Climate Change and Climate Justice Exemplar Curricular Materials

Life Science: The Buzz About Survival 2019-2020

5 Curriculum Developers

What is the purpose of the unit? What do we want students to know?

Essential Questions

How do organisms depend on their environment and each other in order to survive?

Big Ideas

Animals and plants depend on each other and the environment in order to survive.

Changing environments affect the survival of organisms in the past, present, and future.

Priority & Supporting Standards

OR: English Language Proficiency (2014)

Grades 2-3

ELP Standards

An ELL can..

2-3.1 construct meaning from oral presentations and literary and informational text through grade-appropriate listening, reading, and viewing.

2-3.2 participate in grade-appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.

2-3.3 speak and write about grade-appropriate complex literary and informational texts and topics.

2-3.4 construct grade-appropriate oral and written claims and support them with reasoning and evidence.

2-3.5 conduct research and evaluate and communicate findings to answer questions or solve problems.

2-3.6 analyze and critique the arguments of others orally and in writing.

2-3.7 adapt language choices to purpose, task, and audience when speaking and writing.

2-3.8 determine the meaning of words and phrases in oral presentations and literary and informational text.

2-3.9 create clear and coherent grade-appropriate speech and text.

2-3.10 make accurate use of standard English to communicate in grade-appropriate speech and writing.

NGSS: Science Performance Expectations (2013)

NGSS: Grade 3

3.Interdependent Relationships in Ecosystems

Performance Expectations

3-LS2-1. Construct an argument that some animals form groups that help members survive.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals [illegible] ge.*

3-5.Engineering Design

Performance Expectations

3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Students need to know (Content)

When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary to 3-LS4-4)

Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size. (Note: Moved from K–2) (3-LS2-1)

For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)

Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)

Observable phenomena exist from very short to very long time periods. (3-LS4-1)

Knowledge of relevant scientific concepts and research findings is important in engineering. (3-LS4-4)

Science assumes consistent patterns in natural systems. (3-LS4-1)

Students need to be able to do (Skills)

Construct an argument with evidence, data, and/or a model. (3-LS2-1)

Construct an argument with evidence. (3-LS4-3)

Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-LS4-4)

Cause and effect relationships are routinely identified and used to explain change. (3-LS2-1),(3-LS4-3)

A system can be described in terms of its components and their interactions. (3-LS4-4)

Graduate Portrait

Teaching Tolerance and Social Justice

How will we gauge student learning?

Assessments

How will students learn? - High Leverage Instructional Strategies & Resources

Learning Engagements

See overview document: The Buzz About Survival Grade 3 Life Science/ELD Unit Overview

Differentiated Instruction

See overview document: The Buzz About Survival Grade 3 Life Science/ELD Unit Overview

Academic Vocabulary

AVID Strategies

See overview document: The Buzz About Survival Grade 3 Life Science/ELD Unit Overview

Instructional Resources and Materials

See overview document: The Buzz About Survival Grade 3 Life Science/ELD Unit Overview

Distance Learning Resources: PPS-HD

Distance Learning

Resources and Materials for Students

Teacher Tools

3rd Grade
Life Science/English Language Development:
The Buzz About Survival

Content	

NOTES:
*** To request copies of the Science Notebooks, email sciencekits@pps.net with:

1. Your grade level
2. Name of unit you are teaching
3. Number of students in your class

- Science Notebook link is here in case you need extra copies.

Find online units and revisions at the PPS Science website. Use the drop down menus to navigate to your grade level and unit.

Ask questions, give feedback here.

Unit Overview			
Essential Question ● How do organisms depend on their environment and each other in order to survive?			
Enduring Understandings ● Animals and plants depend on each other and the environment in order to survive. ● Changing environments affect the survival of organisms in the past, present, and future.			
Lesson Link	**Slideshow Link**	**Lesson Overview**	**Lesson Guiding Question**
Lesson 1 Phenomena Day!	Slideshow 1	Students are introduced to the phenomenon of honeybees and they make an initial claim about bee habitat.	*How do organisms depend on their environment and each other in order to survive?*
Lesson 2 Animal Groups Days 1 and 2	Slideshow 2	**2 Sessions** **Day 1 (45 min):** Students discuss the phenomenon of how humpback whales get their food in a process called "bubble net fishing". **Day 2 (45 min):** Then, students read an article about animal groups and jigsaw their learning. Students then return to the whale phenomenon and get a brief explanation.	*How do groups of organisms depend on each other in order to survive?*
Lesson 3 Animal Group Skits	Slideshow 3	Students watch a video and discuss reasons for animals living in groups. Student groups get assigned animals and perform a skit that demonstrates why that animal lives in a group. Students write a claim, evidence and reasoning about the survival of their animal group.	*How do groups of organisms depend on each other in order to survive?*
Lesson 4 Honeybees Work Together Day 1 and 2	Slideshow 4	**2 Sessions** **Day 1 (45 min):** Students learn information about how bees work together in a group. **Day 2 (45 min):** Students apply this information by	*How do honey bees work together to help the colony survive?*

