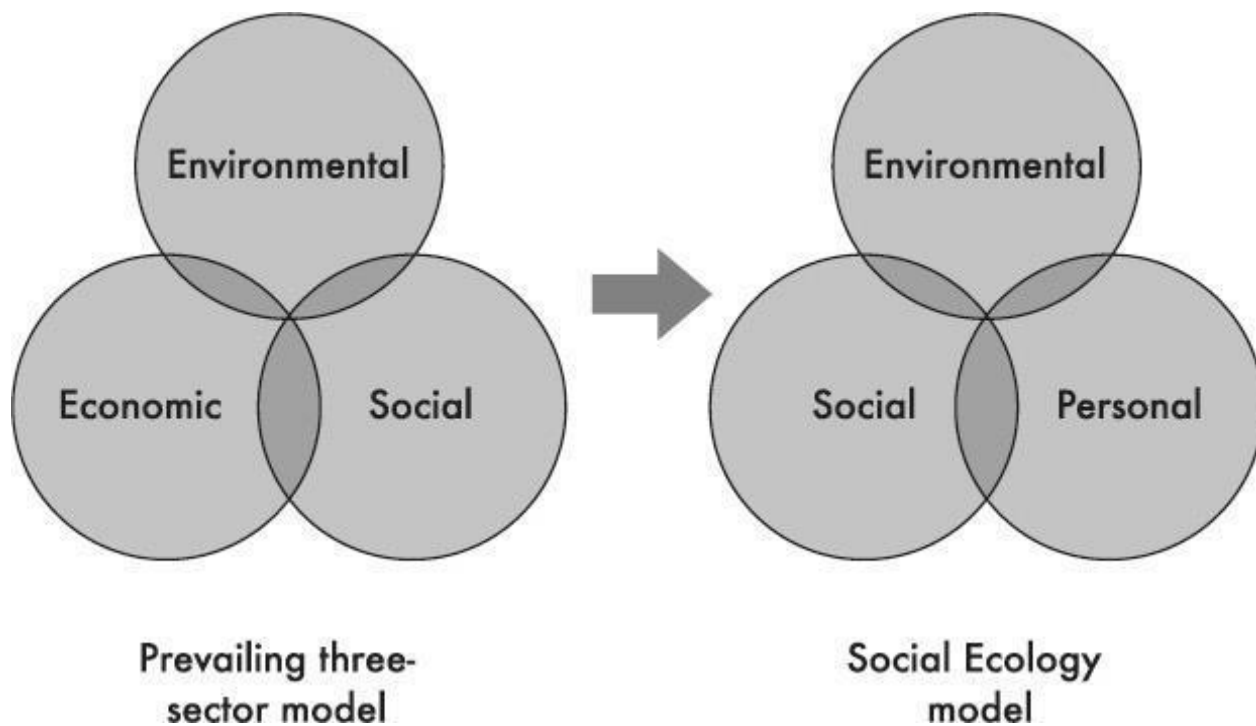
Figure 2. A transitional way of sustainability thinking from the prevailing model to the Social Ecology Model of Sustainability. Retrieved from Mulligan's (2018) textbook publication, An Introduction into Sustainability, 2nd Ed.

PEDAGOGICAL DEFINITIONS
Epistemology: Study of knowledge in the pursuit to determine the way of knowing or validation.
Backwards Design Model: To design and identify learning objectives as the first pedagogical step in curriculum development

Herman Daly's Sustainability Principles

Herman Daly outlined four main Big Ideas associated with pragmatic sustainability and ecological resiliency:

1. Limit the human scale to that which is within the Earth's capacity.

2. Ensure that technological progress is efficiency increasing rather than throughput increasing.

3. For renewable resources, harvesting rates should not exceed regeneration rates and waste emissions should not exceed the assimilative capacities of receiving environments.

4. Non-renewable resources should be explored no faster than the rate of creation of renewable resources.

RMIT Sustainability Principles

Sustainability principles identified from Royal Melbourne Institute of Technology (RMIT) will be used as a framework for Guided-Inquiry assessments in this ITRP:

1. Acknowledge interconnections at all levels within the [Earth's spheres]

2. Acknowledge that there are limits to growth.

3. Remember that prevention is better than cure.

4. Work to improve intergenerational equity.

5. Face up to the challenges of intergenerational equity.

6. Respect requisite diversity in both nature and culture.

7. Work for re-localization with global connectedness.

8. Move from consumerism to quality of life goals.

9. Learn how to travel hopefully in a world of uncertainty.

Rationale for Sustainability Principles

In the contemporary 21st century, sustainability importance is becoming more prevalent and significant to address a changing world on local, regional, and global scales. The ITRP is designed to provide academic and professional educators with the pedagogical frameworks necessary for teaching sustainability for the leaders of tomorrow. Based on pedagogical alignments, Social Ecology Model of Sustainability, Day Herman's Sustainability Principles, and RMIT Sustainability Principles outlined by Muller (2018) publication, A Introduction into Sustainability, the frameworks of these big ideas will be adapted and integrated into the holistic curriculum to provide students with the exposure of sustainability considerations in a dynamic society.

PEDAGOGICAL DEFINITIONS
Guided Inquiry: A tertiary level of pedagogical of Inquiry-based Learning (IBL) which provides teacher expectations of assessment(s); students will design, develop, and synthesize work for evaluation.
Inquiry-based Learning: An educational framework which focuses on investigation of knowledge based on four tiers: confirmation inquiry, structured inquiry, guided inquiry, and open inquiry (Fig 4.; Page 9).

1.1 CURRICULUM

This Integrated Teacher Resource Package (ITRP) is specifically designed for pedagogical learning outcomes in contemporary Environmental Science 11, based off Canadian International Baccalaureate (IB) models of teaching from British Columbia (BC). The Big Ideas (BIs), Core Competencies (CoC), Curricular Competencies (CuC), and Prescribed Learning Outcomes (PLOs) can be adapted and modified for K-12 curriculum, with high degree of alignment with Science 8/9/10, and Earth Science 11.

1.2 ENVIRONMENTAL SCIENCE 11

Course Description

Environmental Science 11 is an introductory, interdisciplinary, survey course to expose students to the depth of interconnected relationships of the natural world from a holistic perspective. With an emphasis of scientific deduction, ecological principles, concepts, and methodologies, the anthropogenic and natural effects of environmental influence will be analyzed from both scales of perspectives: microscopic and macroscopic. Practical and pragmatic examination of environmental risks, mitigation, prevention, and solution will be critically investigated in the contemporary world.

Environmental Science 11 Big Ideas

(1) Diversity in Local Ecosystems
A. Local environments contain diverse ecosystems with many roles and relationships

(2) Processes and Changes in Local Ecosystems
A. Interconnected systems sustain healthy ecosystems
B. Ecosystem stability is an important result of sustainability

(3) Sustainability in Local Ecosystems
A. Human practices affect the sustainability of ecosystems

(4) Conservation and Restoration of Ecosystems
A. Humans can play a role in conservation and restoration of ecosystems

ENVIRONMENTAL SCIENCE 11 COMPETENCIES

Core Competency

> The Core Competency along with literacy and numeracy foundation and essential content and concepts are at the center of the redesign of curriculum and assessment. Core competencies are sets of intellectual, personal, social and emotional proficiencies that all students need to develop in order to engage in deep learning and lifelong learning.

Figure 2. Core Competency definition set by the British Columbia's Ministry of Education. Retrieved from https://curriculum.gov.bc.ca/competencies.

CORE COMPETENCIES

COMMUNICATION

C

1. Share and develop ideas
2. Obtain, interpret, and present information
3. Work together to plan, carry out, and review tasks and activities
4. Describe/recall and reflect on experiences and what one can do

CREATIVE THINKING

T

1. Novelty and value
2. Generating ideas
3. Developing Ideas

CRITICAL THINKING

T

1. Analyze and critique
2. Question and investigate
3. Develop and design

POSITIVE PERSONAL & CULTURAL IDENTITY

PS

1. Relationships and cultural contexts
2. Personal values and choice
3. Personal strengths and abilities

PERSONAL AWARENESS & RESPONSIBILITY

PS

1. Self-determination
2. Self-regulation
3. Well-being

SOCIAL RESPONSIBILITY

PS

1. Contributing to community and caring for the environment
2. Solving problems in peaceful ways
3. Valuing diversity
4. Building relationships.

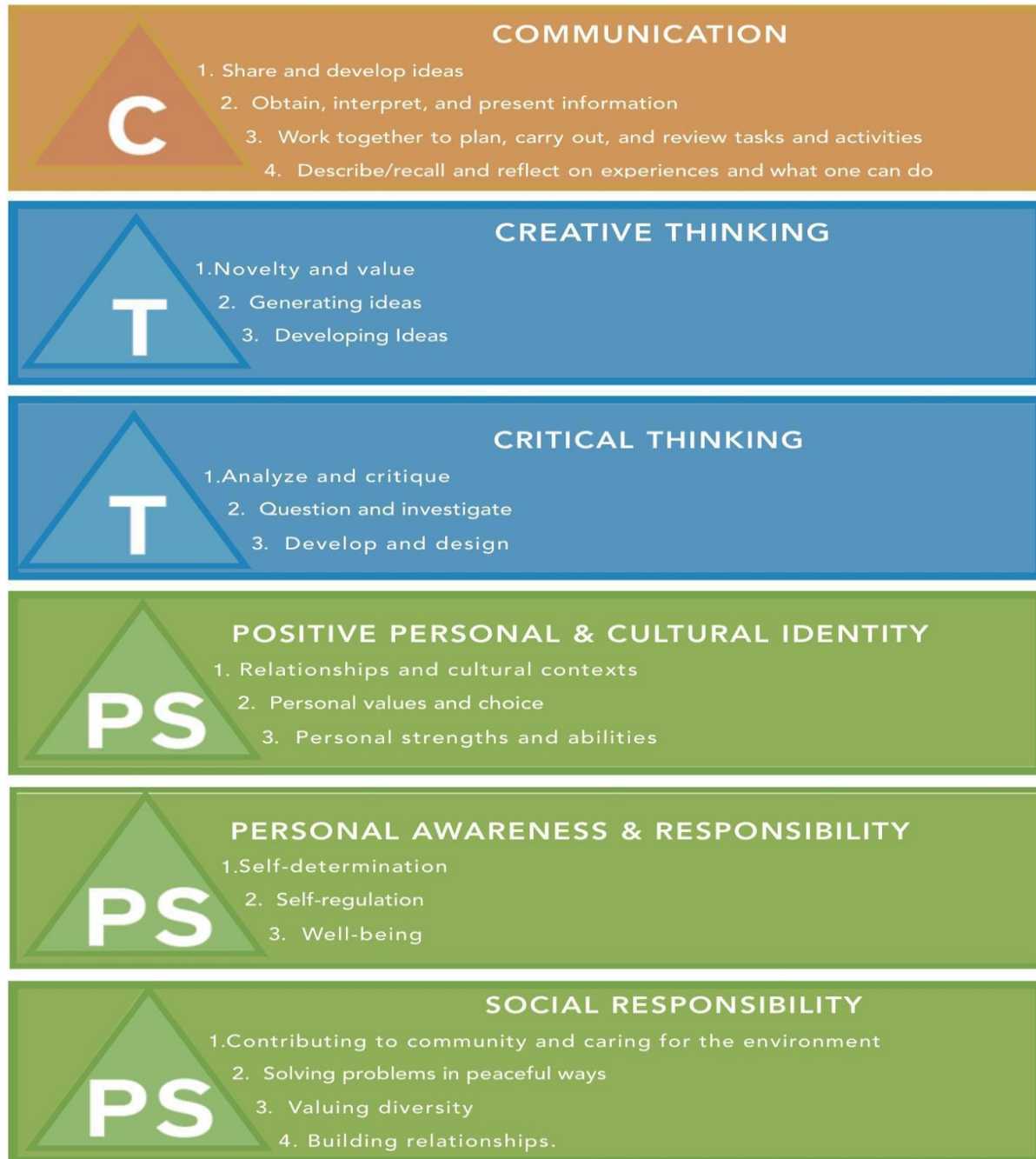**Figure 3.** An infographic Core Competency poster, highlighting the three domains of pedagogical understanding: Communication (C), Critical Thinking (T), and Personal and Social (PS) Competency. This poster is attributed and created by British Columbia's Ministry of Education, which follows and abides by the Creative Commons: Attribution - NonCommercial 4.0 International (CC BY-NC 4.0). [LINK B]

Curricular Competencies

Environmental Science 11 Curricular Competencies are cross-curricular, with a strong emphasis of principles and modalities of education which focuses studential learning from a critical perspective. By integrating and implementing holistic and unifying approach to learning, studential learning will be enriched with reflective, critical, creative, and applicative epistemology of the contemporary world. The following Environmental Science 11 Curricular Competencies are drawn from the 2018/2019 BC Ministry of Education [SOURCE 1].

