



COVID-19
8 LESSONS FOR PREK-12 AND
COMMUNITY

Lawe li'ili'i ka make a ka Hawai'i,
lawe nui ka make a ka haole
 Death by Hawaiians takes a few at a
 time; death by foreigners takes many.

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Princess Lili'uokalani (Wikimedia Commons)

Title: COVID-19: *Lawe li'ili'i ka make a ka Hawai'i, lawe nui ka make a ka haole.* Death by Hawaiians takes a few at a time; death by foreigners takes many (No.1960, Pukui)

Grades:PreK-12, not all lessons suitable for all grades

Time: 1-4 hours per lesson, 3 weeks for unit.

Next Generation Science Standards: Cross-cutting concepts span disciplines

1. **Patterns:** Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.
2. **Cause and Effect:** Mechanism and Prediction: Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.
4. **Systems and System Models.** A system can be described in terms of its components and their interactions.
6. **Structure and Function:** The way an object is shaped or structured determines many of its properties and functions.
7. **Stability and Change:** For both designed and natural systems, conditions that affect stability and factors that control rates of change are critical elements to consider and understand.

National Health Education Standards:

Standard 3: Accessing Information, Products, and Services Students will demonstrate the ability to access valid information, products, and services to enhance health.

Standard 7: Self-Management Students will demonstrate the ability to practice health-enhancing behaviors and avoid or reduce health risks.

Nā Hopena A‘o: Learning outcomes rooted in Hawai‘i

1. Strengthened sense of belonging: I stand firm in my space with a strong foundation of relationships. A sense of Belonging is demonstrated through an understanding of lineage and place and a connection to past, present, and future. I am able to interact respectfully for the betterment of self and others
2. Strengthened Sense of Responsibility: I willingly carry my responsibility for self, family, community and the larger society. A sense of Responsibility is demonstrated by a commitment and concern for others. I am mindful of the values, needs and welfare of others.
3. Strengthened Sense of Excellence: I believe I can succeed in school and life and am inspired to care about the quality of my work.
4. Strengthened Sense of Aloha: I show care and respect for myself, families, and communities. A sense of Aloha is demonstrated through empathy and appreciation for the symbiotic relationship between all. I am able to build trust and lead for the good of the whole.
5. Strengthened Sense of Total Well-being: I learn about and practice a healthy lifestyle. A sense of Total Well-being is demonstrated by making choices that improve the mind, body, heart and spirit. I am able to meet the demands of school and life while contributing to the well-being of family, ‘āina, community and world.
6. Strengthened Sense of Hawai‘i: I am enriched by the uniqueness of this prized place. A sense of Hawai‘i is demonstrated through an appreciation for its rich history, diversity and indigenous language and culture. I am able to navigate effectively across cultures and communities and be a steward of the homeland.

TO THE TEACHER: CONNECTIONS TO PLACE & CULTURE(S)

Lawe li‘ili‘i ka make a ka Hawai‘i, lawe nui ka make a ka haole. Death by Hawaiians takes a few at a time; death by foreigners takes many. Hawai‘i’s indigenous people suffered from many epidemics caused by diseases introduced by outsiders. Much of this history is recorded in Hawaiian language newspaper articles. John Papa ‘Ī‘ī wrote in *Ka Nupepa Ku‘oko‘a* of ancient epidemics brought by men who came from Kahiki and traveled around the islands: “every island where they went ... fatal diseases spread among the chiefs and commoners” (‘Ī‘ī 1959, p. 47). Memorizing the history of a disease from its place and time of first appearance was part of the training of medical kahuna. This centuries old practice precedes current efforts to track *Patient 0*, the first known person with COVID-19. The medical and historical truth of epidemics in Hawai‘i is captured in the *‘ōlelo no‘eau* selected as the title of this curriculum unit.

We owe this and many other *‘ōlelo no‘eau* to the lifelong dedication of Mary Abigail Kawena‘ulaokalaniahī‘iakaikapoliopolekawahine‘aihonua Naleilehuaapele Wiggin Pukui who began collecting *‘ōlelo no‘eau* when she was 15 years old (Williamson 1983). Her parents gave her to be raised (*hānai*) as a *punahēle*, favored grandchild by her mother’s mother Nali‘ipo‘aimoku, a former dancer in Queen Emma’s court. Knowledge of chant, dance and Hawaiian language was passed down to her by her grandmother and mother, Pa‘ahana who spoke to her only in Hawaiian and passed down the traditions she had learned from her mother such as short proverbs, *‘ōlelo no‘eau*. These reflect keen observational skills that led to condensed statements such as “*Lawe li‘ili‘i ka make a ka Hawai‘i, lawe nui ka make a ka haole.* Death by Hawaiians takes a few at a time; death by foreigners takes many” (No.1960). The saying recognizes that “The diseases that were known in the islands before the advent of foreigners cause fewer death than those that were

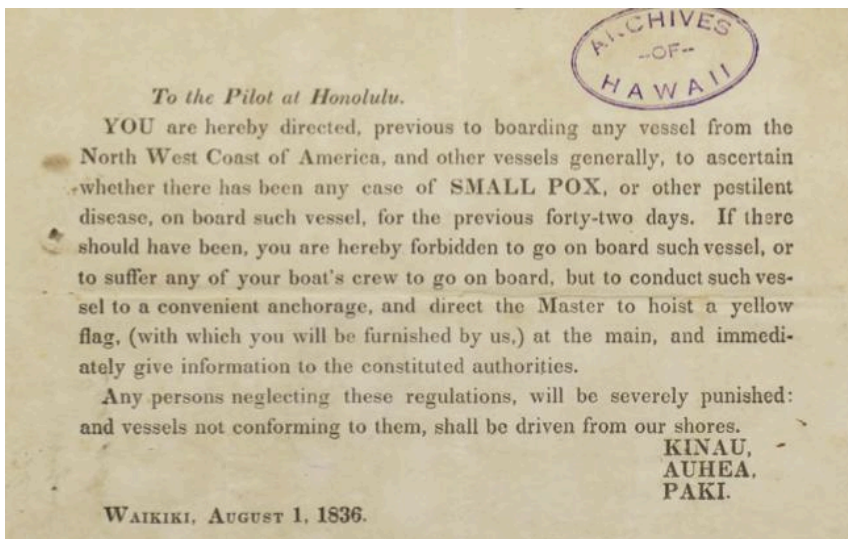
introduced” (p. 211). This *‘ōlelo no ‘eau*, like a scientific law, is based on numerous observations spanning many experiences with epidemics.

Hawaiian language newspapers published between 1834 and 1948 included articles on past and current epidemics that provide insights into the lives, suffering, deaths, and population declines of indigenous people in Hawai‘i and elsewhere. Rapid cultural change and the deaths of chiefs and *kūpuna* spurred the call to record and share the knowledge of the Hawaiian people. Hawaiian language newspapers provided an open forum for ideas and commentary that helped maintain the culture and cohesiveness of a nation. Articles written by citizens who learned to read and write in more than 1000 schools (at least one per *ahupua‘a*) attest to an estimated 90% literacy rate of the Hawaiian people. Translations of Hawaiian newspaper articles on epidemics are found at <https://nupepa-hawaii.com/category/epidemic/>.

Contemporary writers describe the impact of epidemics in Hawai‘i and Pacific Islands. Shanks’ (2016) “Pacific Island Societies Destabilised by Infectious Diseases” describes how deaths from infectious diseases disproportionately affected the leaders of Pacific Island societies. Schmitt and Nordyke’s (2001) “Death in Hawai‘i: The Epidemics of 1848-1849” document epidemics during an unusually cold and wet year leading to population declines, destabilization of the Hawaiian economy and the need for overseas labor. In “Influenza Deaths in Hawai‘i, 1918-1920” (1999) they note that Native Hawaiians were most susceptible to Spanish flu that killed more than 2,300 in Hawai‘i. Newspapers printed public health messages urging readers to “avoid public gatherings, keep children away from other children who have coughs or colds, keep your hands clean, don’t shake hands” (p. 106). Shulman, Shulman and Sims (2009) write about the deaths of King Kamehameha II and Queen Kamamalu in 1824 in London from measles likely contracted when visiting a children’s home. Their deaths foreshadow the 1848 arrival of measles from California, killing up to a third of Hawaiians and weakening the Kingdom (Blakemore, 2019). Measles epidemics occurred in 1861, 1889, 1898, and 1936, the last causing 205 deaths.

Herman (2020) responds to the current COVID-19 epidemic in “Shutting Down Hawai‘i: A Historical Perspective on Epidemics in the Island.” He reports that in past epidemics some missionaries used religion to justify their good health in contrast to the deaths of Hawaiians: “God has hitherto preserved our health; but the heathen around us are wasting away by disease, induced not by the climate, but by their imprudence and vices.”

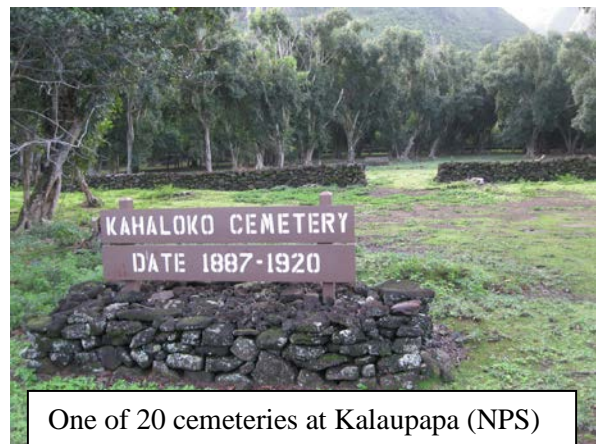
The marginalization of indigenous knowledge and stigmatization of traditional healing may have led to distrust between the Native Hawaiian community and the Western medical community (Hughes 2004, Kamaka *et al* 2011). Hiraishi (2020) reports that Hawai‘i’s first recorded public health measure was issued by Kuhina Nui Kina‘u in 1836 for the Honolulu Harbor pilot to board all foreign vessels to



check if small pox occurred in the past 42 days and if so to be quarantined (see order above). This presents Hawaiian community health in a historical context through the policies and institutions of the Hawaiian Kingdom, the wisdom in *'ōlelo no 'eau*, and the accounts of epidemics and indigenous health in Hawaiian language newspapers. This approach may be especially relevant to Hawai'i's vulnerable Native Hawaiian and Pacific Islander population in this current pandemic.