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Lesson 4 REVISED Will replace original lesson 6/6/20	Slideshow 4 REVISED Will replace original slides 6/6/20	playing a simulation game. Students gather information to help them make a claim about why a group of animals form a group.	
Lesson 5 Researching About Bees Day 1 and 2	Slideshow 5	**2 Sessions** **Day 1 (45 min):** Students do preliminary research on bees to clear up any misconceptions. Students focus on how bees are interdependent with other bees, humans, and their habitat. Students are introduced to the phenomenon of Colony Collapse Disorder. **Day 2 (45 min):** In pairs, students read an article, complete a journal entry and share their findings with another set of pairs.	*How are humans, bees, other animals, and plants interdependent?*
Lesson 6 Colony Collapse Simulation Lesson 6 REVISED Will replace original lesson 6/6/20	Slideshow 6 Slideshow 6 REVISED Will replace original lesson 6/6/20	**2 Sessions** **Day 1 (45 min):** Students learn about the factors that contribute to colony collapse disorder through participating in another simulation. **Day 2 (45 min):** They gather evidence and begin to explain why colonies struggle.	*Why do bee colonies struggle?*
Lesson 7 Solutions to CCD Day 1 and 2 Lesson 7 REVISED Will replace original lesson 6/6/20	Slideshow 7 Slideshow 7 REVISED Will replace original lesson 6/6/20	**2 Sessions** **Day 1 (45 min):** Students will discuss solutions that address Colony Collapse Disorder. Students will read articles in groups and code text for use in a board meeting for the next day. **Day 2 (45 min):** Students are preparing to participate in a Board Meeting to discuss CCD.	*What are the advantages and disadvantages of some solutions of Colony Collapse Disorder?*
Lesson 8 Board meeting: Solutions to CCD	Slideshow 8	Students prepare arguments about solutions and have a whiteboard meeting. Some solutions are provided but students may come up with their own solutions based on the reading and their own background knowledge.	*What are the advantages and disadvantages of some solutions of Colony Collapse Disorder?*

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Lesson 9 Engineering Day 1 and 2	Slideshow 9	**2 Sessions** **Day 1 (45 min):** Students design a pollinator friendly community and evaluate the merits of their designs. **Day 2 (45 min):** Students complete their designs and evaluate the merits of peers' designs.	*How will my design work?*
Lesson 10 Final Assessment	Slideshow 10	Students make a final revision of their argument about bee habitats.	*How do organisms depend on their environment and each other in order to survive?*

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General Science Background for Teachers

Why are honeybees our phenomenon?

Bees form groups. Bees live in groups called hives. Typical hives consist of 20,000 to 50,000 bees. In hives, bees are subdivided into three castes. Each caste group is responsible for performing specific duties within the hive. Below are brief explanations of the duties of each caste.

Drones

The **drone** honey bees represent the males in the colony as they are reproductively active and produce the sperm used to fertilize the queen's eggs. However, they are unique in that they contain half the chromosomes (haploid) of the females and are developed forms of unfertilized female eggs. This literally means they have no fathers. The unfertilized eggs are laid in the larger horizontal cells called "drone comb". After 24 days (on average), the adult drone emerges with the most robust body of the three types and large eyes that meet on top of their head (dorsally). The primary and singular function of drones for the colony is to mate. Successful mating results in death, making these males entirely monogamous. On average, drones live for 20 days and are specifically produced by the colony on during specific times of the year when mating is happening (typically in spring).

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Workers

The **worker** honey bees are sterile females (99% true) that perform the great majority of the work for the colony. As females, they develop from fertilized eggs that are laid in standard horizontal cells (general comb). After 21 days (on average), the adult worker emerges and progresses through a series of jobs, switching as she ages. Generally, she takes care of the brood and other individuals first, then the maintenance of the colony, and finally is allowed to leave the colony for defense and foraging. Workers make up the majority of a honeybee colony. The lifespan for workers varies on the amount of work they do, based upon the wear and tear they put on their bodies. On average, the lifespan for workers is as follows: summer = 15-38 days, spring/fall = 30-60 days, winter = 100-140 days.

