

DISPERSAL BINGO

Grade 4



‘Ōhi‘a Project / Exploring the Islands

Essential Questions

- How did the ancestors of native plants and animals reach the isolated Hawaiian Islands?
- What characteristics enabled colonizing species to cross the Pacific Ocean and reach Hawai‘i?

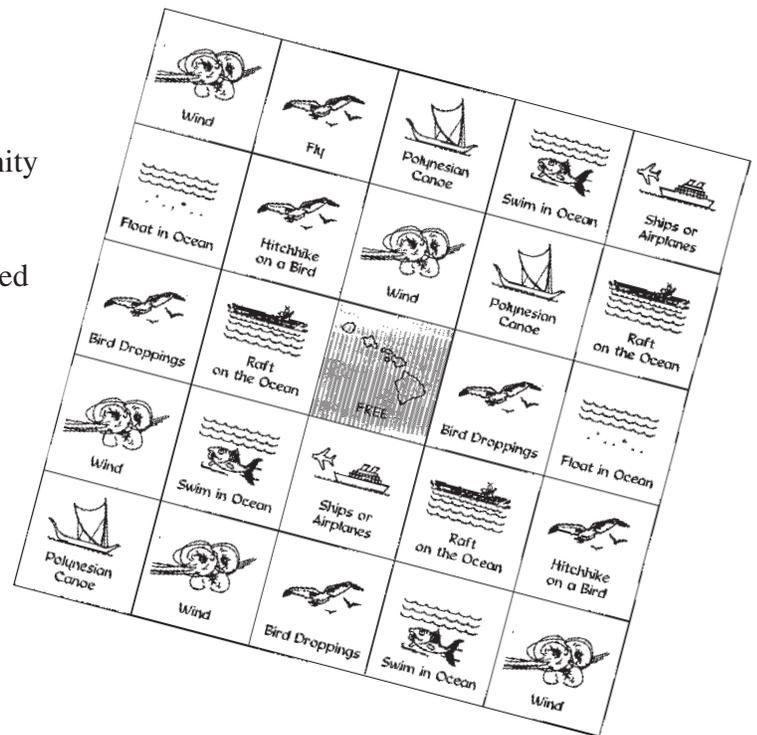
Hawai‘i DOE Content Standards and Performance Indicators

Science: Organisms and Development—Unity and Diversity:

- Examine the unity and diversity of organisms and how they can be compared scientifically.
- Describe the structure and function in living things.

Key Concepts

- Due to the extreme geographic isolation of Hawai‘i, relatively few plants and animals were able to reach and successfully colonize the islands.
- Successful colonizing species had characteristics such as small size, resistance to temperature extremes, or the ability to fly, swim or float long distances.



Activity at a Glance

Students collect and categorize seeds and play a game to discover how plants and animals reached the Hawaiian Islands, and what characteristics enabled their dispersal.

Exploring the Islands Telecast: “Wind, Waves and Wings”

Students from Waimānalo Elementary School discover how the ancestors of native plants and animals reached Hawai‘i. A surprise appearance by “Liz,” the alien anole lizard, helps students distinguish between native and alien species. During the program, students play a Dispersal Bingo game to reinforce what they have learned.

Assessment

Students:

- Classify various seeds according to their potential mode of dispersal and describe characteristics or structures that enabled that type of dispersal.
- Write a summary of how plants and animals reached the Hawaiian Islands that includes:
 - a) examples of at least two characteristics that successful native colonizers had for each mode of dispersal
 - b) examples of types of plants and animals that could not reach Hawai‘i without human assistance and the factors and characteristics that prevented their dispersal.