In 2017, Census data showed Hawai'i had the highest estimated percentage of multigenerational households (housing three or more generations) in the U.S., over twice that of the nation as a whole. More broadly, as a strong sense of community is inherent to Hawaiian culture, expressed in the need for culturally competent health care providers (Hughes 2004, Kamaka *et al* 2011) Hawai'i is a special case in which the current state-wide and nationally mandated strategies to mitigate COVID-19 transmission such as “social distancing” may not be particularly easy to implement either for practical reasons in Hawai'i's multigenerational homes and be a painful reminder of leprosy, a contagious bacterial disease that led to quarantine on Moloka'i from 1865-1946 .

Greene's (1985) “Exile In Paradise: The Isolation of Hawai'i's Leprosy Victims and Development of Kalaupapa Settlement, 1865 to the Present” reports that leprosy was often called *ma'i Pākē*, Chinese illness due to the belief Chinese brought it to Hawai'i. Those who thought it introduced by a chief called it *ma'i ali'i*, the chief's sickness. The search for a cure was unsuccessful and in 1863 William Hillebrand, medical director of Queen's Hospital noted an increase in cases. The disease had spread for decades and the 3-5 year or longer incubation period made tracing and isolating asymptomatic individuals impossible.



In 1865 King Kamehameha V signed the Legislative Assembly's “An Act to Prevent the Spread of Leprosy.” By the end of 1866, 100 patients were quarantined at Kalaupapa, Moloka'i, an isolated peninsula backed by steep cliffs, leading to new names for leprosy-“Ma'i-ho'oka'awale, Disease of Exile or Separation” and “ma'i-ho'oka'awale 'ohana, the Disease-that-tears-families- apart” (p. 22). Princess Lil'uokalani visited Kalaupapa in 1881 and returned in 1884 with Queen Kapi'olani and a German medical expert. By 1890 over 1000 people, around 2% of the Hawaiian population were quarantined at Kalaupapa. In 1940 the disease was considered under control; in 1946 new sulfone drugs ended the need to quarantine patients.

The eight lessons in this curriculum begin in the past and connect to the present. We hope they provide ways to bring ancestral wisdom and experiences to guide decisions in the present that preserve and protect Hawaii's peoples, particularly its vulnerable and treasured kūpuna. Queen's Hospital, Kapi'olani Hospital, Queen Lili'uokalani Trust and Lunalilo Home are testaments to the Royals' concern and care for their people.

Lessons may be adapted for particular audiences and instructional purposes. The archive of 100+ Hawaiian language newspapers and a wealth of Hawaiian texts are ready to inform present day thinking and action (Lorenzo-Elarco 2019). The University of Hawai'i's Institute for Hawaiian

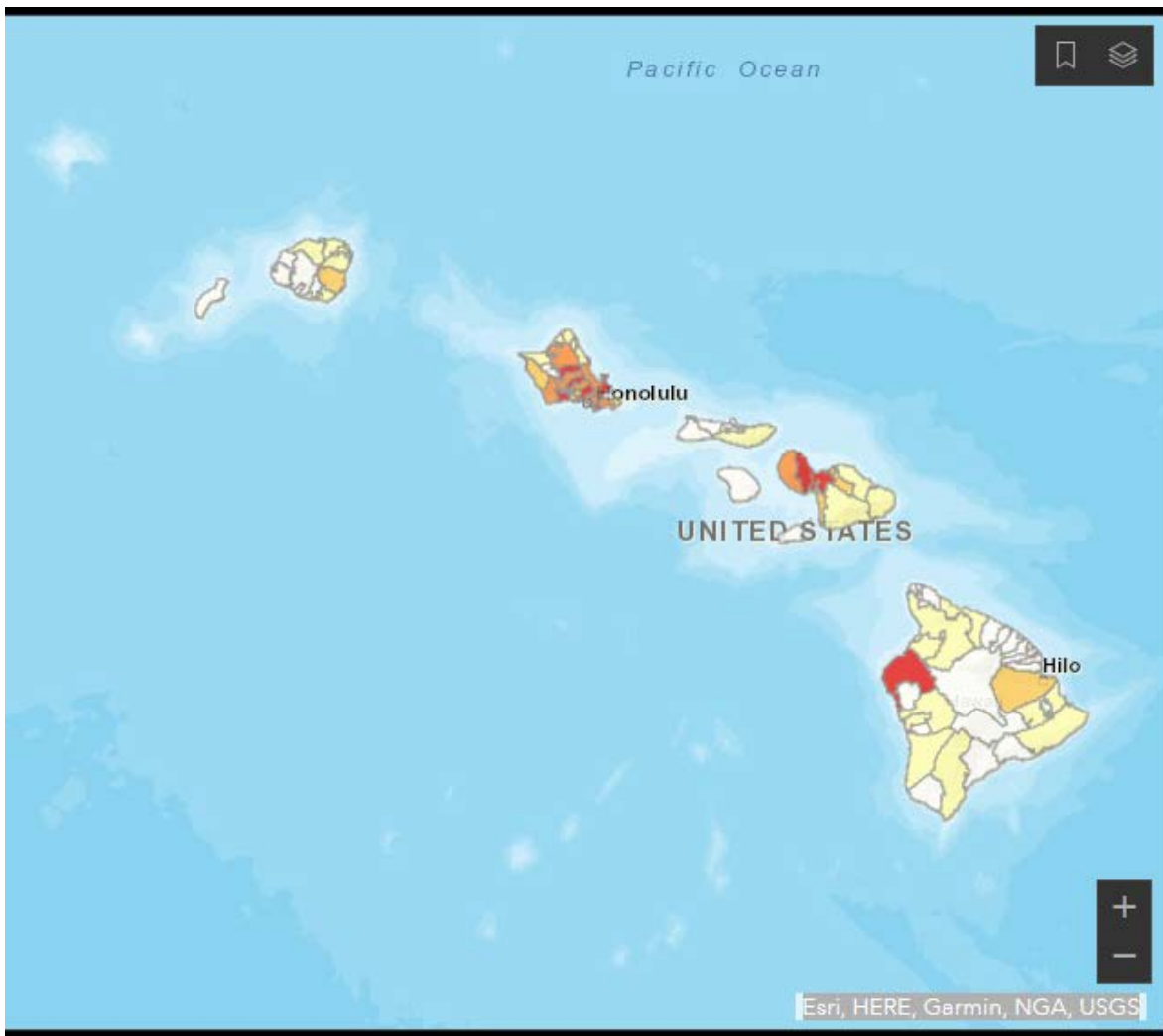
Language Research and Translation hosts translations of Hawaiian language newspaper articles that may be searched by word or category: <http://ihlrt.seagrant1.soest.hawaii.edu/hna/all>. A search for “websites for Hawaiian language newspapers” will bring up many resources for Hawaiian language newspapers.

Bring it home: The role of leaders is to make decisions based on best information to care for the people and the land. Citizens also make these decisions: “What would a Hawaiian do?” a teacher would ask when his 4th graders studied a complex, real world problem. What message does the story of 6 Tongan teenagers shipwrecked for 15 months on a kapu island hold for us today?

<https://www.youtube.com/watch?v=DYebOCCoTYM>

Stay informed: Hawai‘i Dept. of Health COVID-19 Dashboard updated daily with maps of cases, breakdown by “race” and age, travel or community spread.

<https://health.hawaii.gov/coronavirusdisease2019/what-you-should-know/current-situation-in-hawaii/>.



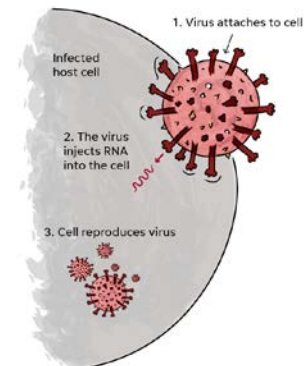
Hawai‘i Dept. of Health map shows COVID-19 cases by zipcode May 25, 2020

OVERVIEW LESSONS I-VIII

MATERIALS: Computers - 1 per student, readings, websites for Hawaiian newspapers, readings, YouTube videos and COVID-19 information, e.g., <https://google.com/covid19-map/?hl=en>.

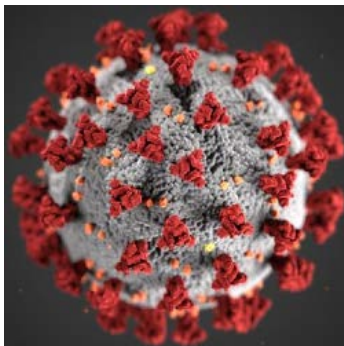
INSTRUCTIONAL ACTIVITIES:

Lessons follow 5E format: Engage, Explore, Explain, Elaborate/Extend, and Evaluate (<https://www.michiganseagrant.org/lessons/wp-content/uploads/sites/3/2019/07/5Es-Teaching-Great-Lakes-Science-1.pdf>)



Lesson activities may be carried out individually, but students are likely to be most engaged in pairs or small groups followed by group reports and whole class discussion. Lessons are designed for face-to-face or distance learning. Each concludes with actions students can take to protect themselves and others from COVID-19 and teach others about it. The final lesson examines values and behaviors underlying sustainable and resilient social ecosystems.

LESSON 1. BUILDING KNOWLEDGE OF INFECTIOUS DISEASES AND COVID-19



Source: Wikipedia

This lesson introduces fundamental ideas about transmission of COVID-19 and is appropriate for grades 4-12 and community outreach. Content integrates Science, Hawaiian Studies, Social Studies, Health, Technology, and Math. Mini-Inquiries A -C are each estimated to take 30-60 minutes, depending on numbers and time for discussion. A projector, computer, and internet are needed.

Genetic analysis suggests SARS-CoV-2, the RNA virus that causes COVID-19 likely originated in horseshoe bats, transferred to other animals then to humans. “How the Virus Got Out,” (New York Times, March 22, 2020) visualizes spread from Wuhan, China to US:

www.nytimes.com/interactive/2020/03/22/world/coronavirus-spread.html

LESSON II. SOAP MEETS COVID-19: The Amphiphile Phenomena

This preK-12 lesson introduces fundamental ideas about transmission of COVID-19 and is appropriate for preK-12 and community outreach. The goal of the lesson is to provide compelling, personal experiences on the why and how of handwashing with soap to reduce spread of COVID-19. Content integrates Science, Hawaiian Studies, Social Studies, Health, and Math. Learn why *awapuhi*, shampoo ginger (Photo: Awapuhi, Honolulu Advertiser) is a Hawaiian soap. The depth of the lesson, concepts and vocabulary depend on age of student and content focus. The lesson includes chemistry terms and concepts.