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Queen 

The **queen** honey bee is the single egg laying female in the colony (99% true). As females, they develop from fertilized eggs that are laid in vertical cells (Queen's cup). After 16 days (on average), the adult queen emerges with an elongated abdomen that will soon be ready to mass produce eggs. As a virgin queen, she takes off on her mating flight, mates with multiple males (polyandrous) and returns to lay eggs for the majority of her life, until the colony swarms.

Honey bees are affected by environmental changes. Due to their dependence on the plants in their habitat and their constant interactions with each other, bees can be susceptible to changes and stressors in their environment. This will be covered in more detail in the "What is CCD?" portion of this background information.

Honey bees are adapted to live in a variety of places. Due to the popularity of their use in farming, honey bees are found on every continent except Antarctica. They are well-adapted to survive in many environments, as they successfully compete with native bees throughout the world. Some sources even refer to honey bees as an invasive species.

Honey bees form groups in order to survive. Other animals do as well. Why is this?
In this unit, students focus on three very broad reasons for forming a group: obtain food, defense, and cope with change. There are advantages and disadvantages to living in groups.

There are several major disadvantages to living in groups:
1. Greater competition for food, mates, sleeping sites, and water.
2. Increase parasite and disease load.

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There is an incidental reason why some animals live in groups. Concentrated valuable resources attract individuals. E.g., birds don't nest on cliffs because they benefit by being in a group. They nest together because they are attracted by a scarce resource: cliffs.

How do individuals benefit by living in groups?

1. Cooperative food collection. Wolves hunt together. By doing so each can more easily track and take down large game. Although the individual has to share meat, each still benefits from group hunting. Group hunting is less important in primates. Chimps hunt some but meat is not a major part of their diets. Group hunting is important in many human societies, however.
2. Sleeping together to conserve warmth. This explains why individuals form groups at night but it does not explain why groups are maintained during the day.
3. Shared information. By forming groups, individuals can exchange critical information (reciprocity). For example, frugivores let each other know where fruit trees are located.
4. Protection from predators. There are three reasons why an individual may live in group to avoid predation.
    a. Cooperative defense against predators. Several baboon males can deter a hyena but a solitary baboon will become prey.
    b. Selfish herd. To buffer themselves from predators sheep form herds, fish swim in schools, and birds fly in flocks. Predators can't eat an entire group. An individual lives in a group so as to get someone else between them and a predator. Safety in numbers. This reason is called the selfish herd because, obviously, individuals want to be in the central core of a group, not on the periphery.
    c. Cooperative defense against other groups of your species. Some primates form groups and defend valuable resources, such as fruit-trees, against groups of their own species. Chimp groups defend fruit-trees.
    -from University of Missouri-Columbia

Honeybees are considered to be eusocial, which is the highest level of social organization in a group. Eusocial animal organization has these characteristics: cooperative brood care, overlapping generations within a colony of adults, and a division of labor between reproductive and non-reproductive groups.

What is colony collapse disorder (CCD)?

What does it look like?

Colony Collapse Disorder (CCD) was first reported in 2006. Beekeepers began reporting high colony losses where the adult honeybees simply disappeared from the hives, almost all at the same time. There were few, if any, dead bees found in or around the hives. The queen and immature bees (brood) were often found in the hives with plenty of food stores, inadequately attended by a few adult bees.

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What causes it?
CCD is believed to be complex and a result of multiple factors. One **study** evaluated 61 factors, and found that no single stressor stood out as the primary cause of CCD. However, colonies affected by CCD had more pathogens and more types of pathogens than colonies without CCD. Pathogens are disease-causing organisms. A **group of stakeholders** that gathered in 2012 found a similar consensus, that a complex group of stressors and pathogens are associated with CCD.
-from the National Pesticide Information Center

Current research is now focused on these stressors as potential causes of CCD:

- Increased losses due to the invasive varroa mite (a pest of honey bees).
- New or emerging diseases such as Israeli Acute Paralysis virus and the gut parasite Nosema.
- Pesticide poisoning through exposure to pesticides applied to crops or for in-hive insect or mite control.
- Stress bees experience due to management practices such as transportation to multiple locations across the country for providing pollination services.
- Changes to the habitat where bees forage.
- Inadequate forage/poor nutrition.
- Potential immune-suppressing stress on bees caused by one or a combination of factors identified above.

No time? Watch overviews of these standards in less than 30 minutes?

- LS2.C Ecosystem Dynamics, Functioning, and Resilience
- LS2.D Social Interactions and Group Behavior
- LS4.C Adaptation
- LS4.D Biodiversity and Humans

Interested? Readings about the phenomenon/subject matter.

