Lynden High School – Integrated Course 1 (Possible 3 year map at end)

**Unit 1**
- Driving question: Could we ever run

**Unit 2**
- Driving question: How does water chemistry affect food

**Unit 3**
- Driving question: Can our food sustainability systems survive natural disasters?

- ESS3.A Natural Resources
- LS2.A Interdependent Relationships in Ecosystems
- PS1.A Structure and Properties of Matter
- PS1.B Chemical Reactions
- PS3.A Definitions of Energy
- PS3.C Relationship Between Energy and Forces
- ESS2.C Role of Water in Earth Surface Processes
- LS1.C Matter and Energy Flow in Organisms
- ESS2.D Weather and Climate
- LS2.B Matter and Energy Transfer in Ecosystems
- ESS3.B Natural Hazards
- PS3.B Conservation of Energy and Energy Transfer
Unit 1

Essential question: *Could we ever run out of food?*

DCI:
- ESS3.A Natural resources (human)
- LS2.A Interdependent relationships
- PS3.A Energy
- ESS2.D Weather and Climate

Storyline:
- Human use of ecosystem resources/services and responsibilities. Humans are dependent on ecosystems for food and other ecosystem services. Humans have the capability to drastically alter ecosystems and a responsibility to ...
- Interdependence of organisms and abiotic factors in ecosystem - ecosystems are composed of interacting biotic and abiotic factors and they have carrying capacities. Food is a limiting factor for organism/population growth. Acquiring food is affected by competition, predation, and disease.
- Make sure to tie in energy as currency in ecosystem - Energy is the currency of ecosystems. Food provides chemical potential energy and molecules to living organisms. This energy is transferred between organisms. Other types of energy are necessary to produce food for humans.
- Weather and climate drive food production.

Potential activities:
- Wolf ecosystem dynamics in Washington (Mari has materials)
- Extremophiles in Yellowstone - foreshadowing
- Amount energy to produce a pound of beef - Case Bio
- El Nino / La Nina

Unit 2

Essential question: *How does water chemistry affect food production?*

DCI:
- PS1.A Structure of Matter
- PS1.B Chemical Reactions
- LS2.B Cycles of Matter and Energy in Ecosystems
- ESS2.C Role of Water in Earth’s Surface Processes
- PS3.C Relationship between Energy and Forces.

Storyline:
- The atomic structure of matter determines the characteristics of different substances. The periodic table to help us understand trends such as ionization and conductivity. These apply to ocean acidification and hydroponics.
- Chemical reactions occur between molecules, causing new molecules to be produced. Many reactions in water involve carbon cycling, equilibrium and feedback.
The ocean is a complex system in which matter cycles and energy flows. Photosynthesis and respiration are central drivers.

Water on surface and underground - The water cycle, driven by energy from the sun and moved by gravity, allows us to grow food in some places and not in others. Water from terrestrial ecosystems eventually ends up in the ocean, due to gravity.

Large bodies of water, such as lakes and oceans, influence climate because of water’s unique properties.

Relationship of energy and forces - Gravitational interactions between the moon and the Earth leads to tides, which in turn affect ocean acidification and food production.

Potential activities:
- Hydroponics - Case Bio
- Ocean acidification
- Double ditch
- Fast plants

Unit 3
- Essential question: Can our food sustainability systems survive natural hazards?
- DCI:
  - ESS3.B Natural Hazards
  - PS3.B Conservation of Energy and Energy Transfer

Story line:
- Natural (disasters) lead to disruptions in these transfers of energy.
- Energy can be transferred from one form to another, and is conserved during transformations.
- Photosynthetic organisms take sunlight energy and store it in forms usable to themselves and other organisms. This energy is transferred between trophic levels in an ecosystem, with usable energy lost as heat between each level. Matter and energy are linked for many of these processes.

Potential activities:
- Missoula flood and Columbia basin
- Damming of rivers and displacement
- Photosynthesis/Respiration manipulation labs
- Volcanoes
- Calorimetry experiments
Unit 1: Could we ever run out of food?