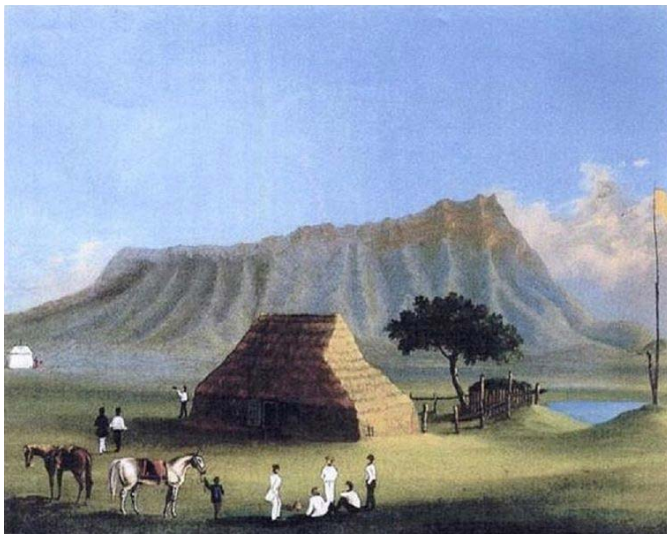
LESSON III. PRINCESS LILI‘UOKALANI’S RESPONSE TO 1881 SMALLPOX EPIDEMIC

Lawe li‘ili‘i ka make a ka Hawai‘i, lawe nui ka make a ka haole. Death by Hawaiians takes a few at a time; death by foreigners takes many (No.1960, Pukui)

The lesson is designed for secondary students and upper elementary students with teacher support. Content integrates Science, Hawaiian Studies, Hawaiian Language, Social Studies, Health, and Math. It introduces the impact of infectious diseases on the vulnerable Hawaiian population and the Royals’ responsibility to care for their people. When a smallpox epidemic looms threatens King Kalākaua is away, Princess Lili‘uokalani must decide to protect her people or allow business as usual.



Princess Lili‘uokalani (Wikimedia Commons)



LESSON IV. IMPACT OF EPIDEMICS ON HAWAI‘I AND THE HAWAIIAN KINGDOM

This secondary, integrated Language Arts, Social Studies, Hawaiian Studies, Hawaiian Language, Health/Science 3 class lesson includes 3 homework sessions of 2 hours each. It presents the impact of introduced diseases and ensuing population, cultural, political and economic changes that threatened the existence of the Hawaiian Kingdom.

“View of Smallpox Hospital” by Paul Emmert, c. 1853-59 (Wikimedia Commons)

LESSON V. COVID-19 and TOURISM Kaleo Hanohano, Kaimuki HS Hospitality Academy



This integrated Language Arts, Social Studies, Hawaiian Studies, Hawaiian Language, Health/Science lesson follows Lesson III and is expected to take a minimum of 2-3 hours. Students need to know that Princess Lili‘uokalani made the tough, evidence-based decisions our leaders are making now. The lesson is appropriate for upper elementary through secondary students. It introduces students to the economic and health impacts associated with COVID-19.

Photo: Waikīkī surfboard rentals (Wikimedia Commons)

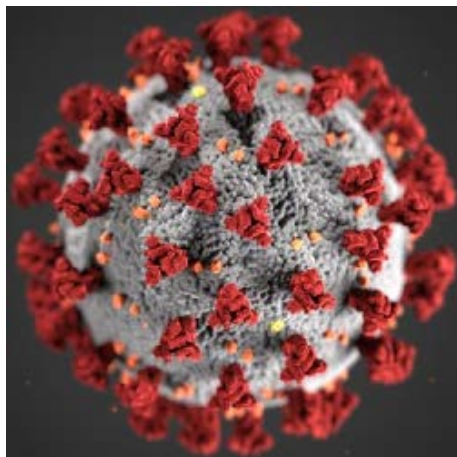
LESSON VI. HOW DO VIRUSES JUMP FROM ANIMALS TO HUMANS?

This grade 4-12 lesson builds on Lessons I and II and is based on a 5-minute video showing how viruses can be transmitted to humans from animals (and vice versa). The video transcript supports second language speakers in peer and teacher discussions. Princess Lili'uokalani controlled human behavior to stop the spread of smallpox in 1881. Today, social distancing, wearing masks, cleaning, and self-quarantine are practices to control COVID-19, caused by a coronavirus in the same family as SARS and MERS. Though less deadly than SARS and MERS it spreads easily, is more deadly than seasonal flu and so far has no vaccine (www.cdc.gov/flu/other/index.html).



LESSON VII. VIRAL PANDEMICS: CURRENT CONCERNS, NEW TOOLS, “OLD” PRACTICES

Kyle (Kolomona) Nakatsuka and Pauline W. U. Chinn



This lesson is recommended for middle and high school students in life science, biology, health and math classes. It is designed for 3 class sessions with homework to view 2 videos, conduct independent research, and develop presentations. Students learn and apply key terms and concepts in epidemiology, analyze current data to develop hypotheses, and discuss the roles that politics and economics play in the current pandemic. The role of public health and Hawaiian practices of constant observation, monitoring, and decision-making are connected to concepts of resilience and sustainability of social ecosystems, the interconnected human and natural systems we are all a part of, not apart from.

LESSON VIII: SUSTAINABILITY AND RESILIENCE: TEENAGE LESSONS



In 1965, 6 Tongan teenagers cut out from school and steal a boat to travel to Fiji. Instead, they are caught in a storm and shipwrecked on an island kapu for a century after slavers captured the villagers. They survive for 15 months as their families hold their funerals. The documentary helps learners K-gray explore the aspects of culture, values, knowledge, and practices that lead to healthy, sustainable and resilient social ecosystems.

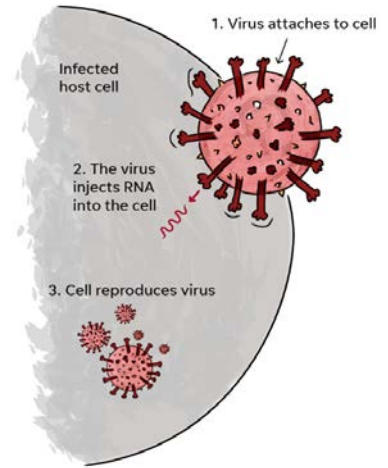
<https://www.youtube.com/watch?v=DYebOCCoTYM>

Lesson VIII can be a class, a project starter or a guide to rethinking curriculum and pedagogy.

LESSON 1. BUILDING KNOWLEDGE OF INFECTIOUS DISEASES AND COVID-19

This lesson introduces fundamental ideas about transmission of COVID-19 for grades 4-12 and community. SARS-CoV-2, the name of the coronavirus causing COVID-19 shows its close relationship to SARS (Severe Acute Respiratory Syndrome).

Estimated time: 2 days, 3-4 hours. Mini-Inquiries A, B, and C each take 30-45 minutes, depending on number of participants and time for discussion. A projector, computer, and internet access are needed. Provide students with resources to study before class sessions and form small groups in advance.



1. Engage: What do you know about Coronavirus, COVID-19? Write for 1 minute, share with 2-3 partners, compile group answer, share with whole class.

2. Explore and Explain: Mini-inquiries A, B, C

Mini-Inquiry A “Spread Aloha, NOT COVID-19”: open, read, click on links in document <https://static1.squarespace.com/static/5476c58ce4b0f2ef39513777/t/5e7d3de2854e1012be94483d/1585266150050/SpreadAlohaNotCOVID19.pdf>

1. Explore: Spread Aloha, NOT COVID-19

- a. **If you test positive for COVID-19**, but are not hospitalized, what do you do and how do you know when you can interact with others again? Hint: click on links to CDC.
- b. **Before lockdown**, how many people in a typical day did you get closer to than 6 feet?
- c. **After lockdown**, how many people do you get closer to than 6 feet in a typical day?
- d. **Write a private list** of 10 people you care about. Which are vulnerable and why?
- e. What can you do to protect your own health **and** health of vulnerable people?

2. Explain: Share your mini-inquiry A with your partners then share with the class. How has “social distancing” changed how many people you’re closer to than 6 ft. **before** and **after** lockdown? How many have health issues and what are some these? How do you show you care for them? Share something new you’re doing to spread aloha.

Mini-Inquiry B “How do infectious diseases spread?”

1. Explore: Before class read, view, take notes on the following:

Read Yikes! Saliva Droplets From Mild Cough Travel Up to 18 Feet,

<https://scitechdaily.com/yikes-saliva-droplets-from-mild-cough-travel-up-to-18-feet/>

View: <https://m.youtube.com/watch?v=e-3Li7iMqMM>

View: How the Virus Got Out:

www.nytimes.com/interactive/2020/03/22/world/coronavirus-spread.html

Imagine you are a COVID-19 carrier but don’t know it – you’re *asymptomatic*. Imagine this is your classroom and your classmates. You hug your friends, walk around, say hi to everyone. Watch the 1-minute video as many times as you wish.

2. Explain: With 1-2 partners, do Mini-Inquiry B

- a. Video: About how many people including yourself are in the classroom?
- b. How does the infection spread through the classroom? Why does everyone eventually wind up infected? What actions can stop the spread?

- c. How did the virus get out from Wuhan? What technologies allowed it to spread so fast and far? What technologies were missing?
 - d. What dilemma do political leaders face when there is a pandemic? In the US how does political affiliation affect decision making? Provide evidence and examples.
 - e. Until there is a vaccine, what do the readings and video suggest we **personally** all need to do to protect others even if we feel perfectly healthy? What do you think our **state and national leaders** need to do to protect both people and the economy?
- 3. Explain and share** your answers from Mini-Inquiry B with partners and class.

Mini-Inquiry C: What is the current status of COVID-19 in Hawai‘i?

1. **Explore the HIDOH website** <https://health.hawaii.gov/coronavirusdisease2019/what-you-should-know/current-situation-in-hawaii/>
 - a. **Click on Map:** Which county and zip codes have the highest number of cases, total and past 28 days? What may be reasons for the pattern? Explain your reasoning.
 - b. **Click on Epicurve Total cases:** From left to right, what are patterns for **travel** vs. **community spread**? What may be causes? What policies minimize spread for each source?
 - c. **Click on Lab Testing:** Rank each county’s 5 most recent percent positive tests (orange line) from highest to lowest. Possible reasons for this pattern?
 - d. **Click on Age:** What is the pattern of least to greatest percent of hospitalization? No. of cases? Possible reasons for this pattern?
 - e. **Click on Race:** Which are overrepresented? underrepresented? Possible reasons?
2. **Explain and share** your answers from Mini-Inquiry C with partners and class.

4. Elaborate/Extend, Mini-Inquiries A, B, C:

- a. What actions or decisions do you want national leaders to make?
- b. What actions or decisions do you want Hawaii’s leaders to make?
- c. What are at least 3 personal actions everyone should do to reduce spread of COVID-19?
- d. What should you do that shows you care for others, especially vulnerable people?
- e. What is one thing you can do in your own life to reduce spread, feel better, and/or show you care? Share your idea with class.
- f. What are steps you and your classmates can take to share what you’ve learned with others?
- g. After this lesson do you feel more or less worried about COVID-19? What could we do or learn that would reduce your worries?