A. Questioning and Predicting
- Demonstrate a sustained intellectual curiosity about a scientific topic or problem of personal, local, or global interest
- Make observations aimed at identifying their own questions, including increasingly abstract ones, about the natural world
- Formulate multiple hypotheses and predict multiple outcomes

B. Planning and Conducting
- Collaboratively and individually plan, select, and use appropriate investigation methods, including field work and lab experiments, to collect reliable data (qualitative and quantitative)
- Assess risks and address ethical, cultural, and/or environmental issues associated with their proposed methods

C. Processing and Analyzing Data and Information
- Experience and interpret the local environment
- Apply First Peoples perspectives and knowledge, other ways of knowing, and local knowledge as sources of information
- Seek and analyze patterns, trends, and connections in data, including describing relationships and identifying inconsistencies
- Use knowledge of scientific concepts to draw conclusions that are consistent with evidence
- Analyze cause-and-effect relationships

D. Evaluating
- Evaluate their methods and experimental conditions, including identifying sources of error or uncertainty, confounding variables, and possible alternative explanations and conclusions
- Describe specific ways to improve their investigation methods and the quality of the data
- Evaluate the validity and limitations of a model or analogy in relation to the phenomenon modelled
- Demonstrate an awareness of assumptions, question information given, and identify bias in their own work and in primary and secondary sources
- Consider the changes in knowledge over time as tools and technologies have developed
- Connect scientific explorations to careers in science
- Exercise a healthy, informed skepticism and use scientific knowledge and findings to form their own investigations to evaluate claims in primary and secondary sources
- Consider social, ethical, and environmental implications of the findings from their own and others' investigations
- Critically analyze the validity of information in primary and secondary sources and evaluate the approaches used to solve problems
- Assess risks in the context of personal safety and social responsibility

E. Applying and Innovating
- Contribute to care for self, others, community, and world through individual or collaborative approaches
- Co-operatively design projects with local and/or global connections and applications
- Contribute to finding solutions to problems at a local and/or global level through inquiry
- Implement multiple strategies to solve problems in real-life, applied, and conceptual situations
- Consider the role of scientists in innovation

F. Communicating
- Formulate physical or mental theoretical models to describe a phenomenon
- Communicate scientific ideas, information, and perhaps a suggested course of action, for a specific purpose and audience, constructing evidence-based arguments and using appropriate scientific language, conventions, and representations
- Express and reflect on a variety of experiences, perspectives, and worldviews through place

1.3 PEDAGOGICAL IMPLEMENTATIONS

Bloom's Taxonomy: Hierarchical Learning

A learning objective framework to formatively and summatively evaluate and assess learning objectives of students. Elaborations in Environmental Science 11 will expand beyond low tier learning, with strong emphasis in curricular objectives of higher learning (apply, analyze, evaluate, and create).

Figure 4. An adapted, contemporary model of Bloom's Taxonomy. This image retrieved by Kraus-Anderson follows and abides by the Creative Commons: Attribution - NonCommercial 4.0 International (CC BY-NC 4.0). [LINK C]

Inquiry-based Learning (IBL)

IBL is a pedagogical approach which focuses on student-led epistemology through facilitation and guidance rather than teacher-led learning which incorporates aspects of problem-based learning and competencies [SOURCE 2]. There are four main tiers (Structured, Controlled, Guided and Free Inquiry) of student inquiry outlined by the graphic representation below (Fig. 4).

Studential Inquiry Tiers of Learning

Primary Tier: Structured Inquiry

Secondary Tier: Controlled Inquiry

Tertiary Tier: Guided Inquiry

Quaternary Tier: Open/Free/True Inquiry
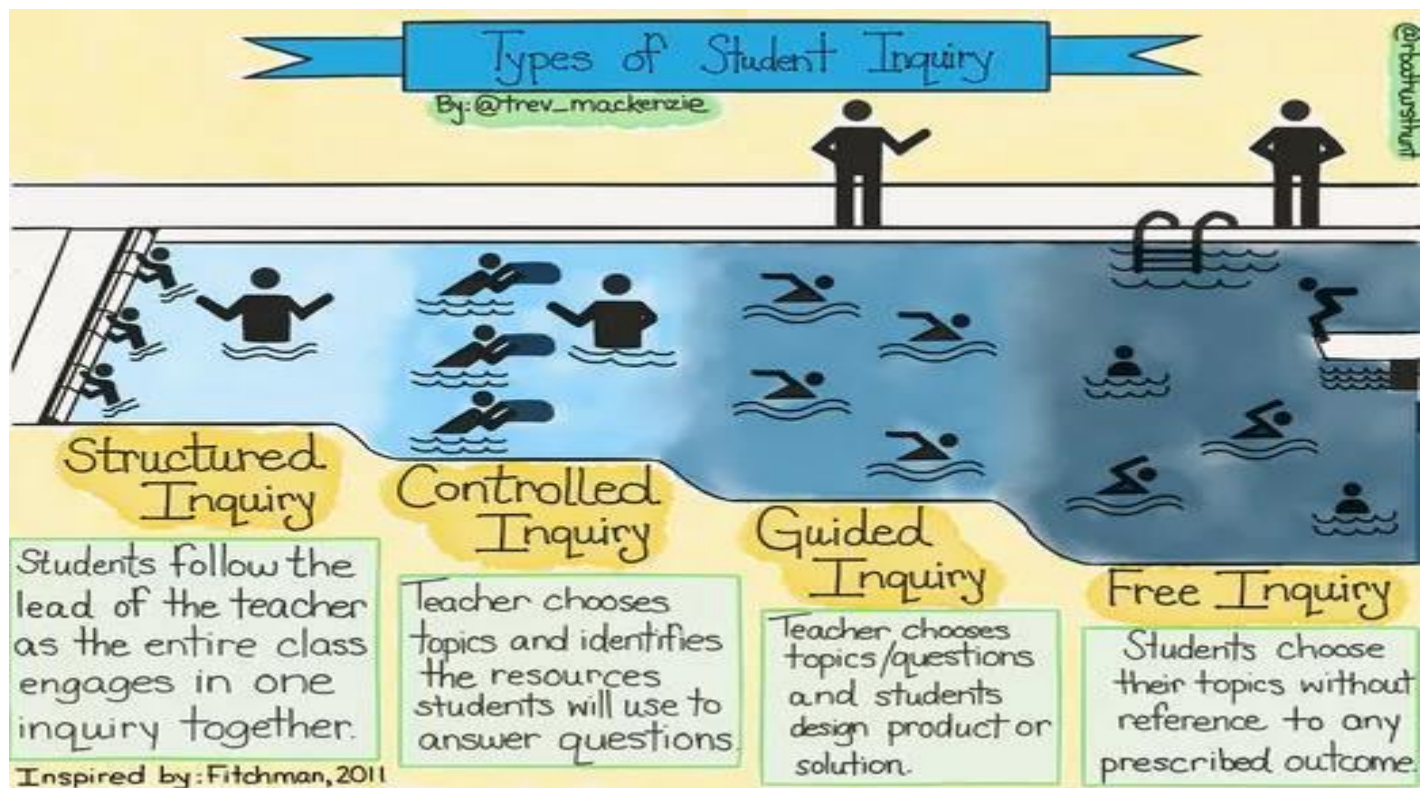
Figure 4. A visual infographic poster to illustrate the four main types of inquiry through the lens of a swimming analogy. This artistic drawing was created by Trevor Mackenzie in 2017 from inspirations of Fitchman (2011). Usage of this image follows and abides by the Creative Commons: Attribution - NonCommercial 4.0 International (CC BY-NC 4.0). [LINK D]

Inquiry Epistemology

Based off Trevor Mackenzie (2017) work on comprehensive inquiry for professional educators, he identified four main pillars of inquiry-based epistemology to help assist students achieving successful inquiry (Fig 5.).
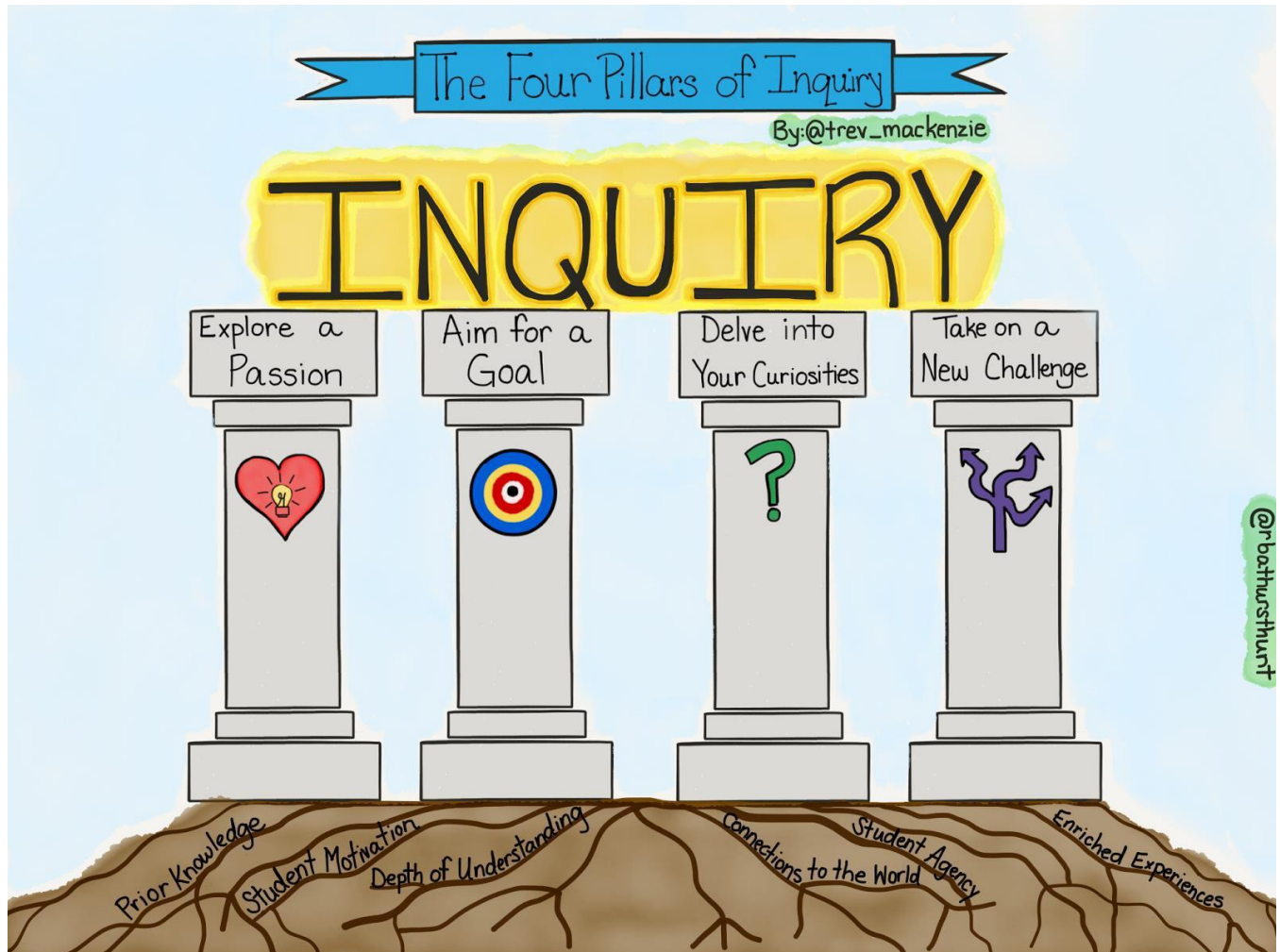
Figure 5. A artistic representation of guidance and structure to achieve successful inquiry. This depiction was created by Trevor Mackenzie in 2017 which follows and abides by the Creative Commons: Attribution - NonCommercial 4.0 International (CC BY-NC 4.0). [LINK E]