- NRDC-Would a World Without Bees Be a World Without Us?
- Planet Bee Foundation-The Vanishing of the Bees
- Teen Vogue-Colony Collapse Disorder, Explained
- Xerces Society-The Wilsonville Bee Kill

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NGSS Alignment in this Unit

Performance Expectations (PEs) Present in this Unit

- 3-LS2-1 Construct an argument that some animals form groups that help members survive.
- 3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]
- 3-LS4-4 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.* [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [*Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.*]

Science and Engineering Practices Present in this Unit

- Engaging in argument from evidence

Crosscutting Concepts Present in this Unit

- Cause and effect
- Systems and systems models

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English Language Proficiency Standards at a Glance

Overview of English Language Proficiency Standards in This Unit

There are 10 ELP standards that are consistent K-12. The lessons in this unit address the following.

		Lesson									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
ELP Standards	1 – construct meaning	x	x	x	x	x	x	x			x
	2 – participate	x	x	x	x	x	x	x	x		
	3 – speak and write		x	x		x		x	x		x
	4 – construct claims	x		x	x	x	x	x	x		x
	5 – conduct research		x		x	x	x	x	x		
	6 – analyze claims							x	x		
	7 – adapt language			x					x		
	8* – determine meaning										
	9* – create clear speech and text										
	10* – standard English										

* ELP standards 8, 9, and 10 ongoing in every lesson

ELP Standards

1 - Construct meaning from oral presentations and literary and informational text through grade-appropriate listening, reading, and viewing
2 - Participate in grade-appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions
3 - Speak and write about grade-appropriate complex literary and informational texts and topics
4 - Construct grade-appropriate oral and written claims and support them with reasoning and evidence
5 - Conduct research and evaluate and communicate findings to answer questions or solve problems
6 - Analyze and critique the arguments of others orally and in writing
7 - Adapt language choices to purpose, task, and audience when speaking and writing

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8 - Determine the meaning of words and phrases in oral presentations and literary and informational text
9 - Create clear and coherent grade-appropriate speech and text
10 - Make accurate use of standard English to communicate in grade- appropriate speech and writing

ELP standards and descriptors of proficiency levels available here.

Language Development Routines at a Glance

	Lesson									
Language Development and Interaction Strategies	1	2	3	4	5	6	7	8	9	10
Accountable Talk Bookmark										
Anticipatory Guide (template) (template 2)										
Bees and Flowers	x			x						
Board Meeting								x		
Clarifying Bookmark Task Description										
Cloze										
Coding the Text										
Collaborative Paragraph Writing			x							

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Collaborative Poster					x					
Discussion Diamond										
Double Entry Journal										
Four Corners										
Gallery Walk										
Give One, Get One		x					x			
Jigsaw Reading										
Information Gap activities		x								
Lines of Communication							x			
Mix and Mingle										
Novel Ideas Only										
Numbered Heads Together										
Partner Speaking and Listening Strategies										
Postcard Home										
Quick Write										
Quiz, Quiz, Trade										
Reading with a focus		x				x				
Role Play/Simulation			x	x		x				
Sentence Frame/Starters										

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Six Word Summary										
Sort (closed, open)										
Think, Pair, Share/ Think, Write, Pair, Share										
Three Step Interview										
Vocabulary Review Jigsaw										

List of Common Language and Interaction Strategies with instructions

Need more ideas for supporting language learners? Visit the PPS ESL website and look under *Instructional Strategies*.

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Assessment Map
Pre- and post-assessments provide a way for teachers to determine student learning over the course of the unit. They are designed to measure the key science and language standards. In addition, formative assessments allow teachers and students to measure progress across the lessons, and allow teachers to make needed adjustments. Blue text indicates that the assessment is oral. A language recording sheet is provided to record oral language to measure progress on ELD targets.

Lesson	NGSS	ELD	Assessment
1: Phenomenon: Which habitat is better for bees?	CER bee habitat	Make a claim and support it with evidence and reasoning	Initial bee habitat argument (NGSS) Bees and flowers (ELD)
2: Animals in groups - reading for information	Describe group behavior in animals	Read for information; explain why animals live in groups	Exit Ticket (NGSS & ELD)
3: Animals in groups - skits	Show (act out) how animals survive by living in groups	Make a claim and support it with evidence and reasoning	CER notebook page (NGSS & ELD)
4: Honey bees work together	Bees and other animals form groups for a number of reasons	Explain phenomenon using cause and effect language	Lesson 4 assessment (NGSS) Bees and flowers (ELD)
5: Researching about bees	Use information from research to find evidence about interdependence.	Explain interdependence by using cause and effect language	--- (NGSS) Poster presentations (ELD)
6: Colony collapse simulation	Participate in simulation that models how bees work together in a colony	Explain why bee colonies struggle (cause and effect)	Simulation (NGSS) Science notebook (ELD)
7: Solutions to	Read to identify solutions to	Express cause and effect using if	CCD Planning Sheet (NGSS)

