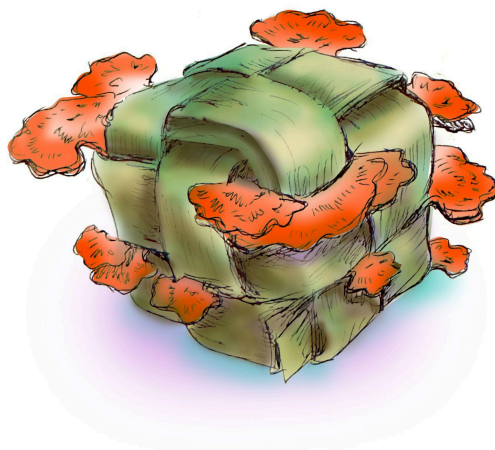


Maui Silt-Sock Mycoremediation Experiment Program



Lesson Title:	Mycelium Woven Chambers	Authors:	Corinne Okada Takara
Academic Content Area(s):	Science, Social Studies, Fine Art		
Discipline(s):	Ecology, Engineering, Sustainable Design, Hawaiian Studies		
Grade Level	Can be scaled from 6th grade through high school and up		
Lineage of Knowledge: (origin of lesson with credit to inspiration sources)	<p><i>This project was seeded in the knowledge shared by Emma Broderick, Aunty Lorna Pacheco, and Leialoha Mahuka of the KĪPUKA and KEANAHALA programs of the Puʻuhonua Society. Mahalo to these alakaʻi and kumu for sharing their knowledge of lauhala weaving, hala collection and the Hawaiian burial “planting” tradition of woven hīnaʻi lauhala. Mahalo to experiment.com for project funding support. Mahalo to Chase McLean, David Pollmiller and Dr. Rolando Perez for collaborating on the program this activity was designed for:</i></p> <p>https://experiment.com/projects/maui-silt-sock-mycoremediation-experiment-program</p> <p><i>Note, this activity will be revised with the feedback of Maui Montessori students and will result in co-designed curriculum.</i></p>		

Overview:

Brief Description	<p>A hands-on experiment using natural local materials to create woven mycelium chambers that can be incorporated into Hawaiian bioremediation systems centered in locally sourced materials and Hawaiian knowledge systems and ritual. Students weave local palm frond chambers to growing mycelium as bioremediation units to incorporate into fire burn scar soils or to be used in regenerative disposal of contaminated soils from soil experiments. Using Hawaiian and Polynesian weaving techniques students create woven palm frond chambers to incubate local Abalone Oyster (<i>Pleurotus cystidiosus</i>) and will test if these natural fiber woven chambers grown mycelium inoculated substrates more quickly than if they are placed only in gas exchange</p>
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	<p>containment bags. Through the use of pH strips and quaternary, students will also explore pH and chemical change in soil after a period of 3 weeks.</p> <p>Wovenhīna'i lauhala chambers are made for ceremonial "planting" burials. The Hawaiian traditional burial of the deceased is considered a planting and is followed by physical and spiritual growth. It is believed descendants are nourished from foods fertilized by the bones and remains of ancestors. So there are a lot of beautiful connections to traditional Hawaiian frameworks to the purpose of any mycelium bioremediation woven chambers placed into the land.</p>
Lesson Time	2 hours
Core Concept	<p>Expressing ideas and challenges for integrated bioremediation environment systems. Innovative designing experimentation can incorporate Indigenous practices and place based materials.</p> <p>[this section still under construction]</p>
Goals	<ul style="list-style-type: none"> • Uplift and adapt Hawaiian Indigenous and Polynesian weaving practices as innovation • Grow student knowledge in current mycelium propagation techniques and potential future ones. • Center Hawaiian place-based practices as essential to future solutions in bioremediation education in Hawaii. • Increase awareness of types of plants (invasive, endemic, native, canoe) • Grow knowledge in experiment design and documentation.
CCSS NGSS Standards:	HS-PS3-3 Energy (Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy).
Common Core English Standards	CCSS.ELA-LITERACY.WHST.6-8.2.D (Use precise language and domain-specific vocabulary to inform about or explain the topic.)
Common Core Math Standards	NA
Hawaiian Core Social Studies	<p>Anchor Standard 5: Taking Informed Action:</p> <p>Inquiry Standard SS.9-12.5.1 Identify local, regional and/or global problems or issues by using interdisciplinary lenses</p> <p>Inquiry Standard SS.9-12.5.3 (Apply a range of deliberative strategies and procedures to make decisions and propose possible solutions to address local, regional, and/or global concerns)</p>



