DETAILED PROJECT PLAN

The project: In this project, students learn about the impact that coral reefs have on different systems and create their own systems thinking map.

TEACHER TIP || Questions to ask when planning to roll-out this project*:

	Prior Knowledge: *What prior knowledge (if any) do my students have about coral reefs?*
Authentic Audience: *Who is the authentic audience for your students? Who might benefit from being the recipient of the systems maps that students will develop in this project?*	
	Context in Place: *What is the ahupua'a that our school community lies in? What types of activities take place from mauka to makai? What does the ocean bottom topography in my geographic region look like? What impacts is climate change having on coral reefs in Hawaii?*
Project Management: *Will students work alone or in teams? If students work in teams, how will they be assigned? How will they be assessed individually vs. in a team?*	

***Project-based learning vs. traditional lesson planning:** *In the midst of project-based learning, students are actively doing the work, learning, creating, and inquiring - eventually heading towards their end goal or product. Often misunderstood is that the organized chaos of what you might see in a PBL environment is carefully and intentionally designed by the teacher well before the project begins. The questions above should allow you to set the stage for student learning to unfold in the following project. Anticipating student questions and areas of need will help you to feel planned and ready in advance of a project.*

Coral Systems

Climate Action Project Planner

Essential Question:	What is the true impact that coral has on our environment?

Skills and content needed to answer the Essential Question: *Refine these skills and content standards to the scope and need of your project. This project is designed to be interdisciplinary - but if you don't teach a subject, it doesn't mean that that skill or standard can't still play a role in the experience! - These selected skills and content will be supported throughout the project with activities, formative assessments and additional resources.*

Skills	Content/Standards
• Critical Thinking • Inquiry Based Discussions • Systems Thinking • Cause and Effect • **Add other skills to practice in this project*	**NGSS MS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. **NGSS MS - LS2 -2 Ecosystems: Interactions, Energy and Dynamics** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems **CCSS.ELA-LITERACY.W.8.7 Research to Build and Present Knowledge** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. **CCSS.ELA-LITERACY.WHST.6-8.9 Evidence for Support** Draw evidence from informational texts to support analysis, reflection, and research. **Add or remove standards to practice and assess in this project*

Activites, Products and Assessments: *Below you will find the proposed activities, student products and assessments for this project. Refine them to match the scope and need of your project, making sure that they align with the skills and content you chose to drive from in the previous section.*

Final project & summative assessments:

Students create a systems thinking map that analyzes how coral interacts and impacts a system.

Teacher Tip: Present the project calendar early on to show students where they are headed. *Students should know what is expected at the end from the beginning of the project. Use the templates provided to plan out the scope and sequence of the project. Include students in this process.*

Mauka to Makai

How does what we do on land impact the ocean?

Begin with an activity that explores the activities that take place in the ahupua'a (land division), from mountain to sea. Launch the project by showing students **these series of images** that depict the activities, and their impacts, that take place on land, near the ocean, and in the ocean.

See - Think - Wonder *(Visible Thinking Activity)*
Have students write down:

- **SEE:** 3 things they see in the images
- **THINK:** 3 things they **think** are happening in the images
- **WONDER:** 3 things they are wondering about the series of images.

Discuss in partners, and as a class.

Introduce the essential question, the project calendar and the final product that students will be working towards. Generate questions that students might have about the project and write them on the board or on chart paper. **Revisit these questions throughout the project.**

Extension Lessons, Activities and Background Knowledge on Ahupua'a and Coral Reefs for Teachers:

- Hō 'ike o Haleakalā *Keeping an Eye on Coral Reefs* Lesson Plans
- Pacific American Foundation Aloha 'Aina Curriculum
- Department of Land and Natural Resources *Place-Based Learning* Resources
- Kamehameha Schools Interactive Ahupua'a Resource
- **Research Paper:** The unnatural history of Kāne'ohe Bay: coral reef resilience in the face of centuries of anthropogenic impacts (2015)

What to collect from students:
-Students participate in the discussion, sharing the **results of their See, Think, Wonder** protocol.

Type of assessment:
-Formative

Skills and content:
-Critical Thinking

-Research to Build and Present Knowledge (CCSS.ELA-LITERACY.W.8.7)

Coral Reefs

What is coral?