**Learning Progression 1:** LS2.A Interdependent Relationships in Ecosystems

**Performance expectation:** HS-LS2-1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales

**BIG idea:** Ecosystems are complex, dynamic, interconnected systems.

**Learning Target 1:**
Ecosystems are composed of biotic and abiotic factors that interact in complex ways.

**Learning Target 2:**
Interactions between biotic factors include predation, competition, parasitism, and mutualism. These interactions affect populations of organisms differently.

**Learning Target 3:**
Some factors affect the size of a population based on the density of organisms in that population. Other factors affect the size of a population regardless of density.

**Learning Target 4:**
Density dependent and independent reduction factors reduce a population’s size and overtime determine a population’s carrying capacity.

**Success Criteria:**
Formative Assessment

**Driving Question:**
How do invasive species affect ecosystem function and alter food production?

**Phenomenon:**
Unit 1: Could we ever run out of food?

Learning Progression 2: ESS3.A Natural Resources

BIG idea: Resource availability has guided the development of human society. Yet all forms of resource extraction have associated costs.

**Learning Target 1:**
Natural resources are found and used in many different forms (e.g., fresh water, fertile soils, fossil fuels, and minerals).

**Learning Target 2:**
Availability of natural resources influences human development.

**Learning Target 3:**
Costs and benefits are associated with resource use and extraction and are not always immediately obvious.

Success Criteria: Formative Assessment

Success Criteria: Formative Assessment

Success Criteria:
Formative Assessment

Performance Expectation: ESS3-1
Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

Driving Question: How has resource availability and extraction affected the Lynden community?

Phenomena ideas:
- Comparing US economic progression to other countries.
- Water issues in Whatcom County & Lynden. Whatcom conservation district. Rural watershed steward’s program: mobile watershed.
- Food costs and resource impacts.
- Halo activity for Target 3 (Mari has activity)
Unit 1: Could we ever run out of food?

Learning Progression 3: PS3.A Definitions of Energy

**BIG idea:** Energy is a measurable property of a system that depends on the motion and interactions of matter and radiation in that system.

**Learning Target 1:** There are different types of energy (e.g. thermal, chemical, light, kinetic), but all come from interactions and motion at a microscopic level.

**Learning Target 2:** Energy arises from relative positions and interactions between microscopic particles.

**Learning Target 3:** Understanding energy at the microscopic level helps us understand its manifestation at the macroscopic level.

**Learning Target 4:** The storage of energy in molecules is chemical potential energy.

**Success Criteria:**
- Formative Assessment
- Formative Assessment
- Formative Assessment
- Formative Assessment

**Driving question:** How does preparing food in a kitchen show all the different forms of energy?

**Phenomena:** Kitchen unit
- Jean-Jacques is in charge

Performance Expectation: HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
Unit 1: Could we ever run out of food?

Learning Progression 4: ESS2.D Weather and climate

Success Criteria: Formative Assessment

BIG idea: Earth's climate is shaped by the sun's energy and changed by natural processes and human activity.

Driving question: How do weather and climate drive food production?

Phenomenon: The creeping threats of desertification and/or ocean acidification.

Learning Target 1: Distinguish between weather and climate

Success Criteria: Formative Assessment

Learning Target 2: The sun's radiation is reflected, absorbed, stored, and redistributed in a variety of ways.

Success Criteria: Formative Assessment

Learning Target 3: Historically, gradual atmospheric changes were due to plants and other organisms that captured CO₂ and released O₂.

Success Criteria: Formative Assessment

Learning Target 4: Changes in the atmosphere due to human activity have increased CO₂ concentrations and thus affect climate.

Success Criteria: Formative Assessment

Performance Expectation: HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth’s surface can create feedbacks that cause changes to other Earth systems. HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth’s systems result in changes in climate. HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth’s systems and life on Earth.
Unit 2: How does water affect food production?


**BIG idea:** The microscopic structure of atoms determines their macroscopic properties.

**Learning Target 1:** Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons (and how we know this).

**Learning Target 2:** The periodic table orders elements horizontally by the number of protons in the atom’s nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

**Learning Target 3:** The structure and interactions of matter at the macroscopic scale are determined by electrical forces within and between atoms.