Project-Based Learning (PBL)

PBL uses the core competency of communication and collaboration from a social lens as a medium for meaningful learning opportunities which are delegated through project-based activities and assignments. PBL integrates all aspects of Core Competencies (Communication, Critical Thinking, and Social and Personal Responsibility) established by the BC Ministry of Education (Fig 3; Page 6). Not only does PBL demonstrate high compatibility with Core Competencies, the Curricular Competencies and the Bigs Ideas are holistically imbedded in the experiential and pragmatic learning interactions established by large scale projects [SOURCE 3]. Based on anecdotal and validated reports of PBL in North American K-12 education, there is strong correlation between student autonomy, creativity, innovation, and competency of students as a whole when conducted and structured properly (Grant, 2002).

PROJECTS	PROJECT-BASED LEARNING
Can be done alone	Requires collaboration and teacher guidance
About the product	About the process
Teacher-directed	Student-directed
All projects have the same goal	Students make choices that determine the outcome
Products are submitted to the teacher	Products are presented to an authentic audience
Lack real-world relevance	Based in real-world experiences or problems
Occur after the "real" learning	Real learning occurs through the project

Figure 6. A categorical dichotomy between the terms, project and Project-Based Learning (PBL). This image was retried from Susan Riley (2016) from affiliation to Education Closet, which follows and abides by the Creative Commons: Attribution - NonCommercial 4.0 International (CC BY-NC 4.0). [LINK F]

Experiential Learning

Experiential learning is pedagogical process which is similar to hands-on learning. By being an active participant of learning, rather than a passive participant, students may learn through reflection and reflective anecdotes. Framing the educational opportunities as an experience adds value to the overall learning of the participant. Using experiential learning as a medium for learning may increase student autonomy, engagement, retention, and critical thinking from a holistic framework (Kolb, 2014). Experiential learning on small and large scales will be investigated in studential learning opportunities. Anecdotal and validated qualitative and quantitative surveys, experiments, and reports strong suggest that experiential learning is the foundation of curiosity associated with epistemological understanding (Kirschner et al., 2006)
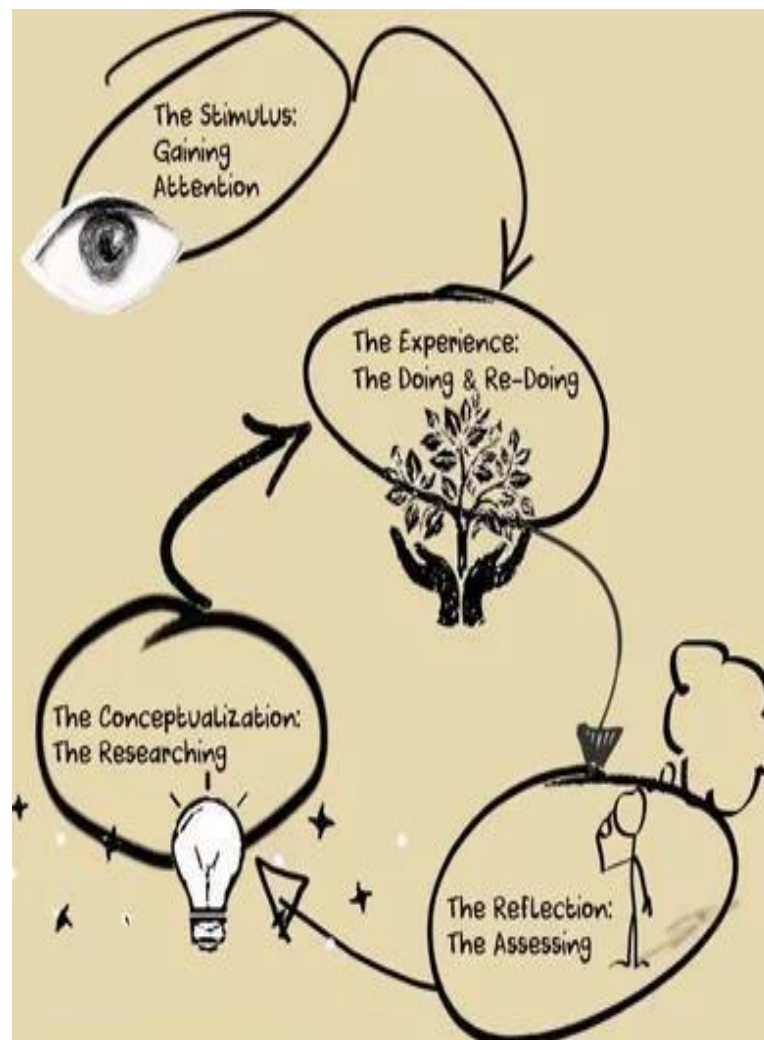
Figure 7. A cyclic depiction of how experiential learning through stimuli is the catalyst for epistemology. This artistic drawing was created by Jackie Gerstein which follows and abides by the Creative Commons: Attribution - NonCommercial 4.0 International (CC BY-NC 4.0). [LINK G]

1.4 EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD) LEARNING OUTCOMES

Based off Education for Sustainable Development (ESD) and Learning for a Sustainable Future (LSF) frameworks of Prescribed Learning Outcomes (PLOs), there are three main dogmas of understanding: knowledge, skills, and values. [SOURCE 4] These PLOs from the ESD and LSF will be adapted, modified, selected, and integrated into the Curricular Competencies and Big Ideas of Environmental Science 11.

Knowledge

- The planet earth as a finite system and the elements that constitute the planetary environment.
- The resources of the earth, especially soil, water, minerals, etc., and their distribution and role in supporting living organisms.
- The nature of ecosystems and biomes; their health, interdependence within the biosphere.
- The dependence of humans on the resources of the environment for life and sustenance.
- The sustainable relationship of native societies to the environment.
- The implications of the distributions of resources in determining the nature of societies and the rate and character of economic development.
- Characteristics of the development of human societies including nomadic, hunter gatherer, agricultural, industrial and post industrial and the impact of each on the natural environment.
- The process of urbanization and implications of de-ruralization.
- The interconnectedness of present world political, economic, environmental and social issues.
- Aspects of perspectives and philosophies concerning the ecological and human environments; for example, the interconnectedness of matter, energy and human awareness.
- The implications for the global community of the political, economic and socio-cultural changes needed for a more sustainable future.
- Processes of planning, policy-making and action for sustainability by governments, businesses, non-governmental organizations and public.

Skills

- Frame appropriate questions to guide relevant study and research.
- Apply definitions of fundamental concepts, such as environment, community, development and technology, to local, national and global experiences.
- Use a range of resources and technologies in addressing questions.
- Assess the nature of bias and evaluate different points of view.

- Develop hypotheses based on balanced information, critical analysis and careful synthesis, and test them against new information and personal experience and beliefs.
- Communicate information and viewpoints effectively.
- Develop cooperative strategies for appropriate action to change present relationships between ecological preservation and economic development.
- Work toward negotiated consensus and cooperative resolution of conflict.

Values

- An appreciation of the resilience, fragility and beauty of nature and the interdependence and equal importance of all life forms.
- An appreciation of the dependence of human life on the resources of a finite planet.
- An appreciation of the role of human ingenuity and the individual creativity in ensuring survival and the search for appropriate and sustainable progress.
- An appreciation of the power of humans to modify the environment.
- A sense of self-worth and rootedness in one's own culture and community. A respect for other cultures and recognition of the interdependence of the human community.
- A global perspective and loyalty to the world community. A concern for disparities and injustices, a commitment to human rights and to the peaceful resolution of conflict.
- A realistic appreciation of the urgency of the challenges facing the global community and the complexities that demand long-term planning for building a sustainable future.

1.5 INTERDISCIPLINARY SUSTAINABILITY: TRADITIONAL ECOLOGICAL KNOWLEGDE (TEK)

Traditional Ecological Knowledge (TEK) is a collection of indigenous ecological knowledge which pertains to sustainability of local resources, often mediated through oral transmission of knowledge from one elder to another, TEK is an adaptive and cumulative practice which emphasizes the interconnected relationships between environmental, social and personal connections with nature from a unit perspective (McGregor, D. (2006). TEK is anecdotally validated through qualitative observations of the natural environment through a spatial and temporal lens of abiotic, edaphic, and biotic interactions. Based off Josee Beaudry's (2015) investigation of TEK for holistic understanding, there is strong support for pedagogical integration and implementation to elevate learners and leaders of tomorrow in education.
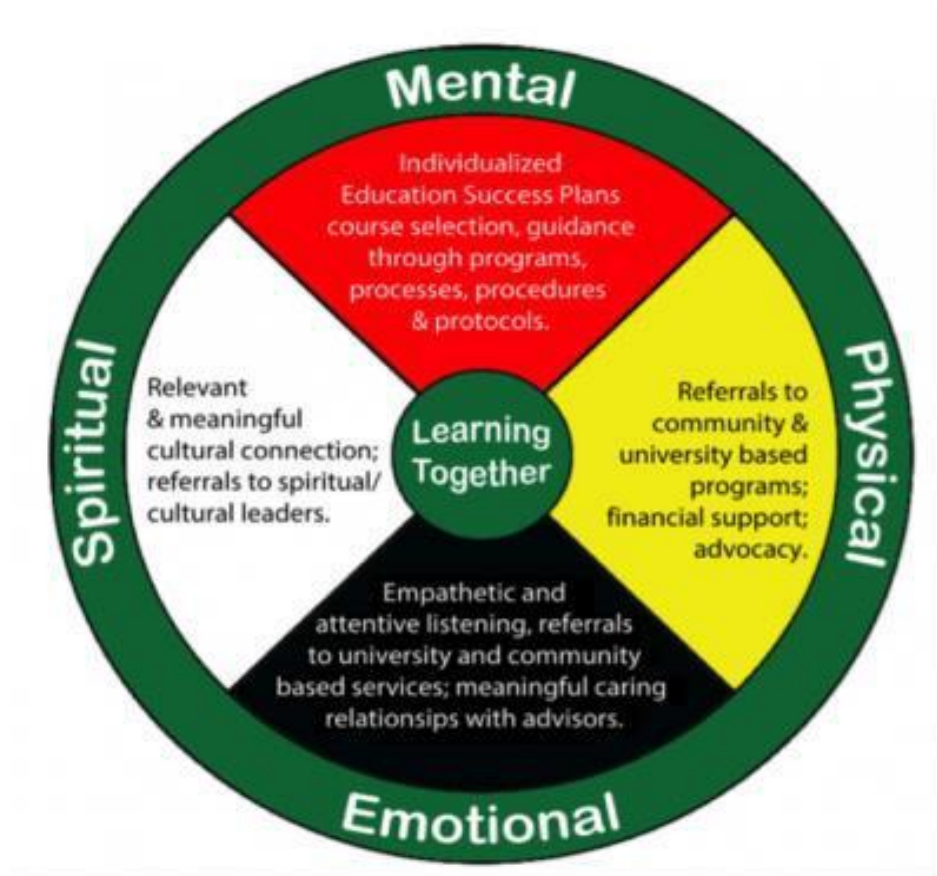
Figure 8. An adapted Holistic Model (HM) based off the Medicine Wheels of indigenous ways of knowing. There are four main entities in the HM: Mental, Physical, Emotional, and Spiritual Wellness. This HM was published by Josee Buduny (2015) from Carleton University which was inspired by Traditional Ecological Knowledge (TEK), cultural integration, and contemporary pedagogy. This diagram follows and abides by the Creative Commons: Attribution - NonCommercial 4.0 International (CC BY-NC 4.0). [LINK H]

2.0 BIOSPHERE LESSON PLAN

A Holistic Inquiry into Macroscopic and Microscopic Interactions of Earth's Biosphere

OVERVIEW

This section intends to develop an understanding of the core concepts of the biosphere. This section will also develop an understanding of the ways in which our biosphere impacts the overall health, sustainability and well-being of our environment and communities from ecological, social and personal inquiry perspectives.