- 5. Evaluate: Write and share:** What are 1-2 things you learned that you didn’t know before? What actions do you want your leaders to take? What can you do to protect others and spread aloha? After this lesson I’m still or more worried about_____. After this lesson I’m less worried about_____.

Teacher Reflection, how could the lesson be more effective? What went well, what would you do differently?

Further Reading:

1. COVID-19 case clusters offer lessons and warnings for reopening.
https://www.sciencenews.org/article/coronavirus-covid-19-case-clusters-lessons-warnings-reopening?utm_source=email&utm_medium=email&utm_campaign=latest-newsletter-v2&utm_source=Latest_Headlines&utm_medium=email&utm_campaign=Latest_Headlines

LESSON II. SOAP MEETS COVID-19: THE AMPHIPHILE PHENOMENON

Alison Ka`olinokaimana Yasuoka and Pauline W.U. Chinn

This preK-12 lesson introduces fundamental ideas about transmission of COVID-19 and is appropriate for preK-12 and community outreach. The goal of the lesson is to provide compelling, personal experiences on the why and how of handwashing with soap to reduce spread of COVID-19. Content integrates Science, Hawaiian Studies, Social Studies, Health, and Math. Learn why *awapuhi*, shampoo ginger (Photo: Awapuhi, Honolulu Advertiser) is a Hawaiian soap. The depth of the lesson, concepts and vocabulary depend on age of student and content focus. The lesson can be developed further for chemistry students.



Polynesian voyagers brought around 30 plants to the Hawaiian Islands. Knowledge passed down through generations guided the selection of plants destined for new islands. Food, medicinal, and fiber plants were prioritized for a founding colony. One was *awapuhi*, shampoo ginger, *Zingiber zerumbet*, one of eight plants brought for medicinal use (Abbott 1992). One use is found in its name, shampoo ginger. *Awaphuhi* contains *saponins* (from Latin *sapon*, soap), a class of compounds that foam in water. The liquid in the flower head (see photo above) is a natural shampoo, sometimes applied by a whack on the head with a flower stalk! Paul Mitchell turned this knowledge into *awapuhi* shampoo. He purchased land in Hamakua mauka of the cane fields to plant *awapuhi* and installed a field office with own solar power, water systems and Balinese houses. Carl Ramsey, Na`alehu MS, Ed Ginoza, Maui HS, and Pauline Chinn, Roosevelt HS partnered with Paul Mitchell and Jonathan Tennyson on the 1988-89 solar vehicle project. Funded by a \$25,000 award from the state's Division of Energy, the research and design STEM project won the U.S. Dept. of Energy's Best Energy Education Project award. In 1990, Hawai'i Preparatory Academy's solar car was the first high school entry to complete the 2000-mile Australia race (see movie "Race the Sun").

Saponin molecules in *awapuhi* act like soap and detergent because they have one end that can hang on to water molecules (hydrophilic, water loving) and one end that can hang on to oil molecules and repel water (hydrophobic). This dual ability gives a *saponin*, soap, or detergent molecule the name *amphiphile*, meaning to like both oil and water. This makes amphiphiles "bridge molecules" that hang on to oils and viruses, lift them from our skin and form little globules (*micelles*) with oily substances attached to the oil-loving end with the water-loving end outside hanging onto water molecules. As the COVID-19 virus' coat has oily characteristics, soap will remove virus along with our skin's natural oils. This is why our hands "dry out" when we wash with soap and water.

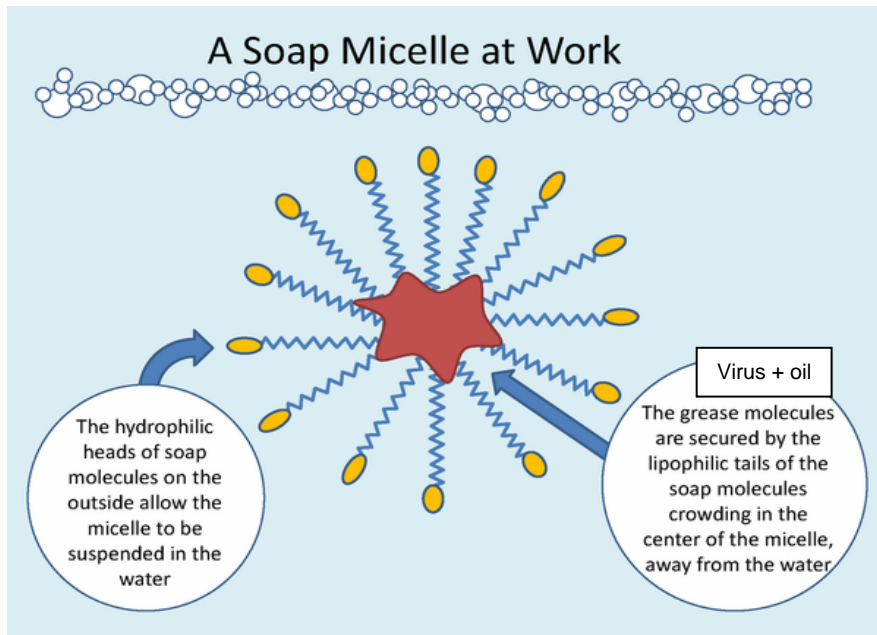
Carry out the **Hands-on Activity: Scrub it up!** and see graphics on next two pages. This is the short version of Lesson II accessible on Kahua A`o project website.

DIRECTIONS:

1. Pour ½ teaspoon of vegetable oil into your palm, rub it all over, including top of hand.
2. Run tapwater over hands and rub them together. Does oil come off? How do your hands feel?
3. Using soap or dishwashing liquid, wash hands vigorously for 20 seconds, top of hands, around thumbs and around nails. What do you see?
4. Rinse thoroughly. Does oil come off? Dry your hands with a paper towel, then use it to turn off the tap so you don't pick up virus and bacteria. How do your hands feel and look?

How does soap remove oily substances including viruses?

Soap, detergents, and *awapuhi* contain molecules called **amphiphiles** after Greek *amphi*, both and *philia*, love, friendship. **Amphiphiles** are long molecules with one end that attracts water (*hydrophilic*, water-loving) while the other end (*lipo-phobic*, oil-loving, or *hydro-phobic*, water-fearing) attracts oily substances. This makes them **amphiphilic** molecules, attracted to two different substances. (Think of *amphibians* like frogs and toads that live both in water and on land.)



Most viruses have an oily covering, so the oil-loving ends of the amphiphiles attach to the virus while the water-loving ends attach to water molecules. The virus coating begins to break up the way oils on greasy dishes break up.

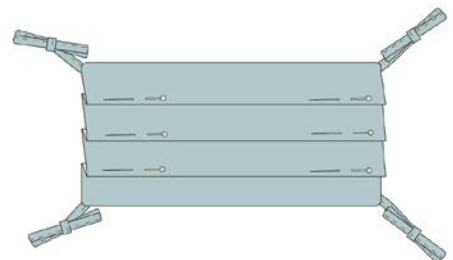
Amphiphiles surround the virus forming a **micelle**. When you washed your oily hands, micelles made the soapy water cloudy, then you rinsed them away along with viruses and germs.

Show aloha, care for yourself and others. Wash hands with soap, wear a face mask, stay 6 ft apart.

DO-IT-YOURSELF: FABRIC FACE MASKS

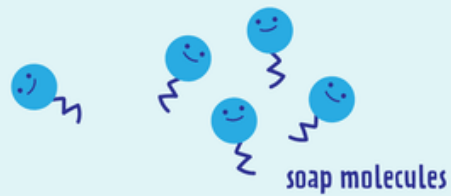
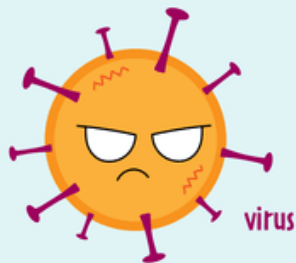
1. <https://www.nytimes.com/article/how-to-make-face-mask-coronavirus.html>,

Directions: <https://int.nyt.com/data/documenthelper/6860-printable-face-mask-tutorial/ded6e67bb78f2599a7ff/optimized/full.pdf#page=1>



2. Bandana no-sew face mask with coffee filter:
<https://www.youtube.com/watch?v=oPYp-kjiqtw>

How washing our hands with **soap** and **water** helps protect us from **coronavirus** (and other germs)

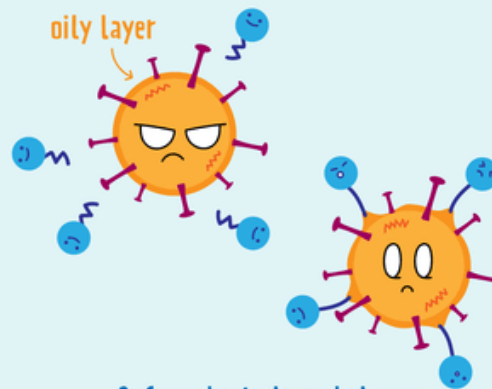


Graphics by: Jovana Andrejevic

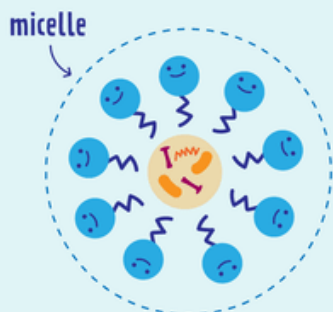
More information: <https://www.cdc.gov/handwashing>



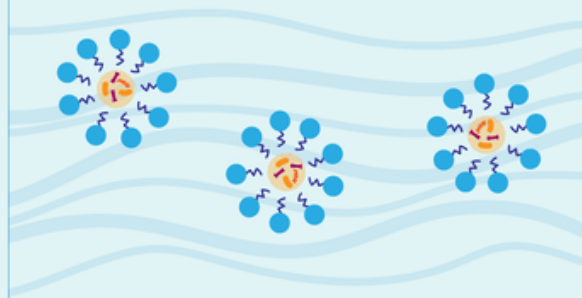
1. Soap molecules have one end that attracts water and another end that attracts oil and fat.



2. Some bacteria and viruses (including coronaviruses) are surrounded by an oily layer, but soap molecules can pull it apart.



3. As you scrub your hands for 20 seconds (while singing your favorite hand washing song), soap molecules encircle and trap the viral debris into bubbles known as micelles.