Time

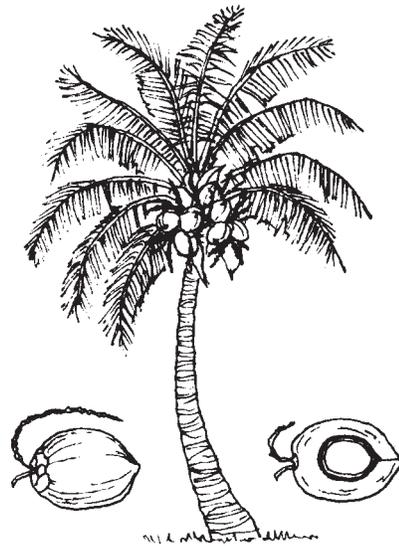
two–three class periods

Materials/Resources

map of Hawai‘i and the Pacific (provided)
answer sheet (provided)
plant and animal cards (provided)
scissors
ruler
scotch tape
sheets of acetate (optional)

During the *Exploring the Islands* telecast:

student activity sheet (provided)
beans or buttons (20 per student)
clear container filled with water (to test seed flotation)
four labels: 1) WIND, 2) WAVES, 3) WINGS, and 4) PEOPLE
seeds (students collect from home and bring to class)



Preparation

Make a copy of the student activity sheet for each student and gather the beans or buttons (about 20 per student) to play the Dispersal Bingo game. Make four labels, one with each of the following words: WIND, WAVES, WINGS and PEOPLE. If you don't have projection capability from your computer, copy the Pacific map and the plant and animal cards onto acetate to use as a transparency with an overhead projector.

Vocabulary

native, introduced, alien, isolation, dispersal, rafting, endemic, indigenous

Teacher Background Information

Located more than 3,200 km (2,000 mi) from the nearest large land mass, the Hawaiian Islands are the most isolated group of high islands in the world. Due to this extreme **isolation**, relatively few plants and animals reached and colonized Hawai‘i before the arrival of humans. Scientists studying dispersal, estimate that most of the original colonizing species (65%) originated from Southeast Asia. Approximately 25 percent of the colonizing species are believed to have originated in North America. The successful colonizers that arrived in the islands without human assistance are referred to as **native** species. Those species that occur only in Hawai‘i are **endemic**. Native species that occur naturally in Hawai‘i, as well as other areas, are referred to as **indigenous**. The ancestors of native organisms arrived by WINGS (in birds’ digestive tracts or by attaching to birds), by WIND (flying or floating on air currents), or by WAVES (swimming, floating, or **rafting** in ocean currents).

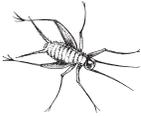
The successful dispersal of native species to the islands was due in large part to chance, and to the characteristics of the colonizers. Plants that survived the long journey across the Pacific had seeds that were tolerant to salt water or small enough to be carried in the wind, or in a bird’s digestive tract. Successful colonizers included seeds and snails that could stick to a bird’s feathers or float on a raft of vegetation, and animals that could fly or be carried in the wind, such as birds, bats, and small insects and spiders.

Hawai‘i’s marine environment was colonized by animals, including turtles, monk seals, fishes and mollusks that swam or drifted to the islands. Hawaiian freshwater organisms drifted on ocean currents and probably evolved from the larvae of similar species inhabiting streams on high islands elsewhere in the Pacific. The chart on the following page outlines how plants and animals reached the islands.

Scientists studying Hawaiian biota estimate that plant and animal colonists were limited to 280 flowering plant species, 135 non-flowering plant species, 20 bird species, 300–400 arthropod species, including insects and spiders, 22–24 snail species and 2 mammal species. Based on these figures, a plant would have successfully colonized Hawai‘i once every 118,000 years! This approximate figure is determined by dividing the age of the oldest island, Kure (33 million years), by the number of colonizing plant species. Plants and animals that reached the Hawaiian Islands at least 33 million years ago could disperse from one island to another as new islands were created over the hot spot. A study of the evolution of the pomace flies indicates life may have started on an island that is now a submerged guyot, which is 40 million years old.

When people arrived in Hawai‘i, they **introduced** plants and animals from all over the world. Polynesians carried with them pigs, dogs, chickens, and approximately 30 plants that were useful as food, fiber and medicines. Since the arrival of Captain Cook, people have introduced thousands of species, many of which have a devastating impact on native environments. Some were introduced intentionally and others inadvertently (e.g., as stowaways on boats or jets). Today, Hawaiian lowland environments are dominated by these **alien** plants and animals introduced by people.