By the end of this section, students will have developed an understanding of:

- The definition of the planet's *biosphere*;
    - It's components;
    - Its significance;
    - The human impacts on the *biosphere*;
    - The ramifications of environmental degradation on micro and macroscopic scales
    - TEK sustainability and biological resilience

Biosphere Lesson Plan Big Ideas

(1) Diversity in Local Ecosystems
A. Local environments contain diverse ecosystems with many roles and relationships

(2) Processes and Changes in Local Ecosystems
A. Interconnected systems sustain healthy ecosystems
B. Ecosystem stability is an important result of sustainability

(3) Sustainability in Local Ecosystems
B. Human practices affect the sustainability of ecosystems

(4) Conservation and Restoration of Ecosystems
B. Humans can play a role in conservation and restoration of ecosystems

Curricular and Core Competency
Examine page 5 - 8 for review

Pedagogical Implications
See page 8 - 12 for review

Prescribed Learning Outcomes (PLOs)
Analyze page 12 - 15 for review

2.2 PART I: INQUIRY INTO THE BIOSPHERE

BIOSPHERE INTEGRATED TEACHER RESOURCE PACKAGE (ITRP)	
TOPIC	**DESCRIPTION**
The Four Spheres (Part 1) https://www.youtube.com/watch?v=VMx jzWHbyFM	**Purpose:** To assist students in introducing the four spheres and the ways in which they relate and impact each other.
Biosphere https://energyeducation.ca/encyclopedia/ Biosphere	**Purpose:** To assist students in gaining an appreciation for the intricate, interconnected, and dynamic abiotic and biotic interactions within Earth's biosphere.
Biosphere Threats https://energyeducation.ca/encyclopedia/ Biosphere	**Purpose:** Investigation of manipulation and effect to the dynamic and wellness of the biosphere from an anthropogenic lens.
Biosphere Inquiry https://www.aurumscience.com/blue_plan et.html	**Purpose:** Immersive video analysis of ecological integrity and beauty of natural phenomena in the biosphere. Worksheets are available for each BBC Blue Earth analysis
Biosphere Importance https://www.britannica.com/science/biosp here/The-importance-of-the-biosphere	**Purpose:** An in-depth review of biosphere importance from an ecological perspective.
Microscopic Investigation http://www.nelson.com/albertascience/pr oductinfo/documents/units/Unit20A_Ener gy_and_Matter_Exchange_in_the_Biosph ere.pdf	**Purpose:** Student autonomy to investigate a taxonomic organism threats within the biosphere (i.e., What Frogs are Disappearing? (P. 13).
Macroscopic & Holistic View https://www.environmentalscience.org/su stainability	**Purpose:** Revision of sustainability from a broad, collective view. This is a prescribed reading needed for their next assignment.

FORMATIVE SELF-REFLECTION: BIOSPHERE

Self-Reflection Format

Individually, each student will self-reflect their theiring outcomes as an Entrance Slip for the Biosphere Inquiry. Self-reflection will be formative in nature, but a rubric is present to guide them in higher tier criticality, introspection, and epistemology. The Entrance Slip will be expected to be completed prior to the start of next class. It is highly recommended that sufficient time to process the supplementary resources is permitted; at least (2) one-hour class sessions are recommended before proceeding to the formative self-reflection worksheet. Students will then share their introspections with one another

through student-led discussion. The teacher will then use Guided Inquiry to open the peer-to-peer discussion to classroom-led discussion. It is estimated that the introspective debriefing will take an entire one-hour class period.

Rubric Pedagogical Rationale

Even though formative assessments are not summatively counted for marks, it is an opportunity for deep self-reflection and personal growth. The rubric is to guide the expectations needed for meaningful and critical introspection on and personal and holistic level.

BIOSPHERE SELF-REFLECTION WORKSHEET

_____

Name: _____ **Period:** _____ **Date:** _____

Entrance Slip: BIOSPHERE

Environmental Science 11

Scientific Communication, Criticality, Self-Reflection, & Introspection

SELF-REFLECTION RUBRIC

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	**A**	**B**	**C**	**D**
	100%	**95%**	**80%**	**65%**	**50%**
	Always	**Constantly**	**Usually**	**Occasionally**	**Rarely**
Description	Demonstrates high anecdotal evidence of **analyzing, evaluating, applying, and Synthesizing** original work from a **holistic, critical,** and **personalized narrative. Introspection** of the **quality** of writing is apparent	Proficient **clarity** and explanation which adequately reflects **main ideas** and **concepts**. Student reflection is appropriate to probing question. Reflection is highly **personalized** which exhibits high degree of **criticality** and **introspection**.	Developing personal reflections which **supports** the main ideas. Students **adequately reflects** upon the main concepts. Student supports may require some more thoughtful and personal revisions as introspection may be **moderate**.	**Emerging effort** to address the main idea. Supports are **minimal** or not fully developed. Quality of writing demonstrates strong evidence for only **knowledge** and/or **understanding comprehension.** Student **revision** for partial inquiry is highly **recommended**.	Demonstrates **low anecdotal evidence** for criticality, introspection, and effort. Ideas are **not fully completed** or **extremely incomplete**. Student **revision** for the quality of works is highly **recommended.**

1. How has your understanding and appreciation for the biosphere changed from the supplementary readings? Use specific scientific language, deduction (logical reasoning), and personal introspection to support your enquiries.

2. *Provide examples of new things which you enquired; provide support, evidence, and rationale for these anecdotal discoveries.*

3. Why are anthropogenic effects to the natural environment of our biosphere problematic? Use deductive reasoning with supports and elaborations to explore potential threats on both scales: microscopic and macroscopic.

4. How has learning about habitat degradation affected your perception of interconnectivity in the biosphere?

5. What are some thing you may do on a microscopic (personal and local) scale to help maintain, perserve, value, and educate yourself and others in your community about conserving our environment?

6. What are some things large corporations, communities, and countries may do on a macroscopic (regional and
global) scale to help maintain, persevere, value, and educate yourself and others in the biosphere about mitigating, conserving, and protecting our environment?

7. Synthesize and draw an artistic representation to depict changes you want to see in the contemporary world on a holistic and interconnected level with regards to the personal, social, and environmental importance of the biosphere. Quality of message will be values more than the artistic capabilities of the designer.

2.3 PART II: EXPERIMENTAL & HOLISTIC LEARNING THROUGH COMMUNITY ACTION
PROJECT-BASED LEARNING (PBL) & INQUIRY-BASED LEARNING (IBL)

CAPSTONE DURATION: 30 Days
Can be done concurrently with entire Earth's Spheres Unit

PROJECT OBJECTIVE
The purpose of this collaboration is to create meaningful change on a personal, social, and environmental level, while contributing and preserving the natural beauty of our community. In groups of four, your team will be responsible for a community action or awareness which maintain the biosphere health and integrity of your local region. This self-directed inquiry will be open-ended, with any topic or investigation of interest permissible as long as it is logistically feasible.

Some Professional Ideas May Include:
- Community Biosphere Survey
- Infographic Representative of Biosphere Data
- Biosphere Pamphlet
- Waste Collection & Logistics
- Local, Biological Nutrient Cycling
- Habitat Restoration
- Flora & Fauna Biodiversity Investigation
- Municipal Project: Environmental Mural/Art
- Biological Indicators
- Environmental Business Initiatives
- Any Validated and Specific Topics

PROJECT GOAL
Students will use a systematics way of conducting their investigation and design of their project. Crucial and essential applicative comprehension of Big Ideas will be conducted, communicated, and evaluated effectively. This project is to expose students to environmental and sustainability leadership and initiative roles which emphasize the interrelationships among science, technology, human activity, and environmental systems.

The Community Project must include the following Big Ideas:

(1) Diversity in Local Ecosystems
  A. Local environments contain diverse ecosystems with many roles and relationships

(2) Processes and Changes in Local Ecosystems
  B. Interconnected systems sustain healthy ecosystems
  C. Ecosystem stability is an important result of sustainability

(3) Sustainability in Local Ecosystems
  A. Human practices affect the sustainability of ecosystems

(4) Conservation and Restoration of Ecosystem
  A. Humans can play a role in conservation and restoration of ecosystems

Professional Collaboration & Competencies

Communication will be essential for this project. To ensure that time management within and beyond classroom times are facilitated properly, essential information of your team members are required for accessible and convenient communication between one another.

TEAM NAME: _____

TEAM TOPIC: _____

Acronym	Initials	Name	Contact Number	Email	Address	Common Lunch Location
YNI						
P1I						
P2I						
P3I						

YNI = Your Name's Initials; **P1I** = Partner One's Initial; **P2I** = Partner Two Initials; **P3I** = Partner Three Initials; **VTI** = Validated Teacher's Initials

ACTIVITY CHECKLIST

STEPS	DESCRIPTION	COMPLETION DATE	YNI	P1I	P2I	P3I	VTI
1	a. Discuss the topic of your project.						
2	b. Discuss rubric, goals, and expectations.						
3	c. Outline steps needed to complete project.						
4	d. Get permission if needed.						
5	e. Seek for potential community collaboration						
6	f. Community research						
7	g. Start constructing and officializing your project						
8	h. Teacher revision(s) and suggestion(s)						
9	h. Review/edit your project.						
10	i. Present project.						

When a group task is completed, stamp the appropriate date of completion and initials, respectively. The group initials are a verifying step for all group members to ensure cohesive collaboration, expectations, responsibility, and time management. The teacher initials are required to validate completion of progress and to provide formative feedback and suggestions. Permissible classroom times will be based on the educator's professional judgment based on formative feedback of time management and progress.

PROJECT RUBRICS
RI - III: *Communication, Critical Thinking, and Social and Personal Competency*
RIV: *Curricular Competency and Big Ideas*
RV: *Self-Reflection*

RI: CORE COMPETENCY I - COMMUNICATION

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	A	B	C	D
	100%	95%	80%	65%	50%
	Always	**Constantly**	**Usually**	**Occasionally**	**Rarely**
Description	Team demonstrates high anecdotal evidence of direct and **transparent** and communication of their project. There project is **transformative** and **extensive** which is **reflective** and **reflective** to the community in a meaningful way.	Proficient **clarity** and explanation of their project through indirect and direct communication. All big ideas are present which adequately reflects main ideas and concepts. High effort, **criticality**, **introspection**, creativity, and effort are apparent.	**Competent** and **effective communication** which is adequately **supported**. Students **adequately reflects** their environmental initiative with the **Big Ideas.** Verbal and/or oral communication are cohesive with picture and graph support.	**Emerging effort** to address the main idea. Supports are **satisfactory** or **minimal**. Quality of writing demonstrates adequate evidence for only **knowledge** and/or **understanding comprehension.** Project would have benefited from more thoughtfully executed revisions.	Demonstrates **low anecdotal evidence** for criticality, introspection, and effort. Ideas are **not fully completed** or **extremely incomplete**. Student **revision** for the quality of works is highly **recommended.** Project does not explore the biosphere connections in-depth.