4. When you rinse your hands, the trapped viral debris gets washed away with water.

LESSON III. PRINCESS LILI‘UOKALANI’S RESPONSE TO SMALLPOX EPIDEMIC:

Lawe li‘ili‘i ka make a ka Hawai‘i, lawe nui ka make a ka haole. Death by Hawaiians takes a few at a time; death by foreigners takes many (No.1960, Pukui)

The lesson is designed for secondary students and upper elementary students with teacher support. It introduces the impact of infectious diseases on the vulnerable Hawaiian population and the Royals’ responsibility to care for their people. When a smallpox epidemic threatens and King Kalākaua is traveling, Princess Lili‘uokalani must decide to protect her people or allow business as usual.

Photo of Bernice Pauahi Paki (left) and Lydia Kamakaeha Paki (Lili‘uokalani)(right) taken around 1859 (Wikimedia Commons).



Instructional Activities

1. **Engage:** Every one shares something: “What do you know about Lili‘uokalani?”
2. **Explore:** read Princess Lili‘uokalani’s response to smallpox epidemic and discusses the Princess response to the threat of a smallpox epidemic in 1881.

Excerpt from [LILIUOKALANI – HAWAII’S LAST QUEEN](#)

Source: J. K. Williams, March 4, 2005

"In 1881, she got her first taste of decision-making and her first bad brush with the business community. Her brother was away on a trip, leaving the 43-year-old princess in charge, when a smallpox epidemic broke out. The native people had no resistance to this foreign disease, and many died. The source was Chinese laborers brought in to work in the cane fields. To protect the health of the native people, Liliuokalani closed the port. This infuriated the sugar growers, but Liliuokalani stood her ground."

Here is a description [in Queen Liliuokalani's own words:](#)

"BUT there are a few matters of interest during this time of which I must now speak. King Kalakaua had been gone but a few weeks when the startling news was in circulation that the small-pox had broken out in the city. It was supposed to have been introduced from China; but our past experience with the disease had shown us how fatal it might become to the Hawaiian people, and whatever the inconveniences it became necessary at all hazards to prevent its spread. Summoning the cabinet, I had all arrangements perfected to stay the progress of the epidemic. Communication between the different islands of the group was stopped. Vessels were absolutely prohibited from taking passengers. A strict quarantine of all persons infected or under suspicion was maintained; and so scrupulously and energetically were these regulations enforced, that when they were relaxed and quarantine raised, it was found that no case had been reported outside the place of its first

appearance. But it was a serious thing to confine its ravages to the city of Honolulu, in which there were some eight hundred cases and about three hundred deaths.

After the privileges of travel were restored to all alike, I had a desire to visit Hilo again; and so, with a large company of retainers, as was fitting to my regency, I started on this excursion. Mrs. Pauahi Bishop, the Princess Ruth, Mrs. Haalelea, and their immediate attendants, had preceded me; and I invited the Royal Hawaiian Band of native musicians to form part of my retinue, not for my own pleasure especially, although music forms to me a great part of the enjoyment of life, but because I wished to bring with me, to my friends and my people on that island, a delight which I knew to them was quite rare, and in which I was quite sure all would find much satisfaction.

It was in the month of August, six months after I had watched the commencement of that lava flow which is now celebrated in the history of that region of wonders. I found Mauna Loa was still alarmingly active, and that three streams of molten fire were creeping down its sides, so that the good people of Hilo were living in daily apprehension that the fiery element would reach their doors, their houses be consumed, and their lives, perhaps, imperiled by the rivers of flame. It was a grand and beautiful sight, in spite of the suggestion of danger, as you rode along the borders of the lava stream, which had chosen the channels of the watercourses or filled the basins where these had formerly spread themselves out into pools of refreshing fluid; their origin, even when rolling along, or falling as a great cascade into some hollow, which was soon filled up with the melted elements of the earth's centre, making one level plain where had been channels or pits in the earth's surface."

Source: *Hawaii's Story by Hawaii's Queen* by Liliuokalani, Queen of Hawaii (1838-1917). Boston: Lee and Shepard, 1898. (<https://digital.library.upenn.edu/women/liliuokalani/hawaii/hawaii.html>)

3. Explain: Princess Lili'uokalani

- a. What was the Princess response to the threat of a smallpox epidemic in 1881?
- b. How many people on O'ahu became ill? How many died? What is the death rate from the smallpox epidemic?
- c. Compare the death rate of infected people from smallpox compared to current death rate of COVID-19 in the U.S.? See <https://coronavirus.jhu.edu/map.html>.
- d. How does Princess Lili'uokalani show she cares for her people?
- e. How do you know that Princess Lili'uokalani cares about the lands her people depend upon?

4. Elaborate/Extend: Put yourself in the Princess' position.

- a. What were challenges faced by Princess Lili'uokalani in 1881 as she made her difficult decision?
- b. What kind of knowledge do current leaders have that she did not?
- c. What kind of knowledge and values helped her make her decision?
- d. What groups were angry with her decision, what groups were happy?
- e. What do you think of her decision and why?

5. Evaluate: Compare actions of Princess Lili'uokalani to current leaders' actions. If you had to describe her actions in 5 words, what words would you choose? Write a 1-2-page essay on current leaders in Hawaii, in the US, or in other countries. Who do you admire and why? Who do you think is not a good leader and why? Conclude with your definition of a good leader.

LESSON IV. IMPACT OF EPIDEMICS ON HAWAI‘I AND THE HAWAIIAN KINGDOM

This integrated Language Arts, Social Studies, Hawaiian Studies, Health/Science lesson is appropriate for grades 7-12. It should follow Lesson III and is expected to take a minimum of 3 class sessions with 1-2 hours of homework prior to class. More time may be needed based on students' reading level and engagement. Readings present the impacts of introduced diseases and ensuing population, cultural, political and economic changes that threatened the existence of the Hawaiian Kingdom and its people in the 19th century. A class reading presents a call for a return to the principles of Hawai‘i’s ahupua‘a system. The concepts of sustainable, resilient social ecosystems are introduced in the context of deadly epidemics as Hawai‘i opened to the world.



“View of Smallpox Hospital” (Wikipedia Commons)

Time: Three 1- hour class sessions with three 2-hour out-of-class sessions to read and prepare.

DAY 1. CLASS READING

“Hawai‘i’s Mountain-to-Sea Ecosystems: Social–Ecological Microcosms for Sustainability Science and Practice”, by Kenneth Y. Kaneshiro, Pauline Chinn, Kristin N. Duin, Andrew P. Hood, Kepa Maly, and Bruce A. Wilcox

Before class 1, students read the article, search “KSBE ahupuaa maps of Hawaiian islands” to find ahupua‘a map of their island

1. **Describe** an ahupua‘a and how it functions in 5-10 sentences.
2. **Explain** why an ahupua‘a system is a model for sustainability in the past and the present.
3. **Identify** 3 changes described in the article that make Hawai‘i less sustainable
4. **Your personal place: Name** the ahupua‘a you live in, **identify** a place with a problem that makes it less sustainable. **Show it** on a paper map or Google Earth. Justify your choice.
5. **Ahupua‘a and disease:** the article describes a disease. What is it and what human changes in the environment increase the risks for this disease? What diseases of animals or humans in Hawai‘i are due to human activities?

Class 1: “Hawai‘i’s Mountain-to-Sea Ecosystems” and independent reading and research.

Engage:

1. Each student reports in 2-3 minutes: What is your ahupua‘a? How long has your family lived there? What was it like in the past? What is it like now?
2. Students share their description of an ahupua‘a and how it functions.

Explore:

1. Each student reports the place and problem that makes his/her ahupua‘a less sustainable. Each shows a photo of the problems or shows it on a map e.g., Google Earth.

2. Each student identifies 3 changes from article that make Hawai‘i less sustainable.

Explain:

1. Each student explains why s/he chose this place as a problem and briefly explains why using an ahupua‘a approach would prevent it from occurring.
2. What disease does the article describe? What changes in the environment increase the risk for the disease? Share examples where this occurred in Hawai‘i.

Extend/Elaborate: Assume you have the power to make it happen: Apply the ahupua‘a approach to address the problem you identified in your ahupua‘a.

Evaluate: Discuss the problems discussed by peers. Why is an ahupua‘a approach more effective to prevent problems than addressing a problem after it occurs? Is ahupua‘a management easy or is it challenging? What does it need to make it work?

DAY 2 TEAM READINGS

Before Class 2: Students work in pairs or trios to prepare for presentations. Suggested format 5-7 slide Powerpoints.

Class 2

Team 1. Reads, summarizes and presents to class 4-5 key points

“Pacific Island Societies Destabilised by Infectious Diseases” by G. Dennis Shanks MD.

Conclude: How do introduced diseases impact Pacific Island and Hawai‘i’s people, economy, lifestyle, political power, longterm health?

Team 2. Reads, summarizes and presents 4-5 key points

“Death in Hawai‘i: The Epidemics of 1848-1849” by R. C. Schmitt & E. C. Nordyke.

Conclude: How do introduced diseases impact Hawai‘i’s people, economy, lifestyle, political power, longterm health?

Team 3. Reads, summarizes and presents 4-5 key points

“Shutting Down Hawai‘i: A Historical Perspective on Epidemics in the Islands” Herman, D. (March 25, 2020). <https://www.smithsonianmag.com/history/shutting-down-hawaii-historical-perspective-epidemics-islands-180974506/>

Conclude: How do introduced diseases impact Hawai‘i’s people, economy, lifestyle, political power, longterm health?

Team 4. Reads, summarizes and presents 4-5 key points

Smallpox—Mai Puupuu Liilii—Hebela, 1862. <https://nupepa-hawaii.com/2019/05/15/smallpox-mai-puupuu-liilii-hebela-1862/>

Conclude: How do introduced diseases impact Hawai‘i’s people, economy, lifestyle, political power, longterm health?

Team 5. Reads, summarizes and presents 4-5 key points

“The Tragic 1824 Journey of the Hawaiian King and Queen to London: History of Measles in Hawaii” Shulman S.T., Shulman, D.L., Sims RH. (2009).

Conclude: How do introduced diseases impact Hawai‘i’s people, economy, lifestyle, political power, longterm health?

Team 6. Reads, summarizes and presents 4-5 key points

“How measles helped destroy the Hawaiian Monarchy”, Blakemore, E., Feb 5, 2019.

<https://www.history.com/news/hawaii-monarchy-downfall-measles-outbreak>.

Conclude: How do introduced diseases impact Hawai‘i’s people, economy, lifestyle, political power, longterm health?

Team 7. Reads, summarizes and presents 4-5 key points

“Hawaiian history lessons for the present-day pandemic, [Hiraishi](#), K., April 16, 2020.

<https://www.hawaiipublicradio.org/post/hawaiian-history-lessons-present-day-pandemic#stream/0>

Conclude: How do introduced diseases impact Hawai‘i’s people, economy, lifestyle, political power, longterm health?