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	Content Standard SS.7PI.3.8.3 Contemporary Solutions
Why do this?	<p>After recent fire disasters and oil disasters in Hawai'i, much of the expertise, solution tools, and frameworks come from the Continental US to address contamination of 'Āina. There is an opportunity to make a concerted effort to center local knowledge in bioremediation as part of solutions. Might Hawaiian Indigenous weaving practices be adapted to create mycelium growth chambers for classroom explorations elevate conversations of Indigenous Innovation in K-12 classrooms while also growing student knowledge in mycelium propagation technique and Hawaiian place-based practices?</p> <p>In workshops 1 and 2, students demonstrated that they can successfully grow locally sourced mycelium in a range of pasteurized local plant opala. Students then chose the two best mycelium growing feedstock to create prototype silt socks for experimentation. In this workshop, we are further exploring mycelium growth rates. Might woven palm frond chambers facilitate quicker mycelium growth, adjust pH, and improve moisture in hydrophobic fire impacted soils? Might students envision a system of woven chambers full of mycelium that are added into existing myco-socks as we imagine multi-species remediation systems growing out of these substrate socks?</p> <p>This project also centers a way we can be pono with the biology in our science experiments and it creates an opportunity to develop science rituals of gratitude embedded in Hawaiian frameworks and 'ike.</p> <p>A hands-on experience with weaving also creates an opportunity to share the history of hīna'i in Hawaiian burials and the legacy of colonialism disruption of burials on people and land.</p>
Words to include in generative and collaboratively grown vocabulary list	<p>Endemic plant- is a native plant species found only in a particular area.</p> <p>Canoe Plant -plant brought to Hawai'i by early Polynesian settlers</p> <p>Invasive Plant-plant that was introduced into a habitat and monopolizing resources such as light, nutrients, water, and space to the detriment of other species.</p> <p>'Āina- that which feeds, that being the land and its produce, as well as the sea and all the things from it we can collect and harvest to sustain ourselves.</p> <p>Pono-Righteousness. A way of being and a way to work, act, respect, and treat people and the land to create balance and harmony. To live justly.</p> <p>Kuleana- responsibility and privilege to care for and protect the land and the community to which we belong.</p> <p>Mālama ka 'āina- take care of the land</p> <p>Kilo- to watch, observe, examine, wonder. Kānaka Maoli observation approach during which practitioners focus on the less obvious, more subtle things in their environment.</p> <p>Ahupua'a- A ridge to reef, mauka to makai, Hawaiian water and land management system that is regenerative and sustainable.</p> <p>'Ike-knowledge</p> <p>Mycelium-root-like structure of filamentous fungus</p>