R1: _____ / 20 Marks

RII: CORE COMPETENCY II - CRITICAL THINKING

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	A	B	C	D
	100%	95%	80%	65%	50%
	Always	Constantly	Usually	Occasionally	Rarely
Description	Demonstrates high anecdotal evidence of **analyzing, evaluating, applying, and synthesizing** original work from a **holistic, critical,** and **personalized narrative. Introspection** of the **quality** of writing is apparent	Proficient **clarity** and explanation which adequately reflects **main ideas** and **concepts**. Student reflection is appropriate to probing question. Reflection is highly **personalized** which exhibits high degree of **criticality** and **introspection**.	Developing personal reflections which **supports** the main ideas. Students **adequately reflects** upon the main concepts. Student supports may require some more thoughtful and personal revisions as introspection may be **moderate**.	**Emerging effort** to address the main idea. Supports are **minimal** or not fully developed. Quality of writing demonstrates strong evidence for only **knowledge** and/or **understanding comprehension.** Student **revision** for partial inquiry is highly **recommended**.	Demonstrates **low anecdotal evidence** for criticality, introspection, and effort. Ideas are **not fully completed** or **extremely incomplete**. Student **revision** for the quality of works is highly **recommended.**

RII: _____ / 20 Marks

RIII: CORE COMPETENCY III - PERSONAL & SOCIAL

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	A	B	C	D
	100%	95%	80%	65%	50%
	Always	Constantly	Usually	Occasionally	Rarely
Description	Demonstrates high anecdotal evidence of **effective social collaboration** between one another. Student **autonomy** and **opinions** are **respected** and **valued** between one another. Cohesion of group dynamic is **efficient, facilitative, diligent, respectful, transparent, and professional.**	**Proficient communicational clarity** and **explanation** between group members. **Respect** of student suggestions are politely acknowledged and delegated **appropriately.** Group cohesion is **diligent, respectful, transparent, and professional.**	**Competent** and **adequate personal** and **social communication** between one other. **Respect** of student suggestions are politely acknowledged and delegated **appropriately.** Group cohesion is **diligent, respectful, transparent, and professional.**	**Developing** and **adapting personal** and **social communication** between one other. **Respect** of student suggestions are politely acknowledged and delegated **appropriately.** Group cohesion is **respectful, transparent, and professional.**	**Emerging social communication** between one other. **Moderate respect** of student suggestions are present. Group cohesion is **responsive,** yet **conflictual** on an intermittent basis. **Teacher** assistance and **facilitation is required**

RIII: _____ / 20 Marks

RIV: CONTENT - CURRICULAR COMPETENCIES & BIG IDEAS RUBRIC

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	A	B	C	D
	100%	95%	80%	65%	50%
	Always	Constantly	Usually	Occasionally	Rarely
Description	**Meets** and **exceeds all Curricular Competencies** and **Big Ideas** established in Environmental Science 11	**Meets all Curricular Competencies** and **Big Ideas** established in Environmental Science 11	**Meets most Curricular Competencies** and **Big Ideas** established in Environmental Science 11	**Meets some Curricular Competencies** and **Big Ideas** established in Environmental Science 11	**Meets few Curricular Competencies** and **Big Ideas** established in Environmental Science 11

RIV: _____ / 20 Marks

RV: COOPERATIVE EVALUATION - SELF-REFLECTION

This Cooperative Learning Rubric was retrieved with permission from Laura Candler (2012). [Source 6]

Cooperative Learning Rubric

Name_____ Class Period_____ Date_____

Directions: Write the number score for each category and the total overall score in the spaces provided.

Category	4	3	2	1
Contribution to Group Goals Score:_____	Consistently and actively works toward group goals; willingly accepts and fulfills individual role within the group.	Works toward group goals without occasional prompting; accepts and fulfills individual role within the group.	Works toward group goals with occasional prompting.	Works toward group goals only when prompted.
Consideration of Others Score:_____	Shows sensitivity to the feelings and learning needs of others; values the knowledge, opinion, and skills of all group members.	Shows and expresses sensitivity to the feelings of others; encourages the participation of others.	Show sensitivity to the feelings of others.	Needs occasional reminders to be sensitive to the feelings of others.
Contribution of Knowledge Score:_____	Consistently and actively contributes knowledge, opinions, and skills without prompting or reminding.	Contributes knowledge, opinions, and skills without prompting or reminding.	Contributes information to the group with occasional prompting and reminding.	Contribute information to the group only when prompted.
Working and Sharing with Others Score:_____	Helps the group identify necessary changes and encourages group action for change; does assigned work without reminders.	Willingly participates in needed changes; usually does the assigned work and rarely needs reminding.	Participates in needed changes with occasional prompting; often needs reminding to do the assigned work.	Participates in needed changes when prompted and encouraged; always or often relies on others to do the work.
Total Overall Score _____	Comments:			

Figure 9. A Cooperative Learning Rubric for self-evaluation. This pedagogical assessment is attributed and created by Laura Candler (2013) for the online teacher resource sharing. The integration and contribution of this illustration follows and abides by the Creative Commons: Attribution-NonCommercial 4.0 International (CC BY-NC 4.0). [LINK I]

RV: _____ / 10 Marks

TOTAL PROJECT MARK: _____ / 90 MARKS

3.0 LITHOSPHERE and HYDROSPHERE LESSON PLAN

An Inquiry into Political Beliefs and Bias Affecting the Reporting of the Impact of Resource Management on Earth's Lithosphere and Hydrosphere

OVERVIEW

This section intends to develop an understanding of the core concepts of the lithosphere and hydrosphere. This section will also develop an understanding of the ways in which our actions, in terms of how we access natural resources, can impact the lithosphere and hydrosphere. Students will also gain an understanding of the philosophical differences between liberals and conservatives, how society's beliefs can be reinforced through social media and how bias in the media impacts the way a reader may perceive an issue.

By the end of this section, students will have developed an understanding of:

- The definition of the planet's *lithosphere* and *hydrosphere*;
    - It's components;
    - Its significance;
    - The human impacts on the *lithosphere* and *hydrosphere*; and
    - The ramifications of environmental degradation through unsustainable acquisition of natural resources
- Some key differences of opinions between liberals and conservatives;
    - Students will determine if their beliefs are more conservative or more liberal;
    - How their beliefs can narrow the news they're exposed to in social media; and
    - The definition of confirmation bias and how this can develop.
- Bias in the media and how it can be created
    - How bias can impact a person's point of view; and
    - The various forms of bias.

Lithosphere/Hydrosphere Lesson Plan Big Ideas

(1) Diversity in Local Ecosystems
A. Local environments contain diverse ecosystems with many roles and relationships
(2) Processes and Changes in Local Ecosystems
A. Ecosystem stability is an important result of sustainability
(3) Sustainability in Local Ecosystems
A. Human practices affect the sustainability of ecosystems
(4) Conservation and Restoration of Ecosystems
A. Humans can play a role in conservation and restoration of ecosystems

3.1 LEARNING TASK 1: POLITICAL BELIEFS AND CONFIRMATION BIAS

The purpose is to investigate where students' political beliefs lie, how their beliefs can be reinforced through social media and how confirmation bias can occur.

Task:
- In this first part of the lesson, students will examine political beliefs and reflect on where their beliefs lie.

Introduction/ anticipatory set:

- Present a controversial statement on the board, such as "Climate change is natural and there is no scientific evidence to support that humans have impacted the Earth's climate".

- With proper facilitation, this should lead to a class debate.

- A discussion of how one's beliefs can be influenced by peers, the media, role-models, etc.

Formative Assessment:

- In the large group, read the differences in opinions between Liberals and Conservatives on the sheet entitled "Are You Liberal or Conservative?" *(page 32)*. Ensure students understand that political beliefs are a spectrum and students may be torn on issues, as some politicians are.

- Afterwards, have students read the key issues, noting whether their stance on the issues identified are more liberal or conservative.

- A whole group discussion can take place to gauge the political beliefs of the various issues within the class.

- Individually, students can complete questions 1-3. Prior to question 3, the teacher must play the video using the link provided.

- A discussion of how students' beliefs have been impacted by their peers, role-models and social media can occur after the completion of the questions.

Are you Liberal or Conservative?

Below you will find a table containing controversial issues. You will also find what Conservatives and Liberals GENERALLY believe when it comes to such issues. (adapted from "Are You Conservative or Liberal?" found at http://wp.lps.org/tnettle/files/2013/12/Liberal-vs-Conservative.pdf).

LIBERALS	CONSERVATIVES
Generally believe in governmental action to achieve equal opportunity and equality for all, and that it is the duty of the government to reduce community issues and to protect civil liberties and individual and human rights.	**Generally** Believe in personal responsibility, limited government, free markets, individual liberty, traditional values and a strong national defense.
Also believe the role of the government should be to guarantee that no one is in need.	Also believe the role of government should be to provide people the freedom necessary to pursue their own goals.
Liberal policies **generally** emphasize the need for the government to solve people's problems.	Conservative policies **generally** emphasize empowerment of the individual to solve problems.
Liberals are often referred to as being on the **LEFT** when put into a political spectrum.	Conservatives are often referred to as being on the **RIGHT** when put into a political spectrum.

Political Spectrum

A political spectrum is a way of modeling different political positions by placing them upon a geometric axis.

Left   Moderate   Right

The Issues Worksheet:

Directions: As you read the views for each issue, record a "L" or "C" in the blank provided under the issue title, depending on what side of the issue your beliefs lean towards (adapted from "Are You Conservative or Liberal?" found at http://wp.lps.org/tnettle/files/2013/12/Liberal-vs-Conservative.pdf).

The Issues	Liberals	Conservatives
The environment _____	Liberals sometimes believe that conservatives don't care as much about protecting the environment. Liberals will argue that Industrial growth can harm the environment. They argue global warming is caused by an increased production of carbon dioxide. Countries should enact laws to significantly reduce that amount even if it reduces some economic growth.	Conservatives want clean water, clean air and a clean planet, just like everyone else. However, extreme environmental policies destroy jobs and damage the economy. Changes in global temperatures are natural over long periods of time. So far, science has not shown that humans can affect permanent change to the earth's temperature.
Religion _____	Support the separation of church and state. Religious expression has no place in government. Support the removal of all references to God in public and government spaces. Religion should not interfere with government.	Oppose the removal of symbols of Christian heritage from public and government spaces. Government should not interfere with religion and religious freedom.
Same Sex Marriage _____	Marriage should be legal for gay, lesbian, bisexual and transgender couples to ensure equal rights for all. All individuals, regardless of their sex, have the right to marry. Believe that prohibiting same-sex citizens from marrying denies them of their civil rights.	Marriage is between one man and one woman. Believe that requiring citizens to sanction same sex relationships violates moral and religious beliefs of millions of Christians, Jews, Muslims and others who believe marriage is the union of a man and a woman.

Taxation	Support higher taxes and a larger government. High taxes allow the government to do good and create jobs. We need high taxes for social welfare programs, to provide for the poor. We can't afford to cut taxes.	Support lower taxes and a smaller government. Lower taxes create more incentive for people to work, save, invest, and engage in entrepreneurial endeavors. Money is best spent by those who earn it.

Confirmation Bias

This is the tendency to "seek evidence verifying our ideas more eagerly than we seek evidence that might refute them" (Myers, 2011).

Discussion Questions

1) Based on your opinions of the issues, are you more liberal or more conservative?