Elaborate/Extend:

Each Team addresses the following questions followed by class discussion: Think about Princess Lili‘uokalani and the articles you read and shared

1. What are similarities and differences between historical and current epidemics in Hawai‘i?
2. What are roles of government, health, and community leaders past and present in responding to epidemics?
3. What are impacts on economy past and present?
4. What are impacts on people by age, gender, ethnicity, economic class past and present?
5. There are likely to be future epidemics—what do you think is important to do differently next time to protect health and economies in an equitable, fair way?
6. The big picture: What about your *ahupua‘a*? How did the overthrow of the Hawaiian Kingdom impact the cultural systems that controlled human behavior mauka to makai for a sustainable and resilient society?

Class 3 Extension Project:

1. What do know now that you want others to know? How can we learn from the past?
2. Create a poster, Public Service Announcement, short story, poem, song, or skit from the point of view of a person living through an epidemic past or present.
3. Include key concepts and terms from discussions and readings. Share with others in Class 3.

Evaluate: Class discussion and personal journal

1. What does *Lawe li‘ili‘i ka make a ka Hawai‘i, lawe nui ka make a ka haole*. Death by Hawaiians takes a few at a time; death by foreigners takes many” mean after these readings?
2. Each person reports: What are 1-2 things you learned that you didn’t know before?
3. Each person reports: What is a change in your life you want to make to protect others and spread aloha?
4. Each person or team reports: What kind of actions and behavior would you like to see in current leaders?

Teacher Reflection, how could the lesson be more effective? What went well, what would you do differently?



Waikīkī surfboard rentals (Wikimedia Commons)

LESSON V. COVID-19's IMPACT ON TOURISM & THE ECONOMY

Kaleo Hanohano, Kaimuki High School Hospitality Academy

This lesson follows Lesson III. Students need to know that Princess Lili'uokalani made the tough, evidence-based decisions our leaders are making now. The lesson takes 2-3 hours and is appropriate for upper elementary through secondary students. It introduces students to the economic and health impacts associated with COVID-19.

What should I know and do to prevent disease and protect citizens, the tourist industry and Hawai'i?

Preclass reading: As Hawai'i prepares to move out of lockdown, German Lopez' May 22, 2020 article "8 ways to go out and stay safe during the coronavirus pandemic" provides guidelines and videos on handwashing and masks.

https://www.vox.com/21262268/coronavirus-tips-covid-social-distancing-harm-reduction?campaign_id=9&emc=edit_nn_20200526&instance_id=18775&nl=the-morning®i_id=53058918&segment_id=29152&te=1&user_id=b03f46dee3cdb9140b6ac3f8996d79c0

Instructional Activities: Teams each have 2 chart papers and a RECORDER who writes what student know at the start and end of the lesson.

1. Engage: Discuss and/or write

- What do I know about tourism in Hawai'i?
- Who do I know who works in tourism? What does s/he do?
- What are pros and cons about tourism?
- Write for 3 minutes, share with team, then share with class.

2. Explore and Explain

Team 1 View #1: <https://www.khon2.com/coronavirus-2/tourism-officials-discuss-economic-impact-of-coronavirus-in-hawaii/>

Explain Actions to prevent and protect citizens and tourists in Hawai'i? On (1) chart paper the RECORDER will write all the NEW things students NOW know about **coronavirus**.

Team 2 View #2: <https://youtu.be/Fha0m7Wo3F0>

Explain Actions to prevent and protect citizens and tourists in Hawai'i? On (1) chart paper the RECORDER will write all the NEW things students NOW know about **coronavirus**.

Team 3 View #3: <https://www.youtube.com/watch?v=zQCNA7oh-w>

Explain: Actions to prevent and protect citizens, the tourist industry and Hawai'i? On (1) chart paper the RECORDER will write all the NEW things students NOW know about **coronavirus**.

Team 4 View #4: <https://youtu.be/EZtvFKyh5xA>

Explain: Actions to prevent and protect citizens and tourists in Hawai'i? On (1) chart paper the RECORDER will write all the NEW things students NOW know about **coronavirus**.

4. Elaborate/Extend:

- a. Teams 1-4 present what was learned from each video and implications for Hawai'i.
- b. Teams plan presentations to share with others
- c. Teams plan projects to address community needs.

5. Evaluate: Each person reports:

- a. What are 1-2 things you learned that you didn't know before?
- b. Discuss the current shutdowns and the people and businesses most affected.
- c. What are the pros and cons of the shutdown?
- d. What are ways to keep people working and safe?
- e. How have your thoughts about tourism been affected by this lesson?

Teacher Reflection, how could the lesson be more effective? What went well, what would you do differently?

Further reading:

1. Wu, N. (June 29, 2020). Hawaii: Wearing a face mask is showing aloha for others. <https://www.staradvertiser.com/2020/06/29/hawaii-news/hawaii-wearing-a-face-mask-is-showing-aloha-for-others/>
2. Zhang, R., Li, Y., Zhang, A. L., Wang, Y., & Molinara, M. J. (June 2020). Identifying airborne transmission as the dominant route for the spread of COVID-19, *PNAS*; DOI: 10.1073/pnas.2009637117. <https://www.pnas.org/content/early/2020/06/10/2009637117>
3. Common Questions and Answers About COVID-19 for Older Adults and People with Chronic Health Conditions, <https://www.nfid.org/infectious-diseases/common-questions-and-answers-about-covid-19-for-older-adults-and-people-with-chronic-health-conditions/>

CDC Do it yourself: "How To Make Cloth Face Coverings: Sew and No Sew Instructions" <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/how-to-make-cloth-face-covering.html>

LESSON VI. HOW DO VIRUSES JUMP FROM ANIMALS TO HUMANS?

This grade 4-12 lesson follows Lesson I or could be stand-alone. It builds on a 5-minute video showing how viruses can be transmitted to humans from animals (and vice versa). The transcript at the end of the lesson supports ELLs and younger readers and can accompany video, peer, and teacher discussions.



In 1881 Princess Lili‘uokalani controlled human behavior to control the spread of smallpox.

Similarly, social distancing and self-quarantine

are practices to control COVID-19, caused by an RNA coronavirus related to SARS and MERS.

Though less deadly than SARS and MERS it spreads easily, is more deadly than seasonal flu and so far has no vaccine. Since its discovery it has mutated, easing the transfer among people. See “This coronavirus mutation has taken over the world. Scientists are trying to understand why,”

<https://www.washingtonpost.com/science/2020/06/29/coronavirus-mutation-science/?arc404=true>.

Viruses mutate constantly. Horseshoe bats host two coronaviruses closely related to SARS-CoV-2. RATG13 was found⁸ in horseshoe bats (*Rhinolophus affinis*) in the southwestern Chinese province of Yunnan in 2013. Its genome is 96% identical to that of SARS-CoV-2 (*Nature*, July 3, 2020). A mutation may change a surface protein, allowing an animal virus to enter human cells where it reproduces then infects other people. Human flu infected pigs in 1998 causing widespread disease; horse flu can cause outbreaks in dogs (www.cdc.gov/flu/other/index.html). Birdpox introduced by foreign birds threatens our native birds.

Our pet dogs are vaccinated for distemper, a DNA virus that also infects seals. Hawai‘i’s endangered monk seals are the first wild species to be vaccinated to prevent disease. Studies show frequent contacts among seals so at least 50% of the 1,300 seals must be vaccinated for *herd immunity*, when spread stops. “Monk Seal Vaccinations,” www.youtube.com/watch?v=MqggRK7a-MY presents concepts and terminology about vaccination in the context of wildlife conservation.

1. Engage: Individual comments

- What do you know about COVID-19?
- Where did it begin?
- How does it spread?
- Do you know anyone impacted by COVID-19?
- How can the spread of COVID-19 be controlled?

2. Explore: Watch and Read the Transcript: “How do viruses jump from animals to humans?”

https://www.ted.com/talks/ben_longdon_how_do_viruses_jump_from_animals_to_humans/transcript/#t-155581

3. Explain: Pair up to watch the video and read the transcript until you agree on questions below.

- What kind of disease infected 40 people at the Maryland Country Fair?
- What were the symptoms of sick animals?

- c. How are the viruses transmitted to people?
- d. What 3 steps occur for viruses to successfully transfer to the human host?
- e. What host system does the virus enter and take over?
- f. What system protects the host from most viruses?
- g. What change in the genetic material of the virus enables it to infect the host?
- h. Is it easier for a virus to move to a human from a chicken or a chimpanzee? Explain.
- i. What kind of medication protects people from viral attack?
- j. A new viral disease may occur at any time. How do medical personnel find out?

4. Elaborate/Extend

- a. Class discussion: How do you prevent picking up viruses or transferring a virus?
- b. How do people affect the frequency of disease outbreaks? What is the relationship between climate change and infectious diseases? What are possible solutions? See and discuss https://www.youtube.com/watch?v=4J1AqK0ayTE&feature=emb_rel_end
- c. Read and report: Curious about viruses that move between animals and people? Create a class list of viral diseases, see list of select a virus to study, share your findings with the class.
- d. Read and report: Curious about public health specialists who study emerging epidemics and virologists who study viruses? Select someone to study, share your findings with the class.
- e. Invite a public health speaker to your class.
- f. Prepare public service announcements or share what you're learning with parents and other students.

5. Evaluate:

- a. What are 3 things you learned?
- b. What changes in your behavior could you make to protect yourself and others and spread aloha?

TRANSCRIPT: How do viruses jump from animals to humans?

https://www.ted.com/talks/ben_longdon_how_do_viruses_jump_from_animals_to_humans/transcript/#t-155581

At a Maryland Country Fair in 2017, the prize pigs were not looking their best. Farmers reported feverish hogs with inflamed eyes and running snouts. But while fair officials worried about the pigs, the Maryland Department of Health was concerned about a group of sick fairgoers. Some had petted the pigs, while others had merely been near their barns; but soon, 40 of these attendees would be diagnosed with swine flu. More often than not, sick animals don't infect humans. But when they do, these cross-species infections, or viral host jumps, have the potential to produce deadly epidemics. So how can pathogens from one species infect another, and what makes host jumps so dangerous?

Viruses are a type of organic parasite infecting nearly all forms of life. To survive and reproduce, they must move through three stages: 1) contact with a susceptible host, 2) infection and replication, and 3) transmission to other individuals. As an example, let's look at human influenza. First, the flu virus encounters a new host and makes its way into their respiratory tract. This isn't so difficult, but to survive in this new body, the virus must mount a successful infection before it's caught and broken down by an immune response.