How Did Plants and Animals Get to the Hawaiian Islands?

Kind of Organism	Travel Method	Problems They Had	Why They Succeeded
seed, snail, insect 	attaching to a bird (on feathers or in mud on feet)	<ul style="list-style-type: none"> • could fall off over long distance • lack of food, water • cold wind 	<ul style="list-style-type: none"> • small size • sticky or small hooks to hang on • resistant to cold
seabird or migratory bird (such as kōlea) or insect (dragonfly)	flying 	<ul style="list-style-type: none"> • long distance • lack of food • cold wind 	<ul style="list-style-type: none"> • strong flyers • resistant to temperature extremes
seed, land bird, spider, insect, small mammal (bat) 	carried by wind	<ul style="list-style-type: none"> • long distance • lack of food • freezing jet stream • intense sunlight 	<ul style="list-style-type: none"> • resistant to temperature extremes • protective covering (seed) • small size • light weight
seed 	carried inside a bird	<ul style="list-style-type: none"> • long distance • bird may void over ocean 	<ul style="list-style-type: none"> • small size • attractive to birds • “fertilizer” to land in
seed, insect*, snail* 	rafting on branch in ocean	<ul style="list-style-type: none"> • long distance • rough seas could overturn branch • salt water • intensity of sunlight 	<ul style="list-style-type: none"> • resistant to temperature extremes • protective covering • ability to bore into wood (insect) • ability to stick onto branch (snail)
seed 	floating on ocean	<ul style="list-style-type: none"> • long distance • salt water • intensity of sunlight 	<ul style="list-style-type: none"> • ability to float • protective covering • resistant to temperature extremes
marine mammals 	swimming in ocean	<ul style="list-style-type: none"> • long distance 	<ul style="list-style-type: none"> • migratory • strong swimmers
* Eggs of insects and snails may be found in mud on birds’ feet or on a branch rafting in the ocean; eggs must be resistant to drying and temperature extremes			

Teaching Suggestions

1. Ask students to collect the following types of seeds and bring them to class: a) seeds that can float in water; b) seeds that stick; c) seeds that are light enough to float in the air; d) edible seeds or fruit.
2. Use the Pacific map to establish the geographic isolation of Hawai‘i. Ask students to examine the seeds they collected and select those that could have traveled to the islands. (Most of the seeds students collect around their homes will be of alien species, but they can hypothesize what types of seeds could have survived the journey.)
3. Challenge students to identify some of the characteristics that may have enabled a seed to survive the journey to Hawai‘i, such as light weight, small size, or protective coating.
4. Discuss dispersal of animals to Hawai‘i.

Discussion Questions

- How did animals reach the Hawai‘i?
 - What were some of the challenges that animals faced in reaching the islands?
 - What characteristics would enable an animal to reach Hawai‘i? What characteristics would prevent successful dispersal?
5. Place each of the WIND, WAVES, WINGS and PEOPLE labels on a small table or desk. Distribute the materials students will need for *Exploring the Islands* (an activity sheet and 20 beans or buttons to each student), and watch the telecast.

During the *Exploring the Islands* Telecast “Wind, Waves, Wings”

***Mystery Minute* Question for this week**

How could the same plants grow naturally on the Hawaiian Islands and on islands far away?

***MindPower Minute* Question**

What does the discovery of a hala fruit imprint in an old lava flow on Kaua‘i tell us?

Student Activities

- Sort seeds into categories and list seed characteristics.
- Play Dispersal Bingo using the student activity sheet and the buttons or seeds as markers.

Mahalo to...

Waimānalo Elementary School for assisting with *Exploring the Islands*!