**Learning Target 4:** A stable molecule has less energy than the same set of atoms separated; one must provide at least this energy in order to take the molecule apart.

**Success Criteria:** Formative Assessment

**Success Criteria:** Formative Assessment

**Success Criteria:** Formative Assessment

**Success Criteria:** Formative Assessment

**Driving question:** What is food ultimately made of?

**Phenomena:** Interactions curriculum (http://interactions.portal.concord.org)

Use water molecule as an example
Unit 2: How does water affect food production?

Learning Progression 6: PS1.B Chemical Reactions

BIG idea: The characteristics of chemical reactions are determined by the types of collisions and the rearrangements between atoms.

Driving question: How are chemical reactions involved in food preparation?
Unit 2: How does water affect food production?

Performance Expectation: ESS2-5
Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

Learning Progression 8: ESS2.C Role of Water in Earth's Surface Processes

**BIG idea:** The abundance of liquid water on Earth’s surface and its unique combination of physical and chemical properties are central to the planet’s dynamics.

**Learning Target 1:**
Water's unique properties allow it to absorb, store, and release large amounts of energy (phase changes).

**Learning Target 2:**
Water expands when it freezes and plays a role in mechanical weathering. Frozen water is less dense than liquid water.

**Learning Target 3:**
Water can dissolve and transport materials such as debris, sediments, and organisms.

**Learning Target 4:**
Water has the ability to lower viscosity and freezing points of material it is mixed with.

**Driving Question:** How do the unique properties of water contribute to Earth processes?

**Phenomena:**
- Missoula flood (find the interactive website http://www.dnr.wa.gov/programs-and-services/geology/glaciers#the-missoula-floods.4)
- Clean water column

Success Criteria: Formative Assessment
Unit 2: How does water affect food production?

Learning Progression 9: PS3.C Relationship between Energy and Forces

**Performance Expectation: HS-PS3-5.** Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

**BIG idea:** When two objects interacting through a field change relative position, the energy stored in the field is changed.

**Learning Target 1:** Distinguish between energy and force.

**Learning Target 2:** Every force is mediated by a field, even everyday contact forces. Forces transfer energy through fields.

**Learning Target 3:** An energy field's strength varies with distance.

**Success Criteria:** Formative Assessment

**Success Criteria:** Formative Assessment

**Success Criteria:** Formative Assessment

**Driving question:** How do objects interact even if they are not touching?

**Phenomena:** Back to Missoula flood. Waterfalls. Water dropped out of airplanes on burning forests.

Bending stream of water.
Unit 3: Can our food sustainability systems survive natural disasters?

Learning Progression 10: ESS3.B Natural Hazards

BIG idea: Natural hazards and other geologic events have shaped and continue to shape the course of human history.

Performance Expectation: HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

Learning Target 1:
Natural hazards include interior processes, surface processes, and severe weather.

Learning Target 2:
Both natural resources and natural hazards vary in their distribution across the world.

Learning Target 3:
Historical occurrences of natural hazards and availability of natural resources have shaped the distribution and migration of human populations.

Learning Target 4:
Natural hazards and the current availability of natural resources can help us predict human population distribution and potential conflict.

Success Criteria:
Formative Assessment
Unit 3: Can our food sustainability systems survive natural disasters?

BIG idea: Energy is conserved and transferred within systems.

Performance Expectations: HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS-PS3-4. Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).
Unit 3: Can our food sustainability systems survive natural disasters?


**BIG idea:** Matter and energy flow through organisms via cellular processes.

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**Performance Expectations:**

- **HS-LS1-5:** Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy. HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules. HS-LS1-7. Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

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**Learning Target 1:**
Life on Earth is carbon based, and there are many ways in which carbon, hydrogen, and oxygen (with some other elements) are combined to form molecules found in living things.

**Learning Target 2:**
The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into carbohydrates plus released oxygen.

**Learning Target 3:**
The carbohydrates are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules, which are recombined in different ways to form products at different organizational scales.

**Learning Target 4:**
Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed. Cellular respiration also transfers the energy needed for life processes.

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**Success Criteria:**
Formative Assessment