Watch the clip from *A Climate for Change* as an introduction to Coral Reefs in Hawaii and their connection to climate change. Have students generate questions and add them to the question chart created on Day 1.

Explore Coral Reefs using the following resources and the Gathering Information Document. Students will complete the **Coral Vocabulary Check-In** to define the vocabulary and highlight important information as they explore the resources. ***Use the below resources to teach a lesson on coral reefs - direct instruction, stations and jigsaw are great methods for content delivery.***

Learning about Coral Reefs:

- Coral Reefs - National Geographic
- Corals Tutorial - NOAA
- The Coral Polyp and the Kumulipo (Origin or Life)
- Things You Can Do - NOAA Infographic
- Coral Reefs - National Geographic Article
- Zooxanthellae and Corals - NOAA
- Zooxanthellae and Corals with Pictures - Smithsonian Ocean

Supplemental:

- Chasing Coral - Full Film
- Education Resources for Coral Reefs - NOAA
- Unstoppable Schools Project Curriculum - Chasing Coral

What to collect from students:
-Students complete the **Coral Vocabulary Check-In** while exploring the resources on Coral Reefs and completing the **Gathering Information Document**

Type of assessment:
-Formative

Skills and content:
-Critical Thinking

-Research to Build and Present Knowledge (CCSS.ELA-LITERACY.W.8.7)

Human Impacts

What impacts do humans have on coral reefs?

In this section, students conduct a group investigation of the following supporting articles to learn about human impacts on coral reefs. In teams, students will complete the *Group Investigation: Reefs* activity. They should use their notes from the previous section, **Vocabulary Check-In** document, to support their thinking.

Options for setting up this activity -

- Run a **Jigsaw** in groups of 4 - each student will read a different article, report back to their group, and work together to complete the *Group Investigation.*
- Set up **Stations**, with each article/resource at a different station. Students can move around the room to complete the *Group Investigation.*

What to collect from students:
-Students complete the **Group Investigation: Reefs** to prepare for the Socratic Discussion.

-An **Exit Ticket** will help students to reflect independently after the Socratic discussion

Type of assessment:
-Formative

Coral Systems

Climate Action Project Planner

Resources for *Group Investigation:* • NOAA - Human Impacts on Coral Reefs (Slides) • NASA- Coral Bleaching Simulation • Time -Dying Coral Reefs Impact in Environment and Economy • NOAA - Human Impacts on Coral Reefs • PBS- Coral Reef Ecosystem Handout • PBS Video- Micronesia Changing Climate, Sustaining Healthy Corals • Time for Kids - Turning the Tide on Coral Bleaching ***Tip**: Modify and adapt texts to your students' reading levels as needed. It's important to maintain the thread of authentic resources, but it is also important to make them accessible!* **Students conduct a** Socratic class or table discussion using evidence from their group investigation. • Question: *What impacts do humans have on coral reefs?* • Use Socratic discussion stems to support students in communicating effectively **Students complete an Exit Ticket** to help them reflect on new learning from the Group Investigation and discussion with peers. Use the exit ticket to gauge student understanding and gaps in knowledge moving forward.	**Skills and content:** -Inquiry Based Discussions -Research to Build and Present Knowledge (CCSS.ELA-LITERACY.W.8.7) -Draw evidence from informational texts (CCSS.ELA-LITERACY.WHST.6-8.9)

Audience + Scope. As you move into the next stage of the project, start determining who the final audience of the project will/can be, and what the scope of the project will be.

Consider the following: ***(use the planning document)***

1. **Audience + Scope:**
    a. **What scope of the final product do you want to work towards with your students?**
        i. **Small scope:** Students develop a systems map on Loopy and share it with their classroom peers.
        ii. **Large scope:** *See Learning Moment: "Taking "Node" and Making an Impact" for more details*
            1. **Small scope +**
            2. Students identify a node that they want to try to develop a solution for.
            3. Students identify the authentic audience for the solution they are developing, and target the solution towards that audience
                a. Example: *writing a letter to a legislator*

Coral in a System

What is systems thinking? How does coral interact and impact the system?