To accomplish this task, viruses have evolved specific interactions with their host species. Human flu viruses are covered in proteins adapted to bind with matching receptors on human respiratory cells. Once inside a cell, the virus employs additional adaptations to hijack the

host cell's reproductive machinery and replicate its own genetic material. Now the virus only needs to suppress or evade the host's immune system long enough to replicate to sufficient levels and infect more cells. At this point, the flu can be passed on to its next victim via any transmission of infected bodily fluid.

However, this simple sneeze also brings the virus in contact with pets, plants, or even your lunch. Viruses are constantly encountering new species and attempting to infect them. More often than not, this ends in failure. In most cases, the genetic dissimilarity between the two hosts is too great. For a virus adapted to infect humans, a lettuce cell would be a foreign and inhospitable landscape.

But there are a staggering number of viruses circulating in the environment, all with the potential to encounter new hosts. And because viruses rapidly reproduce by the millions, they can quickly develop random mutations. Most mutations will have no effect, or even prove detrimental; but a small proportion may enable the pathogen to better infect a new species. The odds of winning this destructive genetic lottery increase over time, or if the new species is closely related to the virus' usual host. For a virus adapted to another mammal, infecting a human might just take a few lucky mutations. And a virus adapted to chimpanzees, one of our closest genetic relatives, might barely require any changes at all.

It takes more than time and genetic similarity for a host jump to be successful. Some viruses come equipped to easily infect a new host's cells but are then unable to evade an immune response. Others might have a difficult time transmitting to new hosts. For example, they might make the host's blood contagious, but not their saliva. However, once a host jump reaches the transmission stage, the virus becomes much more dangerous. Now gestating within two hosts, the pathogen has twice the odds of mutating into a more successful virus. And each new host increases the potential for a full-blown epidemic.

Virologists are constantly looking for mutations that might make viruses such as influenza more likely to jump. However, predicting the next potential epidemic is a major challenge. There's a huge diversity of viruses that we're only just beginning to uncover. Researchers are tirelessly studying the biology of these pathogens. And by monitoring populations to quickly identify new outbreaks, they can develop vaccines and containment protocols to stop these deadly diseases.

Further Reading:

1. 11 (sometimes) deadly diseases that hopped across species
<https://www.livescience.com/12951-10-infectious-diseases-ebola-plague-influenza.html>
2. New strain of swine flu virus spreads to humans in China:
<https://www.staradvertiser.com/2020/06/30/breaking-news/new-strain-of-swine-flu-virus-spreads-to-humans-in-china/>
3. Why are bat viruses so deadly?
<https://www.sciencedaily.com/releases/2020/02/200210144854.htm>
4. Coronavirus rips through Dutch mink farms, triggering culls to prevent human infections.
https://www.sciencemag.org/news/2020/06/coronavirus-rips-through-dutch-mink-farms-triggering-culls-prevent-human-infections?utm_campaign=news_daily_2020-06-10&et rid=17161429&et cid=3361155
5. No sign of injury after Kona monk seal chased by unleashed dogs
<https://www.hawaiitribune-herald.com/2020/05/04/hawaii-news/no-sign-of-injury-after-kona-monk-seal-chased-by-unleashed-dogs/>
6. Expert: To prevent pandemics like COVID-19, 'take care of nature'
<https://www.conservation.org/blog/expert-to-prevent-pandemics-like-COVID-19-take-care-of-nature>

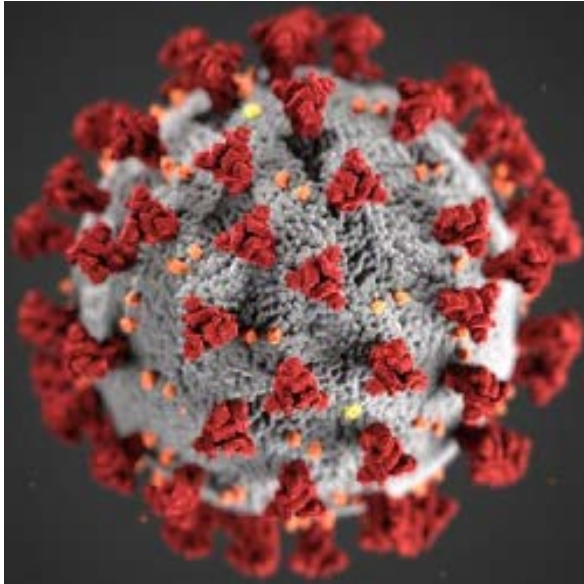


Image: SARS-CoV-2, Wikimedia Commons

LESSON VII. VIRAL PANDEMICS: CONCEPTS, NEW TOOLS, SOLUTIONS

Kyle, Kolomona, Nakatsuka, Pauline W. U. Chinn

This lesson is recommended for middle and high school students in life science, biology, health and math classes. It is designed for 2-3 class sessions with homework to read articles, view videos, conduct independent research, and develop presentations. Students learn and apply key concepts in biology, chemistry, epidemiology, health and social science and use current data from news articles, videos and websites to develop health literacy, participate as citizen scientists, and make decisions to contribute to healthier, more resilient communities.

This lesson should be preceded by at least one lesson or a few readings to introduce historical epidemics in Hawai‘i and the role of leaders in policy-making to reduce spread of diseases. Prior knowledge of historical practices of monitoring, decision-making, and actions necessary for sustainable and resilient communities provides a perspective on COVID-19. As information on the spread of COVID-19 locally, nationally, and globally and vaccine development changes rapidly, educators are strongly encouraged to update readings, videos, and inquiry activities.

Homework before Class 1: (2 hours) Anchoring Phenomena students read and view, take notes, write questions to discuss in class

1. **View: How Pandemics Spread** (5 min.) <https://www.youtube.com/watch?v=UG8YbNbdaco>
2. **Read:** How Bad Will the Coronavirus Outbreak Get? Here Are 6 Key Factors: <https://www.nytimes.com/interactive/2020/world/asia/china-coronavirus-contain.html>.
3. **Explore:** COVID-19 Coronavirus Pandemic <https://www.worldometers.info/coronavirus/>

DAY 1 Activities (2 hours)

1. Engage (15 min):

- a. What do you know about the current COVID-19 pandemic in Hawai‘i?
- b. Where and how did it originate, how did it spread?
- c. Do you know anyone who has contracted COVID-19?

4. Explore (30 min):

- a. Discuss key points from video “How Pandemics Spread”
- b. Teacher introduces the website for current statistics for the COVID-19 pandemic at: <https://www.worldometers.info/coronavirus/> (high school classes should also use <https://ourworldindata.org/covid-testing>)
- c. Students explore the website on their own for 5 minutes then return to share 1) one important new fact they learned from the website, and 2) one thing they still don’t understand and/or want to learn more about.

- d. Why in new and rapidly changing situations is current information necessary for decision-making? Provide some examples of use of data in this or other crises.

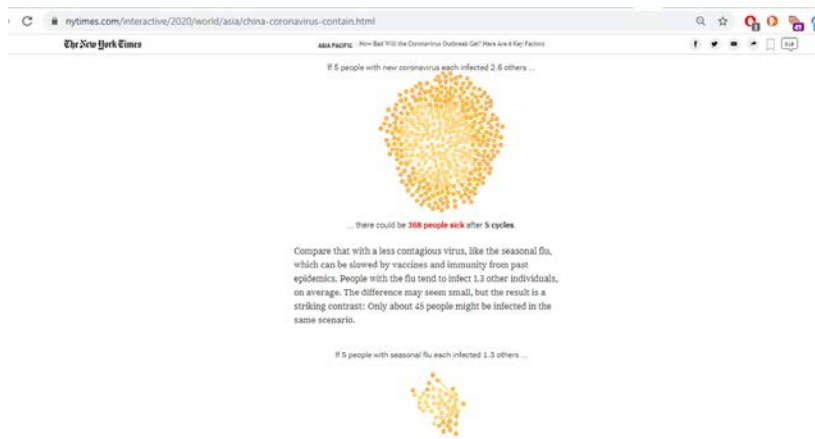
3. Explore/Explain (30 min):

- a. Display the graphics at: <https://www.nytimes.com/interactive/2020/world/asia/china-coronavirus-contain.html>. Section 1 of article introduces the concept of the **Basic Reproductive Number R_0** , R nought, the average number of new people who will pick up the disease from a sick person. This tells you how contagious the disease is.

Students estimate how many people they get closer to than 6 ft for more than 1 minute each day. They imagine they are asymptomatic COVID-19 carriers then estimate how many people they might infect.

- b. Display and study the graphics in the New York Times article <https://www.nytimes.com/interactive/2020/world/asia/china-coonavirus-contain.html>

Find the Basic Reproductive Number for COVID-19 R_0 compared to **seasonal flu** then compare how many people you might infected if you carry the COVID-19 virus compared to the number infected if you are a carrier of seasonal flu. Note, a recent mutation appears to increase the **R_0** .



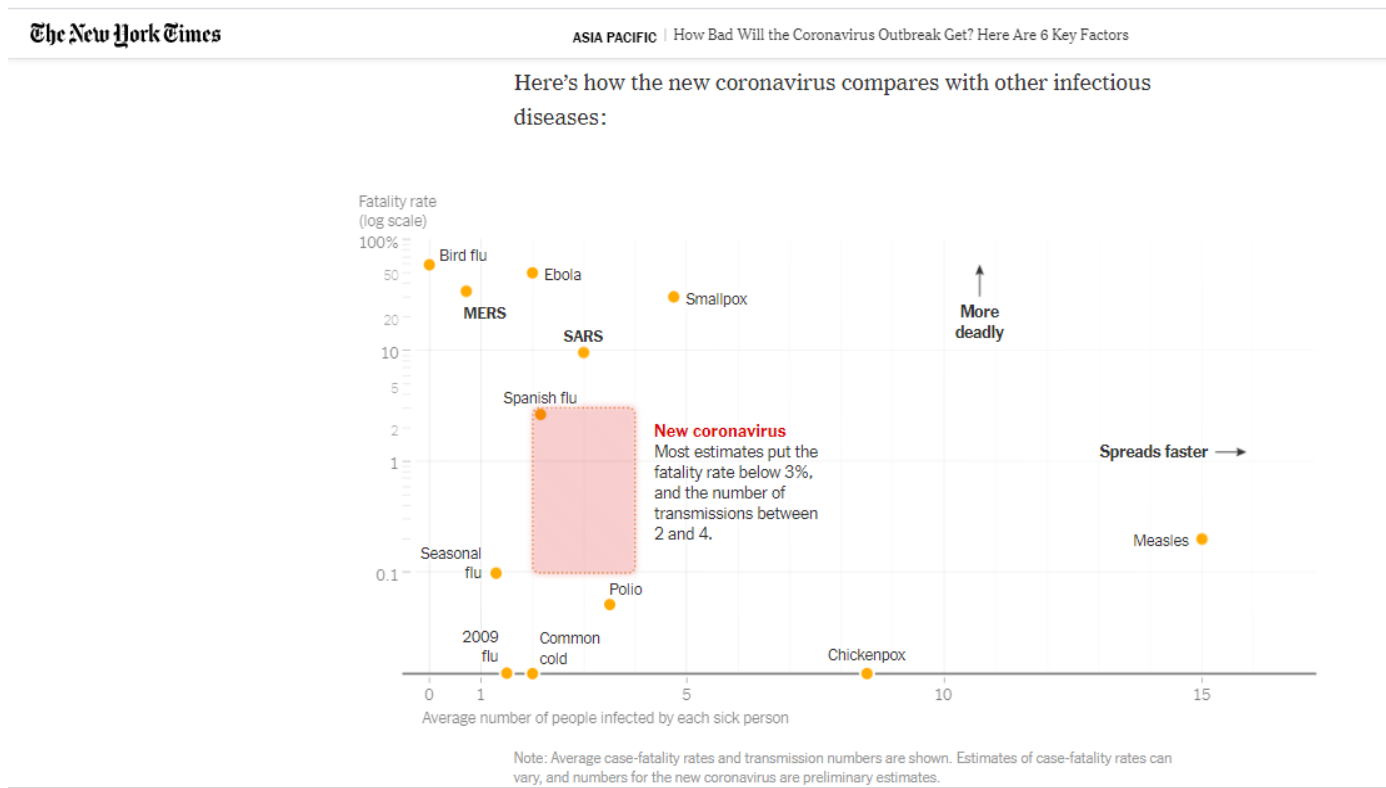
- c. Read Section 2 of the article: concept of **Fatality Rate**, the percentage of people who die from the COVID-19 or other virus: <https://www.worldometers.info/coronavirus/>.