Teachers: Fern Agunat, Lorna Kawakami, Noelani Koch

Students: Kamani Dudoit, Sharray Galdeira, David Horde-Bailey, Rodel Rodriguez

6. After the telecast, play Dispersal Bingo again using the plant and animal cards provided with this activity. After students place a marker on their bingo sheets, ask students for the answer and have everyone remove all incorrectly placed chips. Discuss their answers. Continue projecting plant and animal images until someone declares “Bingo!” by having a vertical, horizontal or diagonal line of chips on the sheet.
7. Check for accuracy and write the winning names on the board. As students complete their sheets, they should remove all chips and start playing again. Continue the game until all students have “won” one or more times or all of the pictures have been displayed.
8. Discuss the dispersal of native Hawaiian plants and animals. Explain that the plant and animal pictures are of organisms that exist today and not necessarily the ancestors, which originally colonized the islands.

Discussion Questions

- Why did only two mammals reach Hawai‘i?
 - Which groups of animals never reached Hawai‘i? (land reptiles, amphibians and large land mammals) Why?
 - Where do you think native Hawaiian plants and animals came from?
 - What characteristics allowed plants and animals to reach Hawai‘i on their own?
 - What do the categories “endemic” and “indigenous” mean?
9. Ask students to complete the assessment activity summarizing the characteristics of successful colonizers and their dispersal methods, and the characteristics that prevented the dispersal of non-native species.

Extended Activities

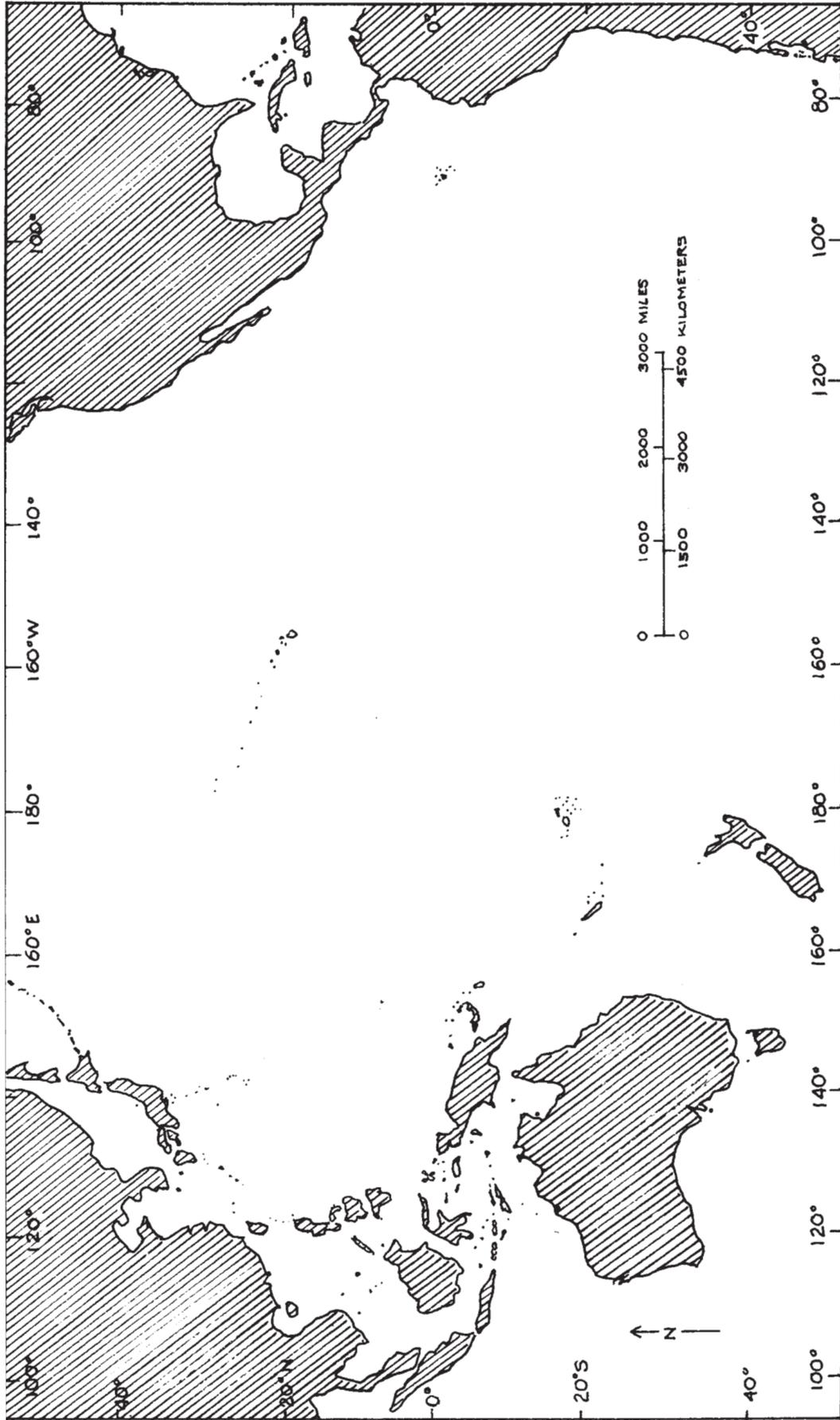
- Play a Bonus Round of Dispersal Bingo. Have students each make a bonus sheet, numbered vertically from 1–10 with three columns: 1) Organism, 2) Structure, and 3) Function. Choose ten organisms from the game. One at a time, show the plant or animal’s picture and give students 10 seconds to list a structure and its function that enabled the species’ dispersal, for example: ‘ōhi‘a – small seed – disperse in wind. When the sheets are completed, have students exchange bonus sheets with a classmate and check for accuracy. Award five points for each correct structure and five points for each correct function listed.
- Play a dispersal funnel game. “Dispersal funnel” refers to the concept of there being a diminishing number of successful landfalls of species the farther you get from a source area. Draw a circle on the classroom floor to represent Hawai‘i. Position students around the classroom as the various land bodies located in and around the Pacific. Students may use a variety of materials to represent organisms. (For instance a tiny wad of paper could be an insect or a paper airplane could be a bird.) Have students roll, toss or fly their objects