Introduce the importance of Systems Thinking by watching the video: A Cautionary Tale - Cats in Borneo. Discuss the following questions:

- What is the "cautionary tale", or the lesson learned, from Operation Cat Drop?
- Why is it important to think about the **whole system** when solving problems?
- What might happen if we only focus on part of the problem? *(i.e. focusing only on the mosquito problem, instead of all of the factors connected to mosquitos)*

Introduce Systems Thinking Vocabulary

- **Nodes** = *a **factor** that can either increase or decrease*
  - **factor** = *circumstance, fact, or influence that contributes to a result or outcome*

  - **Nodes** should start with:
    - *Level of...*
    - *Amount of...*
    - *Number of...*

Example A:
- *The level of **happiness (node)***
- *The amount of **video games played (node)***

Example B:
- *The level of **hunger (node)***
- *The amount of **sandwiches consumed (node)***

- **Arrows** = connect one node with another, go in one direction, are labeled with a + or a -
  - \+ Is the same relationship
    Both factors increase or decrease
  - \- Is the opposite relationship
    One factor increases and the other decreases

Example A:
- *(+) The level of happiness **increases** when the amount of video games played **increases**.*
  (Arrow from happiness → video games)

Example B:
- *(-) The level of hunger **decreases** when the amount of sandwiches consumed **increases.***
  (Arrow from hunger → sandwiches)

What to collect from students:
-Students practice systems thinking vocabulary with **Node Connection Practice 1**

Type of assessment:
-Formative

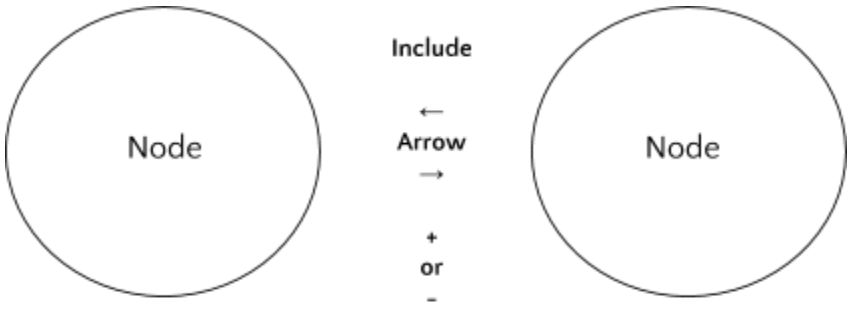
Skills and content:
-Cause and Effect

-Systems Thinking

Node Connection Practice 1

Have students create their own versions of **node connections** using examples from their lives. Their node connections should include:

1. **At least 2 nodes**
2. **A positive (+)** or a **opposite (-)** relationship, indicated with **arrows.**



Introduce Systems Mapping with an example of coral reefs in a system.

Coral and Nodes: Introduce the Coral Map

- How to make a Loopy System Map
- Video Explaining: "What is a Coral Systems Map?"
- Exemplar Coral System Map

Discuss the example maps and point out the vocabulary in action: **nodes, arrows, and similar (+) / opposite (-) relationships.**

The Greater Impact

How does coral interact and impact the system?

Node Connection Practice 2

Start whole class to help students learn how to use the vocabulary and begin to make connections between the words (nodes) related to coral:

*After choosing a **node**, discuss how this **factor** may impact coral reefs.*

- *If this **factor** would increase, how would that affect **coral**? Would it decrease or increase corals?*
- *Identify if this is a + or - relationship between **coral reefs** and the identified node. If one increases, does the other increase or decrease?*
- *If both your **node** and the **coral** increase it is a + relationship. If either your **node** or **coral** increases while the other decreases, it is a - relationship.*

What to collect from students:
-Students informally present with a partner on **Node Connection Practice 2** + **Systems Map Draft Checkpoint**

Type of assessment:
-Formative *(be sure to check accuracy of nodes on paper before moving into digital product)*