Compare the number of deaths to the number of cases and calculate the fatality rate by dividing the number of deaths by the number of cases.

- Why might this rate not represent the **actual fatality rate**? What kind of data is needed?
- Are Fatality and Basic Reproductive Rates the same for **all** groups of people? Explain.

4. Extend/Elaborate: (30 min.)

- a. Examine the data and graph in the articles
<https://www.nytimes.com/interactive/2020/world/asia/china-coronavirus-contain.html>
- b. Compare COVID-19’s Basic Reproductive Value (x axis-average number infected by each sick person) and Fatality Rate (y-axis).
- c. Which disease is most like COVID-19? Why is COVID-19 represented by an area instead of a point? (Note: Fatality Rate on y axis is on a logarithmic scale.)
- d. Using Fatality Rate (y axis) which 5 viral diseases have the highest fatality rates? Which 5 have the lowest fatality rates?
- e. Using Fatality Rate and Basic Reproductive Values, which do you think are **most dangerous** as pandemics? Explain your answer.
- f. Using Fatality Rate and Basic Reproductive Values, which do you think are **least dangerous** as pandemics? Explain your answer.
- g. Using Fatality Rate and Basic Reproductive Values, which do you think are **least dangerous** as a pandemic? Explain your answer



Student rate: Subscribe for \$1 a week until you graduate.

Evaluate: 1st day Exit pass/student share (15 min.)

1. “How do you understand the COVID-19 pandemic now based on the information you gained from this lesson?”
2. What do you think we need to do in Hawai‘i as tourism and air travel begin without a vaccine?

DAY 2 HOMEWORK (2 hours) COVID-19 monitoring and search for vaccines

1. **Read** “Coronavirus doubters follow climate denial playbook,” Dana Nuccitelli, <https://www.yaleclimateconnections.org/2020/04/coronavirus-doubters-follow-climate-denial-playbook/>
2. **COVID-19 in Hawai‘i and the US:**
 - a. Hawaii COVID-19 Dashboard: <https://health.hawaii.gov/coronavirusdisease2019/what-you-should-know/current-situation-in-hawaii/>
 - b. The color of coronavirus: COVID-19 deaths by race and ethnicity in the U.S. (Updated biweekly): <https://www.apmresearchlab.org/covid/deaths-by-race>
 - d. The race for coronavirus vaccines, vaccine basics: How we develop immunity, 2 page diagram: <https://media.nature.com/original/magazine-assets/d41586-020-01221-y/d41586-020-01221-y.pdf>
 - d. King, A. (June 29, 2020). Explainer: how is the vaccine pipeline for Covid-19 looking? Short, clear explanation of vaccines, how they work, most promising under development. https://www.chemistryworld.com/news/explainer-how-is-the-vaccine-pipeline-for-covid-19-looking/4012068.article?utm_source=Nature+Briefing&utm_campaign=c5d6755ef4-briefing-dy-20200629_COPY_01&utm_medium=email&utm_term=0_c9dfd39373-c5d6755ef4-42672195

DAY 2 Learning Activities (2 hours)

1. **Engage:** What surprised you the most from your readings? Did you speak to anyone about what you’re learning? What did you discuss? How did they respond?
2. **Explore/Explain:**
 - a. Hawai‘i: explore Dashboard: Maps, Epicurve, Lab testing, Age, Race
 - What do the maps indicate about spread of COVID-19? What are reasons for hot spots?
 - What does the epicurve data suggest is happening in Hawaii over time?
 - Which ethnic groups and age groups are most at risk? What might be reasons for patterns?
 - List 10 important people in your life: put them into risk categories, some may have multiple risks. Now rank them from highest to lowest risk. Share your list with others. Math application: for your class, decide the best ways to convey your data to others.
 - If you were an epidemiologist advising state policy makers to family members what would you recommend?
 - Share observations: What do you notice about people’s behavior?
 - Analyze: Are most people following recommended guidelines?
 - What could be done to increase compliance? Consider a broad range of strategies.
 - b. Color of coronavirus: discuss national and state patterns of COVID-19 impact on different races nationally and by state.
 - Which states and racial groups suffer highest fatality rates and Rnought?
 - What may be contributing health, cultural, political, and demographic factors?
 - Discuss the role of values and ideology in public health decisions and outcomes.
 - c. How do vaccines develop immunity? Read <https://www.cdc.gov/vaccines/parents/why-vaccinate/vaccine-decision.html> and <https://media.nature.com/original/magazine-assets/d41586-020-01221-y/d41586-020-01221-y.pdf>

Describe how vaccines work using words such as *virus*, *receptor*, *nucleus*, *replication*, *release*, *immune system*, *immune response*, *antigen*, *antibody*, *memory cells*, *immunity*.

- What is *herd immunity*? What are 2 ways it can be achieved in a population?
- What level of *herd immunity* may be needed for COVID-19? If it mutates to be *more* contagious does *herd immunity* need to be higher or lower?
- What considerations lead to decisions to create a vaccine? Explain your reasoning.
- Based on what you know, explain why/why not you'd be willing to be vaccinated against the coronavirus that causes COVID-19.

3. Extend/Elaborate: Discuss the role of public health in *resilience*, defined as the ability to respond to changes before a crisis occurs. Think about leaders in the past and present who cared for the people and the land in good and bad times. Discuss in context of articles “Coronavirus doubters follow climate denial playbook” and students’ sharing of prior knowledge of Hawaiian practices to maintain sustainable, resilient communities and ecosystems.

- a. Why is constant observation, monitoring, analysis, and decision-making needed to maintain a sustainable, resilient society? Share what you know about Hawaiian practices oriented to sustainability.
- b. How do local, national, and international politics impact public health and climate change policies?
- c. At the end of a sustainability science class a teacher said when his 4th grade students studied an environmental issue, he'd ask, “*What would a Hawaiian do?*” What do you think he meant?
- d. How does this teacher’s personal ‘*ōlelo no ‘eau* apply to the health and resilience of communities here and globally?
- e. What is one thing you could do for a more sustainable, resilient community?

4. Evaluate: Final Discussions

- a. Each student asks a question or makes a comment, discuss briefly as time allows.
- b. Each student states 1 change in behavior based on what’s learned from class.
- c. **Exit pass/student journal**
How do you understand the COVID-19 pandemic now based on this lesson?
How can you help in the fight against COVID-19?
Will this be the last pandemic? Explain your reasoning.

Teacher Reflection, how could the lesson be more effective? What went well, what would you do differently?

Further reading:

1. Why are bat viruses so deadly?
<https://www.sciencedaily.com/releases/2020/02/200210144854.htm>
2. Past plagues offer lessons for society after the coronavirus pandemic.
https://www.sciencenews.org/article/coronavirus-covid-19-ancient-plagues-pandemics-lessons-society?utm_source=Editors_Picks&utm_medium=email&utm_campaign=editorspicks052420
3. Wolfe, J. (July 9. 2020). Coronavirus briefing: What happened today.
<https://www.nytimes.com/2020/07/09/us/coronavirus-briefing-what-happened-today.html>

LESSON VIII. SUSTAINABILITY AND RESILIENCE: LESSONS FROM 6 TONGAN TEENAGERS

In 1965, 6 Tongan teenagers decided to cut out from school. They stole a boat to travel to Fiji. Instead, they were caught in a storm and shipwrecked on an unknown island, Ata, kapu after slavers captured villagers in 1863. They survived for 15 months as families gave up hope and their funerals were held in Tonga.



1. **Engage:** Have you ever been lost? What did you do? How would you survive if you were lost for a week without food and water?

2. **Explore:** View <https://www.youtube.com/watch?v=DYebOCCoTYM>

3. **Explain:**

- What basic skills helped the boys survive for 3 months?
- What cultural knowledge and practices helped them survive for the next 12 months?
- What values did they hold and act upon for the entire 15 months?
- What ancestral knowledge helped them survive?
- Why is it important to teach ancestral knowledge even if not usually practiced?
- How does their mini-society demonstrate resilience?
- How does their mini-society demonstrate sustainability?
- What message does the boys' survival hold for us today?

4. **Extend/Elaborate**

- Choose one of the questions, write for 5-10 minutes then share. Your thoughts are most important, don't worry about grammar and spelling.
 - What would I like to see happen in my school or community to make it more sustainable and resilient?
 - What actions can I take so my immediate surroundings become more sustainable and resilient?
- Propose, design, develop and carry out a project that helps you, your family, school, or community become more sustainable and resilient.

5. **Evaluate: Teacher and students**

What how could the lesson be more effective?

What went well, what would you do differently?

Teacher Reflection, how could the lesson be more effective? What went well, what would you do differently? How could you revise your curriculum and pedagogy towards the goals of sustainability and resilience?

Further reading:

Hamilton, S. (May 24, 2020). The curious case of the castaways on an island in Tonga.

<https://www.newsroom.co.nz/2020/05/19/1175166/the-curious-case-of-the-castaways-on-an-island-in-tonga>

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