_____

_____

_____

2) What do you think has influenced you to be either more liberal or more conservative?

_____

_____

_____

_____

Watch the following video prior to answering the next question:

https://vimeo.com/180771524

3) How might social media result in confirmation bias reinforcing a person's beliefs?

_____

_____

_____

_____

_____

_____

_____

3.2 LEARNING TASK 2: BIAS IN THE MEDIA

The purpose is to explore a controversial topic and the ways it has been covered in the media, thereby exploring bias and the ways it is created. The aim is for students to be critical thinkers.

Task:
- Students will examine a report concerning the proposed Pebble mine near Bristol Bay, Alaska and analyze the ways in which the source is either balanced or biased.
- They will compose a piece stating their political beliefs, whether or not these beliefs have affected their opinion of the proposed mine, and whether or not they support the mine.

Introduction/ anticipatory set:
- Show two differing viewpoints of the proposed Pebble Mine near Bristol Bay, Alaska (resources 10 and 11 in the table). As students watch the first video, have them jot down words, phrases, statistics, etc. that are anti-environmental groups/pro- Pebble mine. As they watch the second video, have them jot down words and phrases that are anti-Pebble mine. Ask students what bias is and how each video has displayed bias.
- After this discussion, supply and read pages 4-5 from "Bias in the Media" (resource 9 in the table) with the class.

Group Assessment:
- In the groups of 3-5, students have to read an article or report that is either for or against the proposed mine (resources 1-8). In groups they are to complete pages 6-7 from "Bias in the Media" (resource 9 in the table).
- Students will prepare a brief presentation (3-5 minutes), for which they will be required to:

  i) provide a summary of the article/report;
  ii) identify ways in which their text is bias; or
  iii) explore how the text is balanced if it does not appear biased.

- Complete the cooperative learning rubric on ***page 37***.

Summative Assessment:
- After the group presentations, students should be familiar with the various arguments for and against the proposed mine.
- Students will individually compose a 2-3 page composition in which they address the following (see rubric on ***page 38-39***):

  i) the side of the political spectrum that their beliefs tend to lie;
  ii) whether these beliefs impact their opinion of the proposed Pebble mine;
  iii) after evaluating sources, state their opinion as to whether the Pebble mine can be developed sustainably or not; and
  iv) utilize the sources provided or new, credible sources to support their stance.

	LITHOSPHERE AND HYDROSPHERE INTEGRATED TEACHER RESOURCE PACKAGE (ITRP)	
Resource #	**Title/ Link**	**Publisher**
1	"Fact Sheet: Tailings Storage" https://static1.squarespace.com/static/59d405c98419c26bff4810cb/t/5b5a1e716d2a73a4864a50c7/1532632701600/07+20180525+Tailings.pdf	The Pebble Partnership
2	"Fact Sheet: Earthquakes" https://static1.squarespace.com/static/59d405c98419c26bff4810cb/t/5b5a1e3503ce64a41d21a9cf/1532632649957/03+20180525+Seismicity.pdf	The Pebble Partnership
3	"Fact Sheet: Protecting Water" https://static1.squarespace.com/static/59d405c98419c26bff4810cb/t/5b5a21c9f950b7fbcbf8fc98/1532633603082/06+20180122+Water.pdf	The Pebble Partnership
4	"Pebble mine impact to propel US and Alaskan economies" http://www.miningweekly.com/article/pebble-mine-impact-to-propel-us-and-alaskan-economies-2013-05-31	Mining Weekly
5	"The World Needs Copper. Does It Need This Controversial Mine?" https://news.nationalgeographic.com/2017/11/pebble-mine-alaska-copper-epa-trump-environment/	Nat. Geo.
6	"Developing Alaska's Pebble Mine could threaten salmon population" https://www.cbsnews.com/news/proposed-alaska-mine-could-threaten-salmon-population/	CBS News
7	"Crushing Alaska's Pebble Mine" https://www.nrdc.org/stories/crushing-alaskas-pebble-mine	NRDC
8	"New Study: Bristol Bay fishing jobs outnumber Pebble Mine jobs nearly 100 to one " "http://www.savebristolbay.org/in-the-news/2017/1/31/new-study-bristol-bay-fishing-jobs-outnumber-pebble-mine-jobs-nearly-100-to-one	Savebristolbay.org
9	"Bias in News Sources" http://mediasmarts.ca/sites/mediasmarts/files/pdfs/lesson-plan/Lesson_Bias_News_Sources.pdf	Media Smarts
10	"The EPA's Assault on Alaska's Pebble Mine" https://www.youtube.com/watch?v=D1hSJCyWc3w	N/A
11	"The Pebble Mine" https://www.youtube.com/watch?v=vw53Yh-9Jaw	N/A

PROJECT RUBRICS

RI: COOPERATIVE EVALUATION - SELF-REFLECTION

This Cooperative Learning Rubric was retrieved with permission from Laura Candler (2012).

Cooperative Learning Rubric

Name_____ Class Period_____ Date_____

Directions: Write the number score for each category and the total overall score in the spaces provided.

Category	4	3	2	1
Contribution to Group Goals Score:_____	Consistently and actively works toward group goals; willingly accepts and fulfills individual role within the group.	Works toward group goals without occasional prompting; accepts and fulfills individual role within the group.	Works toward group goals with occasional prompting.	Works toward group goals only when prompted.
Consideration of Others Score:_____	Shows sensitivity to the feelings and learning needs of others; values the knowledge, opinion, and skills of all group members.	Shows and expresses sensitivity to the feelings of others; encourages the participation of others.	Show sensitivity to the feelings of others.	Needs occasional reminders to be sensitive to the feelings of others.
Contribution of Knowledge Score:_____	Consistently and actively contributes knowledge, opinions, and skills without prompting or reminding.	Contributes knowledge, opinions, and skills without prompting or reminding.	Contributes information to the group with occasional prompting and reminding.	Contribute information to the group only when prompted.
Working and Sharing with Others Score:_____	Helps the group identify necessary changes and encourages group action for change; does assigned work without reminders.	Willingly participates in needed changes; usually does the assigned work and rarely needs reminding.	Participates in needed changes with occasional prompting; often needs reminding to do the assigned work.	Participates in needed changes when prompted and encouraged; always or often relies on others to do the work.
Total Overall Score _____	Comments:			

Figure 10. A Cooperative Learning Rubric for self-evaluation. This pedagogical assessment is attributed and created by Laura Candler (2013) for the online teacher resource sharing. The integration and contribution of this illustration follows and abides by the Creative Commons:Attribution-NonCommercial 4.0 International (CC BY-NC 4.0). [LINK I]

Environmental Science- Sustainable Resource Acquisition and Bias in the Media

RII: CORE COMPETENCIES I-II - COMMUNICATION, CRITICAL THINKING

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	A	B	C	D
	100%	95%	80%	65%	50%
	Always	Constantly	Usually	Occasionally	Rarely
Conventions	Spelling, grammar, and sentence structure are very accurate. Improvement is difficult.	Spelling, grammar, and sentence structure are, for the most part, accurate.	Spelling, grammar, and sentence structure are fairly accurate.	Spelling, grammar, and sentence structure are somewhat accurate.	Inaccuracies in spelling, grammar, and sentence structure hinder effective communication.
Ideas	Exceptionally clear and concise communication of scientific ideas and information exists. Identifies bias and evaluates validity of data in primary and secondary sources in an insightful manner.	Very clear and concise communication of scientific ideas and information exists. Identifies bias and evaluates validity of data in primary and secondary sources in a very clear and logical manner.	Fairly clear and concise communication of scientific ideas and information exists. Identifies bias and evaluates validity of data in primary and secondary sources in a clear and logical manner.	Communication of scientific ideas is unclear/ somewhat clear. Identifies bias and evaluates validity of data in primary and secondary sources in a somewhat clear/ somewhat developed manner.	Communication of scientific ideas is unclear/ illogical. Identifies bias and evaluates validity of data in primary and secondary sources in an illogical/unclear / undeveloped manner.

gua ge (Language)	The word choice is sophisticated and enhances the communication of ideas within the essay.	The word choice is very clear and logical. Diction accurately communicates ideas.	The word choice is clear and logical. Diction communicates ideas.	The word choice is somewhat clear and logical. Diction communicates ideas at times; however, instances of unclear communication exists.	The word choice detracts from the essay. It is general or inaccurate.
Sourc es and page	Credible sources have been cited correctly using APA format. The "References" page following all formatting.	Fairly credible sources have been cited correctly, for the most part, using APA "References" page has been created following most formatting.	Sources have been cited correctly, for the most part, using APA format. The page has been created following most formatting.	Some citations are heavily flawed or missing. Formatting in the "References" page. Credible citation selection is lacking for some sources.	Citations are heavily flawed or missing. Substantial formatting in the "References" page. Credible citation selection is lacking.

4.0 HYDROSPHERE and ATMOSPHERE LESSON PLAN

An Inquiry into the Impacts of Human Activity on the Atmosphere and the Hydrosphere and the Need for Individual and Community Intervention

OVERVIEW

This section intends to develop an understanding of the core concepts of the hydrosphere and the atmosphere. This section will also begin to develop an understand of the ways in which human activity impacts the hydrosphere and the atmosphere. Finally, this section will encourage students to consider both the individual and community-based interventions and adaptations necessary to help curb environmental impacts.

By the end of this section, students will have developed an understanding of:

- The definition of the planet's *hydrosphere*;
    - It's components;
    - Its significance;
    - The human impacts on the hydrosphere (micro-plastics);
    - How its degradation impacts the health of our communities.
- The definition of the planet's *atmosphere*;
    - It's components;
    - Its significance;
    - The human impacts on the atmosphere (greenhouse gases);
    - How its degradation impacts the health of our communities.
- How media applications can be used to monitor human activity and to promote positive change and how both individual and community-based interventions can be used to limit human contributions to pollution and climate change.

Hydrosphere and Atmosphere Lesson Plan Big Ideas

(2) Diversity in Local Ecosystems
C. Local environments contain diverse ecosystems with many roles and relationships

(2) Processes and Changes in Local Ecosystems
E. Interconnected systems sustain healthy ecosystems
F. Ecosystem stability is an important result of sustainability

(3) Sustainability in Local Ecosystems
D. Human practices affect the sustainability of ecosystems

(4) Conservation and Restoration of Ecosystems
D. Humans can play a role in conservation and restoration of ecosystems

Curricular and Core Competency
Examine page 5 - 8 for review
Pedagogical Implications
See page 8 - 12
Prescribed Learning Outcomes (PLOs)
Analyze page 12 - 15 for review

HYDROSPHERE AND ATMOSPHERE INTEGRATED TEACHER RESOURCE PACKAGE (ITRP)	
Supplementary Materials - Websites / Videos	
Hydrosphere https://energyeducation.ca/encyclopedia/HydrospHere	**Purpose:** To help students develop an understanding of the hydrosphere, the different components relevant to the hydrosphere, and some of the human impacts on the hydrosphere.
Atmosphere https://energyeducation.ca/encyclopedia/AtmosphEre	**Purpose:** To help students develop an understanding of the atmosphere, the different components relevant to the atmosphere, and some of the human impacts on the atmosphere.
Greenhouse Effect https://energyeducation.ca/encyclopedia/Greenhouse_effect	**Purpose:** This helps students better understand the significance of the Greenhouse Effect as it relates to pollution and the intersection of atmospheric pollution and human impacts.
Micro-Plastics https://oceanservice.noaa.gov/facts/microplastics.html	**Purpose:** As students begin to consider the impact their actions have on the environment, this resource offers a glimpse as to the ways in which human activity, mico-plastics and pollution intersect.
FastWeb https://www.fastweb.com/student-life/articles/eight-simple-ways-to-help-the-environment	**Purpose:** This website outlines ten ways that students can influence positive changes in their environment. This resource can be useful for students as they consider how they can make individual-based changes in their daily habits.
Ecological Footprint? http://www.footprintcalculator.org	**Purpose:** This online and interactive quiz allows students to rate their environmental footprint by evaluating their lifestyle. At the end of the quiz, a student will be given statistics based on their daily activity, and will be offered possible solutions.
EcoLeague Recipes For Action http://lsf-lst.ca/en/projects/teacher-resources/action-programs-youth/eco-league/recipes	**Purpose:** During this assignment, students will think about both individual and community-based action projects to curb environmental impacts. This website is a valuable resource for teachers and students to conduct experiential learning activities geared to engage students in positive and meaningful experiences.
EcoLeague Project Funding and Youth Forums http://resources4rethinking.ca/en/ecoleague	EcoLeague is a valuable resource for students and educators as it highlights the importance of youth as drivers of change in our communities. As a side note, this resource can encourage students to use this activity as a launching-pad for future and experimental learning.