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Colony Collapse Disorder (CCD)	a problem and the advantages/disadvantages of those solutions.	+ then + modal	Give one get one (ELD)
8: Solutions to Colony Collapse Disorder (CCD) - Board Meeting	Make a claim and support it with evidence and reasoning	Make a claim and support it with evidence and reasoning	Exit ticket (NGSS & ELD)
9:			
10:			

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Supplemental Resources and Activities

Pamphlet-Attracting Pollinators to your Garden Using Native Plants
Poster-Bumblebees of the Eastern United States
Poster-Bumblebees of the Western United States
Poster-Native Bees

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Acknowledgements

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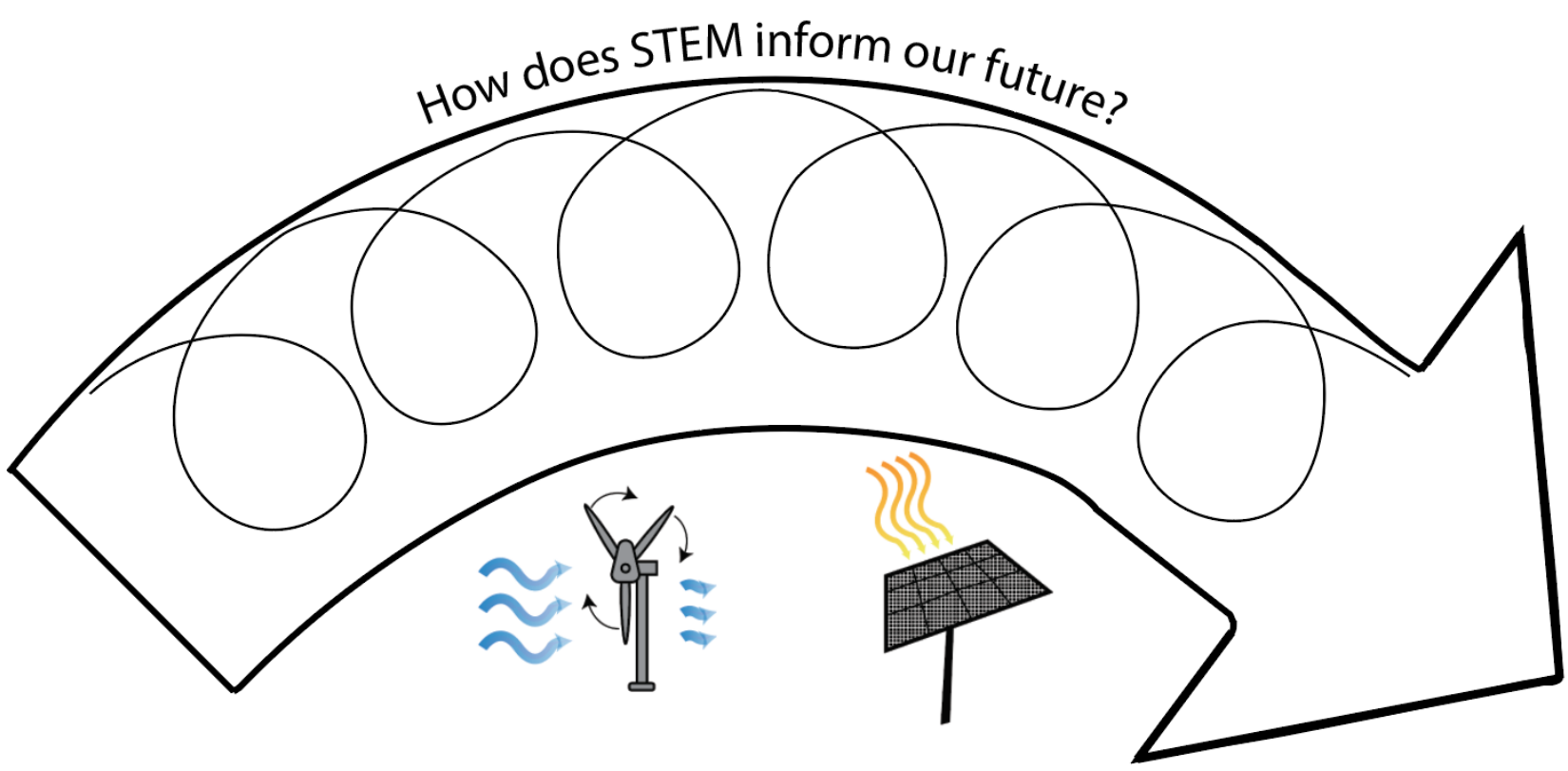
Student Calendar for
Unit 6: Electricity, Power Production, & Climate Science