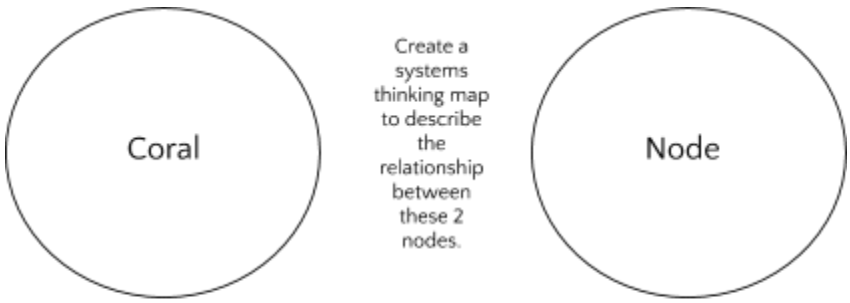
Skills and content:
-Critical Thinking

Coral Systems

1. **As a Whole Class:** Using this example coral systems map, or this Exemplar Coral map, what are some factors or nodes that you can identify?

2. **With Partners:** In pairs, students can practice identifying the remaining nodes and articulating the connections between the nodes. Use the following sentence starters as a scaffold:
   - ***Level 1:*** *_____ is a factor that impacts Coral Reefs.*
   - ***Level 2:*** *_____ is a node that impacts the Amount of Coral Bleaching in the Coral Reefs system.*
   - ***Level 3:*** *The more _____ that occurs, the more Coral Bleaching that will occur.*
   - ***Level 4:*** *An increase/decrease in the _____ node impacts the following: an increase/decrease in _____node (repeated for however many nodes are impacted), and an increase/decrease in the Amount of Coral Bleaching.*

3. **Independent Work Time**
   a. Using the Coral Map that was presented in the last section and the node word bank below, guide students to pick 1 node. **They will create their systems map** to demonstrate the relationship and intricate system that exists between this node and coral reefs. Use the image below to get students started with the **2 main nodes (coral + _____).**



   b. **Choose a Node from the Node Bank Below:**
   *(vocabulary words were introduced in the articles in **Learning Moment: Coral Reefs and Learning Moment: Human Impacts** above)*

Invasive Species
Algae Growth
Land-based pollution
Chemicals
Sediments from construction - turbidity
Plastic
Runoff
Overfishing
Increased population
Urbanization
Carbon Dioxide

-Cause and Effect

-Systems Thinking

-Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
(NGSS MS-LS2-1)

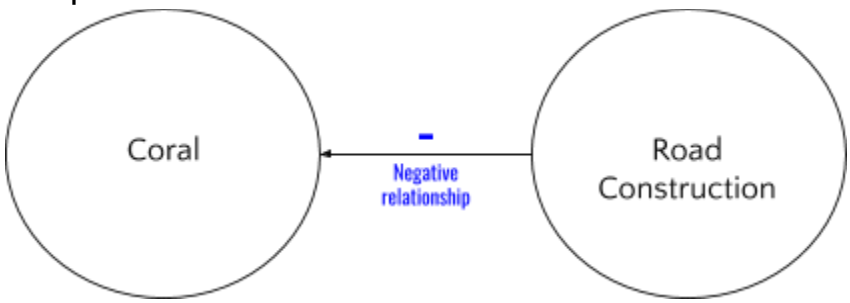
-Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
(NGSS MS - LS2 -2)

Climate Change

c. **First, students should draft their systems map on paper.** This will give students a chance to practice making connections between nodes. Use the guided template here to get started.

d. **Check for accuracy.** At this stage, give students a chance to receive feedback on the accuracy of their node relationships. For example, if they've identified **construction** as a node that has a **negative** relationship towards another node, **coral,** then this should be correctly annotated with **minus signs** and **an arrow from construction to coral.**

Example:



e. **Then, students should transfer their systems maps to a digital platform, such as Loopy.**
   a. ***This is an example of a completed systems map in Loopy*.** Once you've checked the connections between nodes on **paper,** students can begin to build their digital systems maps.
   b. **Watch this video** to learn how to make a systems map in Loopy.

Teacher Tip: Managing work time. *Allowing students time to work on their projects during school is an essential component of PBL. Project work time can sometimes feel a bit nebulous, as it requires trust in students' self-management skills! Work your way up to longer chunks of project work time, and begin by setting a timer for smaller chunks of time (i.e. 15 minutes with a specific deliverable). During work time, make it clear what the students' role should be, and what your role is. As you become more comfortable with Project Work Time, you'll find that it is a great time to check in with students1-1, set up meetings with student teams, and provide interventions for students that need extra attention.*

Feedback

Giving and receiving feedback will help students practice articulating the relationships between their nodes in their systems maps.