	Students can apply to participate in youth forums focused on sustainable action projects. In addition, students can apply for up to $400 in funding to implement action projects in their own schools.
Supplementary Materials – Videos	
Sea Level Rise (12m 03s) http://www.abc.net.au/catalyst/stories/4045476.htm	**Purpose:** This resource allows students to better understand the relationship between climate change, the rising sea level (and its impacts) and how it influences the temperature.
The Water Brothers - Acid Ocean (25m 29s) http://thewaterbrothers.ca/acid-ocean/	**Purpose:** This video resource allows students to understand the ways in which the use of fossil fuels and the prevalence of carbon dioxide are impacting our water systems.
The Water Brothers - The Least Deadliest Catch (25m 29s) http://thewaterbrothers.ca/the-least-deadliest-catch/	**Purpose:** This video resource helps students develop an understanding of the our worlds most vital sources of food - the ocean. This video explores the topics of overfishing and how fisheries can become more sustainable.
Air Pollution - A Major Global Public Health Issue (7m 44s) https://www.youtube.com/watch?v=Tds3k97aAzo	**Purpose:** This short video helps orient air pollution and degradation of the atmosphere as an issue of public health.
Supplementary Materials - Apps (iOS and Android)	
Eco Friendly Calculator Developed by: Manisha Desadla	**Purpose:** This app unpacks the relationship between daily habits and costs to the environment and on the students wallet. This app allows students to track their daily activities and calculates how much money, emissions and trees are impacted by their household daily habits. The app also helps students understand how small changes and substitutions can help limit footprints on the environment.
Global Change Developed by: AUTEL	**Purpose:** This app is an educational tool that can be used to help students develop an understanding of the relationships between carbon and the hydrosphere. This app will encourage students to think about their own activities and how it influenced the climate.
Skeptical Science Developed by: Shine Technologies	**Purpose:** This app can be used to explain many of the central concepts and themes associated

	with climate change. This app uses commonly used skeptical arguments to educate students on facts and evidence-based explanations. The three main goals of this app is to: 1) teach students about global warming, 2) to think critically of what you read and to respond to arguments with hard science and 3) to report which arguments you have heard so it can assess topics that are prevalent in any given time.
GoodGuide Developed by: GoodGuide Inc.	**Purpose:** This app allows students to search, browse and scan the barcodes of products that they use in their own homes. This app will educate students as to the health and environmental hazards associated with each product and will supply alternatives.
CleanSpace Developed by: Drayson Technologies Limited	**Purpose:** This app provides students with information pertaining to the air quality in their homes and communities. It also provides a lot of air pollution data. Finally, this app can act as an incentive for students to make choices that improve air quality, reduce contributions to pollution by collecting CleanMiles on the app.

4.1 LEARNING TASK: ACTIVITY LOG, ENVIRONMENTAL IMPACT ASSESSMENT & COMMUNITY ACTION

Learning Task Description

Within this activity, students are to watch a short video Air Pollution 101 - National Geographic (3m 52s) and are to attempt to think about the ways in which their individual actions impact both the atmosphere and the hydrosphere. This activity might you to pursue outside research and resources to help you understand your environmental impact. The key message here is for you to consider the ways in which your own routines and actions contribute to the degradation of the hydrosphere and the atmosphere. You will then rank which activities do the most harm to the environment and explain why they think that. Students will then develop both an individual, community based intervention to reduce human activity for the top-three ranked activities.

In order to share your findings, you will also create and conduct a short presentation (5-8 minutes) to your classmates, outlining your impact and your intended interventions.

Part #1: Introduction Videos and Critical Reflection

To introduce the topics and the assignment, please watch both videos provided below:

Air Pollution 101 - National Geographic (3m 52s).

https://www.youtube.com/watch?v=e6rglsLy1Ys

Causes and Effects of Climate Change - National Geographic (3m 04s).

https://www.youtube.com/watch?v=G4H1N_yXBiA

As you watch the videos, complete the following questions:

1. What surprised you most about these videos?

2. Brainstorm how you believe human activity impacts both the hydrosphere and the atmosphere?

3. On a scale of 1 to 10 (1 = little impact and 10 = significant impact), rate what your environmental impact. Explain your answer.

Part #2a: Documenting Daily Activity

Now that you have completed Part #1, please fill out a chart which outlines and details a list of your daily activities. For each daily activity, consider how these activities impact both the hydrosphere and the atmosphere. Please be as specific with your activities as possible. As a general requirement students should document **_at least 15 activities_** that highlight their daily routine.

Use the chart below to record your activities:

Description of Activity	Impact on Atmosphere	Impact on Hydrosphere
1		
2		
3		
4		
5		
6		
7		
8		

9		
10		
11		
12		
13		
14		
15		

Notes:

Part #2b: Footprint Calculator

Based on your documented daily activities students should now have a greater understanding of their impact. Please use the website www.footprintcalculator.org and evaluate your environmental footprint. The information collected and provided within this exercise will encourage you to think about how your daily activities specifically impact the environment and how you can influence individual and community-based interventions. This exercise can also be referenced during your short presentation. Be sure to use all the features of this website to help you.

After completing their quiz on the website, copy and paste your results and possible solutions to the activity log from, Part #2a.
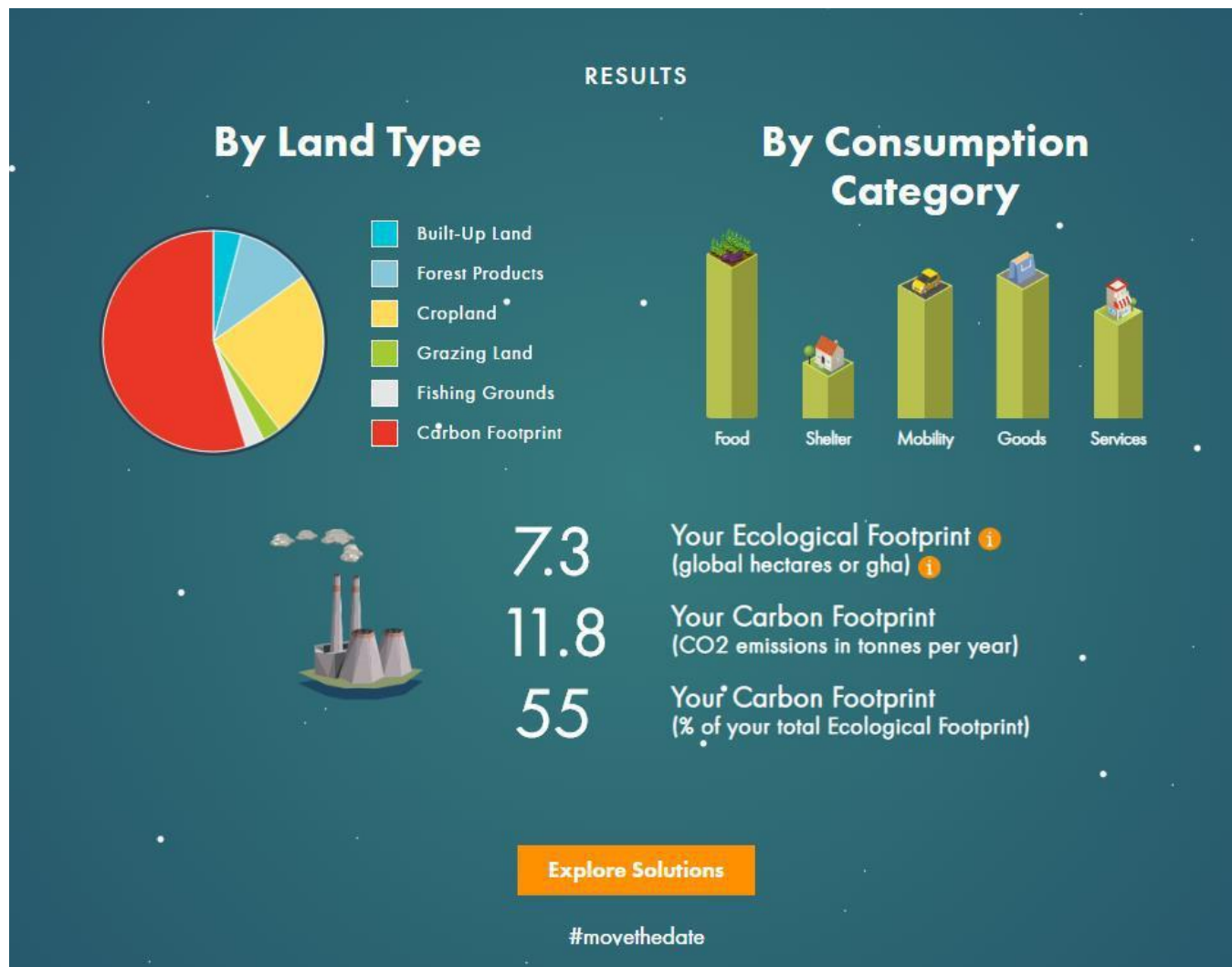
See example below:

Figure 11. A sample results infographic retrieved from the website www.footprintcalculator.org that students can use to evaluate their environmental footprint. [LINK J]

Part #2c: Ranking

After documenting daily activities and considering the environmental impact, please rank
each activity based on their impact on the environment. For ranking purposes represent "#1"
as the most harmful to the environment.

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Part #3: Individual and Community Action

After ranking their activities, students are to focus on their top-three selected activities. Again, these activities should represent activities that you felt had the most harmful impacts on the hydrosphere / atmosphere.

For each chosen activity, create a new chart and discuss both individual based interventions and community-based interventions which can alleviate environmental impact. This part of the activity will allow you to think more critically of your own actions, but also how they can mobilize and support community-based action projects.

Use the chart below:

Selected Activity	Individual Intervention	Community Intervention
#1		
#2		
#3		

Part #4: Share Your Actions for Change

After considering your individual and community interventions, visit www.ourcanadaproject.ca. Our Canada Project is an online sharing platform which inspires youth to share their plans for positive change. Here, students should share their vision and action plan on the website homepage by making an account. Students are encouraged to consider some of the actions they considered in the previous section. See below:

Before completing this part of the assignment, consider the following video:

Our Canada Project (OCP) – Learning for Sustainable Futures (1m 15s).