(Key to reading document) Task Image Task Project Goal Dates	**Should be able to answer this by the end of the task.** **Should be able to do this by the end of the task.** **What we did:** Description of the prioritized learning task. **Activities and Resources:** 1. Links and references for the materials you need to complete the task. **Homework** *See additional resources at the bottom of the table.
 **Voices of the World** **Project Goal:** Build common background knowledge and appreciate the multifaceted nature of power production and our climate. add_dates	**What are the different perspectives on power production and climate change?** **Be able to convey important characteristics about different energy sources used for Power Production.** **What We Did:** We ask what is our plan? Then began exploring Electricity, Power Production, and Climate Science. **Activities and Resources:** 1. Packet for Unit a. 6P1 - Part 1 of 2 b. 6P2 - Part 2 of 2 2. Voices of the World a. Paragraphs for reading 6Activity - Voices Around the World 3. Intro to 50 Year Energy Plan a. 6EP - 50 year Plan Portfolio b. In the Oregon Department of Energy 2018 Biennial Energy Report read Chapter 1 - Energy Numbers pages 1-3 and Chapter 2 - Climate Change pages 1 and 11. c. Write our problem statement d. 6CT - Initial 50-Year Energy Plan with Computational Thinking 4. How do we create power? a. Background research on power production in Packet Part 1 using Student Energy website b. Read How Does Your State Make Electricity? article 5. Exploring our engineering challenge - a. Determine our constraints and criteria in our Portfolio 6. Introduce in-class essay on Exploring Our Engineering Challenge a. 6CER - Section 1 - Exploring Our Engineering Challenge b. Graphic organizer pages in Packet Part 2 7. Kick-off playing Energy City simulation a. 6Simulation - Energy City Strategy and Reflection **Homework:** ● Scan an interesting part of the Oregon Department of Energy 2018 Biennial Energy Report ● Read about the approach to at least 2 of the energy sources (pgs. 20-22) and respond in the discussion thread

Motors and Generators

Project Goal: Take a deep dive into the physics of power production.

add_dates

How do electric guitars work?
Why is our large scale power production and distribution the way it is?

Be able to our technical terms from electricity and new ones we discover to explain the basic physics of how electric guitars work.
Be able to use the big ideas of electricity to explain the design of our large scale power grid.

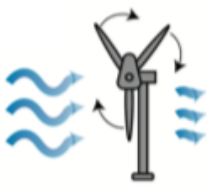
What We Did: Students will learn how to build a speaker.

Activities and Resources:

1. Begin in-class essay on Exploring Our Engineering Challenge
2. Exploring Power Production:
    a. Water Bucket Analogy
    b. The Basic Physics of Electric Power in Packet Part 1
3. Build a Speaker
    a. Background info on how to build a speaker
    b. Instructions for Building a Speaker
    c. Building, Exploring, and Discovering How Speakers Work in Packet Part 2
    d. Construct an argument to describe how speakers work in Packet Part 2
4. How do motors work?
    a. Pages in Packet Part 2
5. Exploring generators:
    a. Phet - Faraday's Law
    b. Pages in Packet Part 2
    c. The Basic Physics of Electric Generators in Packet Part 2
6. Quiz on Basic Physics of Motors and Generators
7. Scaling up to Large-Scale Power Production
    a. Getting Big: Large-Scale Power Production in Packet Part 1

Homework:

- 6extension - Podcast NPR Looks into Geothermal in the America West
- Phet - Circuit Construction
- Watch Intro Video and Play NOVA's Energy Lab Simulation



Wind Turbine Engineering Project

Project Goal: Investigating what it takes to scale up power production.

add_dates

Be able to make data-informed decisions about how to best design your wind turbine to maximize its power production.

Orally communicate with the aid of graphs your experimental results about your wind turbine design parameter

What We Did: Students will design their own wind turbine.

Activities and Resources:

1. Introduce Wind Turbine Project in Packet Part 1
2. How does a wind turbine work?
    a. Energy bar charts in Packet Part 1
    b. Sankey diagram Packet Part 1
    c. Written Explanation Packet Part 1
3. Go over design exploration (parameters to test) of a wind turbine
    a. 6L1 - Lab Template for Investigating a Parameter of Wind Turbine Design
    b. 6E - Wind Turbine Pre Made Blades Specifications
4. Begin data collection on wind turbine
    a. 6L1 - Data Table for Investigating a Parameter of Wind Turbine Design
5. Optional Slides: 6Simulation - NOVALABS: Design a Renewable Future
6. Data Analysis and presentation
7. Engineering Rationale for Final Design Outline in Packet Part 1
8. Optimize wind turbine design and collect data

Homework

- Vernier Kidwind Wind turbine kits
- See this spreadsheet with the pre-made blade specifications

Engineering Slice: Optimize a Solar Array

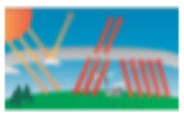
Project Goal: Experience an engineering slice and reveal the complexity of light.

add_dates

What we did: Solar Power is the other expected major growth area for renewable energy and allows students to tackle a new mathematical pattern we have a short engineering slice to optimize the angle of a solar array.