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	<p>Niu-coconut tree (note: this is a canoe plant and Hawai'i is on the edge of the coconut belt)</p> <p>hīna'i-burial vessels for those who have passed.</p> <p>puka- hole</p> <p>Opala-efuse, litter, such as old straw, leaves of trees, dried grass, or anything worthless which may be burnt or blown away by the wind; light rubbish; different things mixed together.</p>		
Instructional visuals	<p>Video</p> <p>Step by step visuals</p> <p>Photos of pilot workshop</p>		
Initial lab notes for project development	<p>https://experiment.com/u/8Ye3A</p>		
Prep Time	20 minutes for palm fiber materials. Mycelium substrate to be prepped 2 weeks prior. (see previous lesson plan)	Total Lesson Time:	1.5 to 2 hours
Instructor Practice and Prep	<p><u>Material Collection</u>: collect 1 palm frond per every 8 students</p> <p><u>Material maintenance</u>: set out palm fronds on the floor and invite students to cut five blades each. Pre dampen rags and place one per student at tables.</p>		
Tips and Precautions	<p>Center the project in kuleana of both the materials and each other, taking care with the ends of the long fronds (this can prevent ideas of sword play with fronds).</p>		
Instructional Materials or Equipment	<p>5 coconut palm blades per student, scissors, mycelium substrate, disposable gloves (for placing myco-sheet into woven chamber), biodegradable bags or mason jars (as secondary containment container for classroom storage), cookie trays or wax paper (clean surface to work on when putting myco-sheet into woven chamber), bucket with water and rags for cleaning palm fronds, pH strips and quaternary strips. Soil for jars. Tape and pen to label with.</p> <p>Note: use live mycelium cultured from your island. Bloody Polypore (Fabisporus sanguineus) was found growing on Trex®, a composite lumber material which is made of plastic and sawdust at our pilot school site. This is a mushroom species that mycoremediators are starting to partner with due to its tolerance for industrial-made substrates which include plastics. Other mushrooms can be used such as oyster mushroom mycelium. Know the mushroom of the mycelium you are working with.</p>		



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Set-up Needs	A floor or table area for palm fronds. Scissors and wet rags at each table and a bowl for the rags
Procedures	<ol style="list-style-type: none">1. [5 minutes] Opening gratitude and sharing2. [10] Introduction to activity:<ol style="list-style-type: none">a. Introduce the contexts of the activityb. [5 minutes] Introduction to the materials3. [10 minutes] Students cut the palm blades pieces from the palm fronds. They will each use 5 blades, cut them in half and remove the spine. 

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4. [10 minutes] **Students learn to weave the fronds** following the instructions on the handout and following sample weaving by the instructor.
5. [35 minutes] **Students weave the hīnaʻi chambers**, referencing the tips on their hand-out sheet and learn about the importance of *hīnaʻi* in context of *burial* and *reburial* of remains.
 - a. *Fold two fronds in half and have the fold facing opposite directions. The bottom frond with the fold to the right.*



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- b. A third frond is folded in half and it faces up and slips over the bottom frond and is placed inside the fold of the top frond.



- c. A fourth frond is folded in half and, facing it downward, it folds over the top horizontal frond and is slid inside the bottom horizontal frond. Tighten by pulling on each folded blade end.



- d. lightly push out the bottom horizontal folded blade so that a loop forms into which you can add the fifth folded blade. This one is slid up over the bottom horizontal blade and inside the fold of the top horizontal blade.



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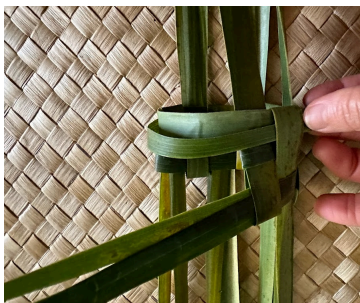
- e. *Fold a sixth blade and slip over the top horizontal folded blade and downward into the bottom horizontal blade.*



- f. *Continue adding folded palm blades until you have eight vertical blades incorporated.*



- g. *Next, fold the strip into a tube and weave the ends into the opposing sides to form a tube. Bend the form so that you have four corners forming a box.*



- h. *Turn the box on its end so that you can weave one open end closed. Do this by folding one loose long blade pair flat over to the other side of the open square edge. Fold adjacent blade pairing over.*



- i. *Next, weave the last two long loose pairs of blades on that side to create a fifth side of the cube.*

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- j. Turn the box over to the open side. Wearing gloves, fill the box with mycelium substrate. (if you want to be more scientifically accurate, you can use a gram scale to weigh the mycelium amount so that you can make a control baggie or mason jar with the same amount of mycelium substrate)



- k. Seal the open end by weaving it in the same manner as the bottom side.