Small Group Feedback:
In small groups, students should prompt each other by asking the following questions:

- Is this a + relationship or a - relationship?
- If one increases, does the other increase or decrease?

They can also highlight what they see in their peer's map:

- *"If both your node and the coral increase it is a + relationship".*
- *"If either your node or coral increases while the other decreases, it is a - relationship."*

See the impact in Loopy:
In small groups, display the systems map and show peers what happens to "coral reef" node when certain commands are made:

- Click the UP or DOWN arrows on your node.
- What happens to our coral reef? How do you know?
- Is this accurate based on what would happen in nature?
- What did we learn through research that supports this?

Finding patterns:

- By increasing or decreasing specific nodes, what impacts does that have on our system?
- Identify 3 causes and effects using your loopy systems map regarding coral reefs and share that with your small group.
    - ***Example****: When I increase construction, sedimentation increases, population increases, and urbanization increases, which causes coral reefs to decrease.*

***

New to Feedback?
Review what Kind, Specific and Helpful feedback looks like.

Set up the feedback round. Pair students up (randomly or intentionally) as feedback partners. You have the option to run this in any way that works for you and your students. A more formal option is to set up a Tuning Protocol. They should complete a feedback form (or index card) for each person they give feedback to, and receive one in return.

Work on finishing touches. Make sure to give students plenty of time to take into account the feedback they received to improve their systems maps.

While students are working, conference with students. This is a chance for you to

What to collect from students:
-Students give and receive **peer feedback** and practice articulating their systems maps out loud.

Type of assessment:
-Formative

Skills and content:
-Critical Thinking

-Cause and Effect

-Systems Thinking

-Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
(NGSS MS-LS2-1)

-Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
(NGSS MS - LS2 -2)

meet with students in groups or 1-1, with the project rubric in hand. Think of it as a *final check-in* before the final project is complete. You may need to remind students to take a step back to the research stage.

Consider asking students:

- *How does this connect to the essential question?*
- *What part of the rubric do you think you still need to include in your project?*
- *What peer feedback did you receive that was helpful?*
- *What other information does your systems map need to include?*

Teacher Tip: Giving and receiving feedback. *Feedback is an essential part of Project-Based Learning! To be able to give and receive feedback is a skill that can be taught and practiced. If your students are new to peer critique, start small: provide sentence starters, show examples, and have them reflect on how the feedback they received impacted their work.*

Taking "Node" and Making an Impact

How might this type of thinking impact the way we think about climate change? What node do you have control over that you might be able to develop a solution for?

This section will be dependent on the Audience + Scope you selected for this project. After students complete their Loopy systems maps, they can:

1. **Small scope: s**hare it with their classroom peers.
    - Present to a partner
    - Fishbowl presentations
    - Whole class presentation

...or dig deeper...

2. **Large scope:** identify a node from their map that they want to try to develop a solution for *(the long term goal of this solution would be to help protect coral reefs!)*
    - Choose a node and consider their own role in making an impact
    - If it is not in their control (i.e. farm fertilizers), they can identify the actions that they could take to contribute towards a solution
    - Identify the authentic audience for the solution they are developing and target the solution towards that audience

        Example 1 : *writing a letter to local farmers about their choice of farm fertilizers*

        Example 2 : *attending a beach clean-up to decrease land-use pollution*

What to collect from students:
-Final Loopy Digital Systems Map
-Students present their final product.
-Students reflect on the project

Type of assessment:
-Summative

Skills and content:
-Critical Thinking

-Cause and Effect

-Systems Thinking

-Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (NGSS MS-LS2-1)

After the presentation, reflection can take place in writing, verbally, through student-conferencing, or through whole class discussion. Option to use the Project Reflection document.	-Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. (NGSS MS - LS2 -2)

Assessment Tip: *Determine before the final presentation day whether you will assess the final projects/presentations before or after the public presentation. If you decide to wait until after, students can be given a chance to reflect on how the public presentation went, make any final changes and then submit to you for assessment.*