Activities and Resources:
Optimizing a Solar Cell Lab

- 6L2 - Lab Template for Optimizing a Solar Cell
- 6L2 - Data Table for Optimizing a Solar Cell
- 6Extension - Wave Particle Duality



Climate Science

Project Goal: Learning to track how energy flows in and out of the Earth System, in order to analyze the impact of various power production means.

add_dates

How do we create a mathematical model that mimics the data we collect?
How do I predict the future for a different system by finding a new pattern in the data?

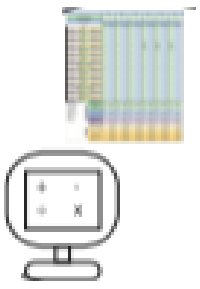
Explain the Mathematical Model you have created.

What we did: Having built up our scientific understanding of how generators work and what it takes to scale them up, we are left with cultivating an understanding of the climate impact different power production means have. This launches us more broadly into climate and the earth system over very large time scales.

Starting with climate vs weather we work through some of the basic science of climate science. Next we dive into the 10 factors called out in the NGSS.

Activities and Resources:

1. Background information for teachers from The Framework for K-12 Science Education
    a. ESS2.D: WEATHER AND CLIMATE pages 186-191
    b. ESS3.D: GLOBAL CLIMATE CHANGE pages 196-199
2. Exploring Climate Models
    a. Simulation
3. Intro Earth System through Sankey Diagram (Packet Part 1 page 17)
4. Looking at the Earth System through multiple scenarios
    a. 6Activity - Sankey Manipulative for Activity (Yellow)
    b. 6Activity - Sankey Manipulative for Activity (Red)
5. Quiz on Basics of Climate Science
6. Philosophical Chairs for Climate Impact Rubric



Using Computational Thinking to Design a 50-Year Energy Plan

Project Goal: Integrate all of our knowledge and skills, including computational thinking to create the best 50-year Energy Plan.

add_dates

What we did: Putting it all together through yet a new form of computational thinking.

Students will simply put in a reasoned guess, then through the computer quickly giving feedback on the constraints and criteria the student will iterate their design until they have optimized it to their own satisfaction.

Upon completing their plan, they will partner up to share plans and evaluate the strengths and weaknesses of the two competing plans.

Then comes our culminating CER of the year, the five-paragraph essay. There are numerous supports and often students are proud of their understanding of the real-life, complex issue of climate change so while it is a lot of work to write the essay they are primed to do so.

Activities and Resources:

1. 50 Year Energy Plan
    a. 6CT - 50 Year Energy Plan with Computational Thinking

Additional Resources:
Patterns Physics Drive Folder

For information on NGSS Performance Expectations, including which Science & Engineering Practices and Crosscutting Concepts are highlighted in the unit, see the:

NGSS Alignment Matrix for the Patterns Physics

ELP Standards:
9-12.1 - construct meaning from oral presentations and literary and informational text through grade-appropriate listening, reading, and viewing
9-12.2 - participate in grade-appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions
9-12.4 - construct grade-appropriate oral and written claims and support them with reasoning and evidence
9-12.5 - conduct research and evaluate and communicate findings to answer questions or solve problems
9-12.6 - analyze and critique the arguments of others orally and in writing
9-12.10 - make accurate use of standard English to communicate in grade-appropriate speech and writing

Unit Essential Question: How does STEM inform our future?

Intro to Climate Change and Climate Justice

3 Curriculum Developers

What is the purpose of the unit? What do we want students to know?

Essential Questions

- What does climate change mean for different communities, especially front line communities, individually, locally, and globally?
- What are some complexities to consider when finding effective solutions to human-created climate change?

Big Ideas

- Climate change is multifaceted and more than just carbon, it is an ethical issue with serious impacts on marginalized communities.
- Climate Justice focuses efforts on designing solutions for the most directly and disproportionately impacted frontline communities and changes systems of oppression.
- People from marginalized communities are working as scientists and activists to solve issues resulting from climate change.