- l. Weave the loose ends one more time into a cube and trim. Photograph it.

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6. [10 minutes] place into a biodegradable plastic bag on top of one cup of soil from the garden. Alternatively, place it into a mason jar with one cup of soil and don't screw the lid all the way down.
7. Students make a control for the study that is mycelium substrate placed in the same type of container with one cup of soil.
8. Place a pH strip against the damp soil in each container for 30 seconds. Take the strip out and take a photo of the strip and log its color in a lab book.
9. Place a quaternary strip against the damp soil. Take the strip out and take a photo of the strip and log its color in your lab book.
10. Follow the same steps with the control soil and log the information. All bags are placed into a dark damp place (two to four weeks).
11. [10 minutes] **Written reflection and hypothesis of what will happen to the woven cubes and control mycelium.**
12. [5 minutes] **closing gratitude**
13. **Clean up**
14. Log growth weekly over a 3-4 week period. After 3-4 weeks, remove from the jar and:
 - a. *Place a pH strip against the damp mycelium substrate. Take a photo of it and log its color in a lab book.*
 - b. *Place a quaternary strip against the mycelium. Take a photo and log its color in your lab book.*
 - c. *Follow the same steps with the control mycelium and log information.*
 - d. *Write your observations, and conclusion.*

Pono disposal or replanting of materials

Collect and compost unused plant materials. Share gratitude for the materials used.

Performances of Understanding/ Assessment

Student:

- created a hīna'i filled with mycelium.
- can explain the purpose of this project.
- can explain what is the control of the experiment and the variable used.
- demonstrates narrative skills by writing an explanation of the importance of carrying weaving knowledge forward

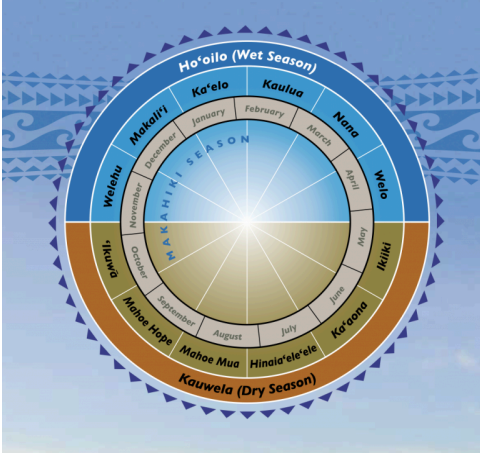


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	<ul style="list-style-type: none"> is able to explain the connection between the materials composition of their woven grow chamber and the importance of looking to ancient and contemporary materials for science innovation.
Prerequisite Skills	none
Additional Resources	<p>Context of hīna'i:</p> <p>https://www.kamakakoi.com/a-brief-historical-overview-of-burial-issues/</p> <p>https://dlnr.hawaii.gov/shpd/files/2015/06/SUMMARY-OF-HAWAII-BURIAL-LAWS.pdf</p> <p>Hawaiian Dictionary: Ulu Kau Dictionary</p> <p>Indigenous knowledge rights: Local Contexts</p> <p>Hawaiian land management system:</p> <p>https://www.mauinuiahupuaaproject.com/ahupuaa</p> <p>Hawaiian climate zones:</p> <p>https://www.hawaiimagazine.com/hawaii-has-10-of-the-worlds-14-climate-zones-an-explorers-guide-to-each-of-them/</p> <p>Hawaiian Climate Mapping tools: http://climate.geography.hawaii.edu/</p> <p>Hawai'i Climate Data Portal:</p> <p>https://www.hawaii.edu/climate-data-portal/glossary-of-terms/</p> <p>Citizen science app to identify plants and animals https://www.inaturalist.org/</p>  <p>https://www.hawaii.edu/climate-data-portal/hawaiian-lunar-calendar/</p> <p>https://www.wpcouncil.org/wp-content/uploads/2023/12/2024_Hawaii-LunarCalendar_WEB.pdf</p>
Extension activities	