to the circle representing the Hawaiian Islands. Add the jet stream factor by positioning a fan to blow over the circle. How many organisms successfully land in Hawai‘i? How does distance from the islands or the direction of the jet stream affect dispersal? (Adapted from an activity of Ina Oshiro from Moanalua Gardens Foundation Teachers’ Workshop, July 1987.)
Note: This activity presumes only one dispersal scene. In actuality, organisms (and their descendants) would have had to survive several dispersals to reach Hawai‘i.

- Challenge students to create an imaginary animal that could live in Hawai‘i and describe how it might have dispersed to the islands. Include physical attributes that would help it survive a journey across the Pacific Ocean.
- Have students select one of the species from the Dispersal Bingo game and conduct research to discover how Hawaiians used the species for food, fiber, medicines, or dyes.

Map of Hawai'i and the Pacific

Dispersal Bingo



Organism

Method of Ancestor's Disperal

monk seal
 goby fish ('o'opu nākea)
 stream snail (hīhīwai)
 kōlea (bird)
 damselfly
 'i'iwi (bird)
 āholehole (fish)
 coconut
 pomace fly
 koa (branch with seeds)
 naupaka kahakai (plant)
 naio (plant)
 tree snail
 tree fern (hāpu'u, spores)
 bat
 happy-face spider
 koa haole (plant)
 wrinkled frog
 'ōhi'a (seeds)
 'ie'ie fruit (seeds)
 taro (kalo)
 sweet potato plant ('uala)
 carnivorous caterpillar
 lava cricket



swim in ocean
 larvae float in ocean
 larvae float in ocean
 fly
 jet stream or storm
 fly, jet stream, or storm
 swim in ocean
 Polynesian canoe
 jet stream
 raft on ocean
 float on ocean
 droppings of a bird
 raft on ocean, hitchhike on bird
 jet stream
 fly, jet stream, or storm
 jet stream or storm
 ships or airplane
 ships or airplane
 jet stream
 droppings of bird
 Polynesian canoe
 Polynesian canoe
 eggs hitchhiked on bird or adult blown on wind
 raft on ocean