Priority & Supporting Standards

Priority

PPS: Ethnic Studies

High School

Ethnic Studies

Ethnic Studies

- ES.HS.15 Analyze and explain the multiple perspectives of ethnic and traditionally marginalized groups to investigate past and present events when national and/or global interests have been in conflict. (History)

OR: Social Sciences (2018)

OR: Grades 9-12

Social Science Analysis

Students will be able to:

- HS.75 Evaluate options for individual and collective actions to address local, regional and global problems by engaging in self-reflection, strategy identification, and complex causal reasoning.

NGSS: Science Performance Expectations (2013)

NGSS: HS Life Sciences

HS.Interdependent Relationships in Ecosystems

Performance Expectations

- HS-LS2-7. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.*

NGSS: HS Engineering Design

HS.Engineering Design

Performance Expectations

- HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

OR: Social Sciences (2018)

OR: Grades 9-12

Civics and Government

Students will be able to:

- HS.11 Examine the pluralistic realities of society recognizing issues of equity and evaluating the need for change.

Geography

Students will be able to:

- HS.42 Use geographic data to analyze the interconnectedness of physical and human regional systems (such as a river valley and culture, water rights/use in regions, choice/impact of settlement locations) and their interconnectedness to global communities.
- HS.46 Assess how changes in the environmental and cultural characteristics of a place or region influence spatial patterns of trade, land use, and issues of sustainability.
- HS.47 Explain how political and economic power dynamics throughout time have influenced cultural identity and environmental characteristics of various places and regions.

History

Historical Knowledge

- HS.66 Examine and analyze the multiple perspectives and contributions of ethnic and religious groups, as well as traditionally marginalized groups within a dominant society and how different values and views shape Oregon, the United States, and the world.

Social Science Analysis

Students will be able to:

- HS.77 Engage in informed and respectful deliberation and discussion of issues, events, and ideas applying a range of strategies and procedures to make decisions and take informed action.

Students need to know (Content)

Student will understand:

- Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
- When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
- New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.
- Moreover, anthropogenic changes (induced by human activity) in the environment — including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change — can disrupt an ecosystem and threaten the survival of some species.
- Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
- Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.
- When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts.
- Much of science deals with constructing explanations of how things change and how they remain stable.

Students need to be able to do (Skills)

Students can:

- Analyze a major global problem
- Describe* the challenge with a rationale for why it is a major global challenge
- Describe*, qualitatively and quantitatively, the extent and depth of the problem and its major consequences to society and/or the natural world on both global and local scales if it remains unsolved
- Document background research on the problem from two or more sources, including research journals
- Define the process or system boundaries, and the components of the process or system
- Identify the physical system in which the problem is embedded, including the major elements and relationships in the system and boundaries so as to clarify what is and is not part of the problem
- Describe* societal needs and wants that are relative to the problem (e.g., for controlling CO_2 emissions, societal needs include the need for cheap energy)
- Define the criteria and constraints of a given major global problem
- Specify qualitative and quantitative criteria and constraints for acceptable solutions to the problem
- Design a solution that involves reducing the negative effects of human activities on the environment and biodiversity, and that relies on scientific knowledge of the factors affecting changes and stability in biodiversity. Examples of factors include but are not limited to:
  i. Overpopulation;
  ii. Overexploitation;
  iii. Habitat destruction;
  iv. Pollution;
  v. Introduction of invasive species; and
  vi. Changes in climate.
- Describe* the ways the proposed solution decreases the negative effects of human activity on the environment and biodiversity.
- Describe* and quantify (when appropriate) the criteria (amount of reduction of impacts and human activities to be mitigated) and constraints (for example, cost, human needs, and environmental impacts) for the solution to the problem, along with the tradeoffs in the solution
- Evaluate the proposed solution for its impact on overall environmental stability and changes
- Evaluate the cost, safety, and reliability, as well as social, cultural, and environmental impacts, of the proposed solution for a select human activity that is harmful to an ecosystem
- Refine the proposed solution by prioritizing the criteria and making tradeoffs as necessary to further reduce environmental impact and loss of biodiversity while addressing human needs

Graduate Portrait

- 3. Transformative Racial Equity Leaders
- 7. Influential and Informed Global Stewards

Teaching Tolerance and Social Justice

How will we gauge student learning?

Assessments

Milestone 6 Environmental solution Ranking Tool

How will students learn? - High Leverage Instructional Strategies & Resources

Learning Engagements

See attached Unit Planner and related Milestone documents

Unit 1 - Intro to Climate Change and Climate Justice

Differentiated Instruction

Academic Vocabulary

Tier 2:
Tier 3:
Frontline Community
Privilege
Climate Justice
Marginalized
Oppression
Climate justice

Instructional Resources and Materials

PPS Login Required for these links.