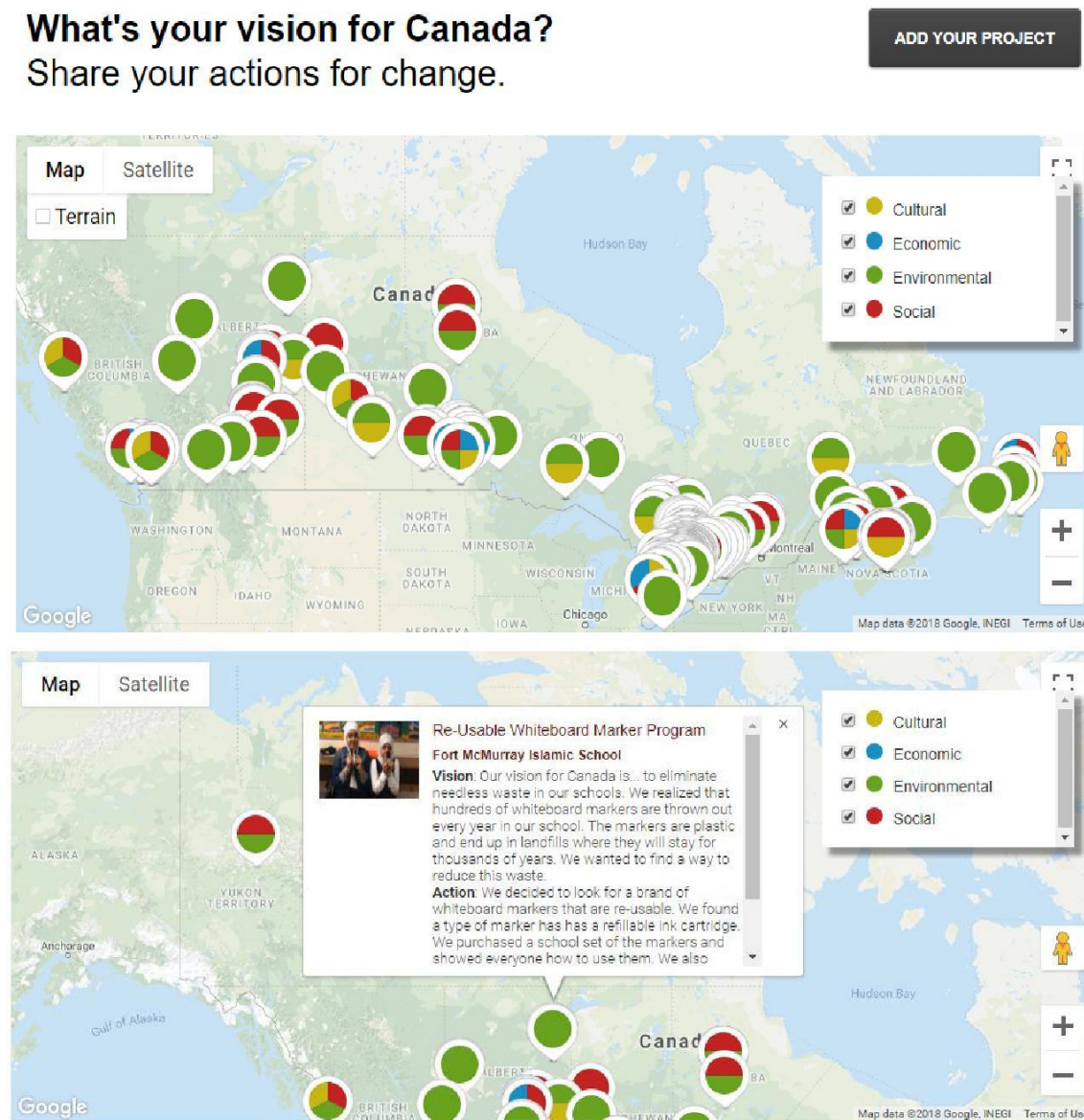https://www.youtube.com/watch?v=WN0yCYVBD5U

Figure 12. A sample results infographic retrieved from the website www.ourcandaproject.ca that students can use share their action projects with youth from across Canada. [LINK K]

Part #5: Community Action Presentation

The final part of your learning activity consists of a short (5-8 minute) verbal presentation where students can communicate their key findings, discuss successes and challenges.

During your presentation, **please address the following**:
- Discuss your daily activity log:
  - What was surprising? What did you learn?
  - What tools / apps / strategies did you use to document your activity and evaluate your impact?
- Discuss the way you ranked your activities:
  - What was your rationale?
- Discuss the actions you recorded and specifically address both the individual and community contributions:
  - Are these goals realistic?
- Please share you *biggest success* and your *biggest challeng*e while completing the project.
- Finally, pleasure share your biggest learning from this assignment and why you believe curbing our environmental footprints is important.

Audio / Visual

- Students are encouraged to be creative with their presentation and should utilize both audio and visual aids to engage their peers.
- Take screenshots of your Our Canada Project submission and include in the presentation.

PROJECT RUBRICS

RI - III: *Communication, Critical Thinking, and Social and Personal Competency*
RIV: *Curricular Competency and Big Ideas*

RI: CORE COMPETENCY I - COMMUNICATION

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	A	B	C	D
	100%	95%	80%	65%	50%
	Always	**Constantly**	**Usually**	**Occasionally**	**Rarely**
Description	Student demonstrates high anecdotal evidence of direct and **transparent** and communication of their assignment and presentation. There project is **transformative** and **extensive** which is **reflective** and **reflective** to the community in a meaningful way.	Proficient **clarity** and explanation of their assignment and presentation through indirect and direct communication. All big ideas are present which adequately reflects main ideas and concepts. High effort, **criticality**, **introspection**, creativity, and effort are apparent.	**Competent** and **effective communication** which is adequately **supported**. Students **adequately reflects** their environmental initiative with the **Big Ideas.** Verbal and/or oral communication are cohesive with picture and graph support.	**Emerging effort** to address the main idea. Supports are **satisfactory** or **minimal**. Quality of writing demonstrates adequate evidence for only **knowledge** and/or **understanding comprehension.** Project would have benefited from more thoughtfully executed revisions.	Demonstrates **low anecdotal evidence** for criticality, introspection, and effort. Ideas are **not fully completed** or **extremely incomplete**. Student **revision** for the quality of works is highly **recommended.** Project does not explore the biosphere connections in-depth.

R1: _____ / 10 Marks

RII: CORE COMPETENCY II - CRITICAL THINKING

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	A	B	C	D
	100%	95%	80%	65%	50%
	Always	Constantly	Usually	Occasionally	Rarely
Description	Demonstrates high anecdotal evidence of **analyzing, evaluating, applying, and synthesizing** original work from a **holistic, critical,** and **personalized narrative. Introspection** of the **quality** of writing is apparent	Proficient **clarity** and explanation which adequately reflects **main ideas** and **concepts**. Student reflection is appropriate to probing question. Reflection is highly **personalized** which exhibits high degree of **criticality** and **introspection**.	Developing personal reflections which **supports** the main ideas. Students **adequately reflects** upon the main concepts. Student supports may require some more thoughtful and personal revisions as introspection may be **moderate**.	**Emerging effort** to address the main idea. Supports are **minimal** or not fully developed. Quality of writing demonstrates strong evidence for only **knowledge** and/or **understanding comprehension.** Student **revision** for partial inquiry is highly **recommended**.	Demonstrates **low anecdotal evidence** for criticality, introspection, and effort. Ideas are **not fully completed** or **extremely incomplete**. Student **revision** for the quality of works is highly **recommended.**

RII: _____ / 10 Marks

RIII: CORE COMPETENCY III - PERSONAL & SOCIAL

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	A	B	C	D
	100%	95%	80%	65%	50%
	Always	Constantly	Usually	Occasionally	Rarely
Description	Demonstrates high anecdotal evidence of **effective social collaboration** between individual and community action. Student **autonomy** and **opinions** are **respected** and **valued** between one another.	**Proficient communicational clarity** and **explanation** between individual and community action. **Respect** of outside ideas and suggestions are politely acknowledged and delegated **appropriately.**	**Competent** and **adequate personal** and **social communication** between one other. **Respect** of outside ideas and suggestions are politely acknowledged and delegated **appropriately.**	**Developing** and **adapting personal** and **social communication** between one other. **Respect** of outside ideas and suggestions are politely acknowledged and delegated **appropriately.**	**Emerging social communication** between one other. **Moderate respect** of student suggestions are present. **Teacher** assistance and **facilitation is required**

RIII: _____ / 10 Marks

RIV: CONTENT - CURRICULAR COMPETENCIES & BIG IDEAS RUBRIC

Categories	EXTENDING	PROFICIENT	COMPETENT	ADAPTING	EMERGING
	A+	A	B	C	D
	100%	95%	80%	65%	50%
	Always	Constantly	Usually	Occasionally	Rarely
Description	**Meets** and **exceeds all Curricular Competencies** and **Big Ideas** established in Environmental Science 11	**Meets all Curricular Competencies** and **Big Ideas** established in Environmental Science 11	**Meets most Curricular Competencies** and **Big Ideas** established in Environmental Science 11	**Meets some Curricular Competencies** and **Big Ideas** established in Environmental Science 11	**Meets few Curricular Competencies** and **Big Ideas** established in Environmental Science 11

RIV: _____ / 10 Marks

TOTAL PROJECT MARK: _____ / 40 MARKS

5.0 ACCREDITATIONS

CITATIONS
Grant, M. M. (2002). Getting a grip on project-based learning: Theory, cases and recommendations. *Meridian: A middle school computer technologies journal*, *5*(1), 83.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational psychologist*, *41*(2), 75-86.

Kolb, D. A. (2014). Experiential learning: Experience as the source of learning and development. *FT press.*

McGregor, D. (2006). Traditional ecological knowledge. *Ideas: the arts and science review*, *3*(1), 1-6.

Mulligan, M. (2018). An Introduction into Sustainability: Environmental, Social and

Personal Perspectives. 2nd Edition. New York: *Routledge.*

Myers, D. (2011). Myer's Psychology for AP. New York: *Worth Publishers.*

WEBSITE ATTRIBUTIONS
Source 1 https://curriculum.gov.bc.ca/sites/curriculum.gov.bc.ca/files/pdf/10-12/science/en_s_10_elab.pdf
Source 2 https://www.edtechteam.com/blog/2017/01/dive-into-inquiry-framework-for/
Source 3 https://educationcloset.com/2016/04/14/using-projects-project-based-learning/
Source 4 http://lsf-lst.ca/en/what-is-esd/esd-learning-outcomes
Source 5 https://carleton.ca/chaimcentre/2015/mushquash-indigenous-youth/
Source 6 https://www.dailyteachingtools.com/cooperative-learning-evaluate.html

IMAGE SOURCES
LINK A http://kennethwbaldwin.com/filter/illustration/Spheres-of-the-Earth-poster
LINK B http://hjcambie.sd38.bc.ca/news/2017/03/05/core-competencies
LINK C https://www.krausanderson.com/wp-content/uploads/2016/09/Bloom.jpg
LINK D https://1.bp.blogspot.com/-6TILtgubVQA/WHZrGvF90AI/AAAAAAAAE9k/bzF0VueVYKw6dMQKCeEl5gofu3EtvVeKwCLcB/s1600/typesofinquiry.png
LINK E https://1.bp.blogspot.com/- x9_SbhckRd0/WHZqklAMVJI/AAAAAAAAE9c/YoVf9qeUnME Nihzb9VaP7Ohbvt0QL7-kACLcB/s1600/four-pillars.png
LINK F https://educationcloset.com/wp-content/uploads/2016/04/project-or-project-based-learning.jpg
LINK G https://i.pinimg.com/736x/45/aa/dc/45aadcc493a78e1db2393e530bba2a33--experiential-learn in g-a-natural.jpg
LINK H https://carleton.ca/chaimcentre/wp-content/uploads/medicine-wheel-400x390.png
LINK I https://www.dailyteachingtools.com/images/500CoopRubricD.jpg
LINK J http://www.footprintcalculator.org/result1a
LINK K http://ourcanadaproject.ca/

DIGITAL SIGNATURE
Yue, M. X., Marquart, K., & Carr, J. (2018). Integrated Teacher Resource Package (ITRP) – Environmental Science 11: Examining the Anthropogenic Effects to Environmental, Social, and Personal Spheres of Sustainability from a Macroscopic and Holistic Systems Perspective. *CBU Fundamentals of Sustainability.*