A Dispersing Knowledge

Summary
Students will learn about how plant species got to Hawai‘i by forming a hypothesis based on characteristics of different seed types and testing their hypothesis.

Objectives
- Students will be able to describe the four ways that organisms got to Hawai‘i.
- Students will be able to describe characteristics of successfully dispersing seeds.
- Students will be able to form a hypothesis and describe the scientific method.

Materials
Large beakers or tubs that will hold water (2 per station)
Mud (enough to fill container listed above)
Water (enough to fill container listed above)
Felt sheets 8½ X 11 (1 per station)
Small pieces of flat lightweight wood ~ 2” x 6” (1 per station) Hint: Kamaboko or Fish cake comes with wood pieces that are the perfect size.
Card stock paper for Paper fans (1 per station)
World Map or Globe
Various types of seeds (see teacher preparation)
Microscopes or Hand lenses (1 per station)
Pipe Cleaners bent into the shape of a bird’s foot (3 per station)
Newspaper (enough to cover each station)
Annie’s Big Adventure, Pgs. 12-13 (1 per student)
The Scientific Method, Pg. 14 (on transparency)
Barren Lava Flow and Old Growth Forest Photos, Pgs. 15-16 (On transparency)
The Plant Detectives Worksheet, Pgs. 17-18
Wing, Waves, and Wind, Labels, Pg. 19 (1 set per station)
Obtaining Native Seeds Table, Pg. 20 (on transparency)
A Story of a Seed, Pgs. 21-22 (1 per student)
Seed Cards, Pgs. 23-24
Definition Glue-In, Pg. 25 (1 per 4 students)
A Journal dedicated to science or a piece of paper (1 per student)
Plastic cups (4 per station)
Permanent Marker (1 for labeling)

Making Connections
Many of us have witnessed different methods of dispersal, but maybe have not known it to be dispersal.
Walking through vegetation here in Hawai‘i most of us have walked away with little “stickers” or “hitch hikers” stuck to our shoelaces or the cuffs of our pants. These “hitch hikers” are seeds with a really nifty way of getting around, catching a ride. Have you ever blown the fluffy-tufted seeds of a dandelion and watch the seeds float in the breeze? Many of us have. These are two specific methods of dispersal or spreading; it is a successful way to move away from its rooted stationary mother and grow somewhere else.

**Teacher Prep for Activity**

1. Collect various types of seeds; try to collect seeds of native plants if possible (See Obtaining Native Seeds Table). If this is not possible, obtaining seeds from your local gardening store or your back yard will do. Try to obtain seeds that have different dispersal methods (see table below). You will divide the class into groups of four or five, each group will test their hypothesis at a station. Collect enough seeds for each group to test. A good rule of thumb is if seeds are large collect one per student, if seeds are small collect ~ 5 teaspoons for each group. Collect three seed dispersal types [wind, wings, and waves]. See table below.

<table>
<thead>
<tr>
<th>Type of Dispersal</th>
<th>What they look like and where they are found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind (light and floats on wind currents)</td>
<td>Find seeds with fluffy tufts. Plants that look like little daisies will produce fluffy tuft seeds when they are mature. These are the types that you blow on and its seeds float on the air. Also seeds that are really small like grains of flour</td>
</tr>
<tr>
<td>Wings (attached to wings of a bird)</td>
<td>To obtain these seeds walking through a tall grassy area with just your socks is the first way to begin. Sometimes they are called “hitchhikers.” You are looking for seeds with spikes, have sticky sap or hairs, or hooks. These seeds are evolved for dispersal.</td>
</tr>
<tr>
<td>Waves (Float on the ocean)</td>
<td>These are seeds that float. To find seeds that float you should generally look for seeds that are large, foamy in texture, or corky in texture. A good place to start is near the shore. Hint: Take a cup of water and test to see if they will float…even if you push them under water.</td>
</tr>
<tr>
<td>Wings (eaten by bird)</td>
<td>Look for small fruits and berries. As birds are attracted to bright colors look for fruits that are red, purple, blue, etc. Generally if they look good to eat a bird would eat it too.</td>
</tr>
</tbody>
</table>

2. **Station Preparation** - You will need to prepare one station for each group of five students:

   a. Cover table (station) with newspaper.

   b. Fill 1 tub with water per station.

   c. Fill 1 tub with mud per station. (Mud consistency should be thick enough to stick to pipe cleaner bird feet, add water to soil until the proper consistency is reached).

   d. Cut bird shapes out of felt, one felt bird per station.
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3. Print student materials, *Annie's Big Adventure* (one per student), *The Plant Detectives* (one per student), and *A Story of a Seed* (one per student).

4. Print *The Scientific Method* and *Barren Lava Flow and Old Growth Forest Photos* on transparencies.

**Wind dispersal (Optional):** see Math Extension Activity. This activity may be included into the lesson or done separately in math (measuring activity). Instructions are in extension activity. If you decide to use this in the lesson it replaces the wind dispersal method embedded in the lesson of using a fan or simply blowing on seeds.

**Background**
When Hawai‘i came up out of the ocean it was barren and sterile. Today we have a diversity of native flowering plants, ferns, lichens, birds, insects, and mosses. With the closest land mass to Hawai‘i being over 2,000 miles away it’s a wonder how any of these organisms got here. There are three ways that plants are known to have gotten to Hawai‘i besides the help of humans. These include wings, wind, waves (will be referred to as the 3W’s). The 3W’s are methods in which an organism arrives to an area naturally, meaning without the help of humans. These organisms are termed native. Plants that came to the Hawaiian Islands did not come as fully-grown plants.
They came as seeds from many different parts of the Pacific area and other places in the world. Let's discuss the different ways seeds are dispersed!

First, is wing dispersal. Birds either migrate to and from Hawai‘i or are blown over to Hawai‘i in the jet stream over the islands and then unintentionally bring seeds with them. Seeds are either eaten by birds and deposited in a new location, stuck to their feathers (barbed or sticky seeds), or stuck and dried in the mud on the bird’s legs and feet.

The second is wave dispersal. Many seeds are adapted to disperse over the ocean. They are corky, spongy, or hollow and many are saltwater tolerant (the seed coat protects the embryo on the inside from salt water penetration). Seeds can even raft on a log. Logs or large branches with seeds tucked in its crevices fall into the ocean and can float over long distances to different places around the world such as Hawai‘i.

The third way is wind dispersal. Seeds that disperse by wind usually have some kind of physical mechanism that aids them. Some have papery wings, some have hard flat panels that work like a Frisbee, some have tufts of soft cotton-like hairs, and some are simply tiny and float on the wind like the spores of a fern or the tiny hair-like seeds of the ‘Ohi’a tree.

The fourth way is with the help of humans. For example, Polynesians have brought many plant species to Hawai‘i in their canoes, these included food plants and plants used for materials such as cloth or cordage. Since the arrival of humans, plants were brought to Hawai‘i for many reasons but mainly for agriculture and ornamental plant industries. Some plant species were brought here unintentionally, such as the seeds stuck to the wool of imported livestock, or in the pots of other imported plants.

The natural arrival of organisms is continuous, but is few and far between. It is estimated that one arrival of a flowering plant happens approximately every 105,000 years. Hawai‘i is a small target for seeds to hit in the vast Pacific Ocean. When these organisms do arrive, the chances of survival are even less than its chances of arrival. For example, a seed from a California plant may be accustomed to thick and rich soil but may not be able to survive on Hawai‘i’s harsh, nutrient poor lava flows. Thus, the plants that reach here are special indeed!

Vocabulary
Alien: An organism introduced to an area it is not native to.
Dispersal: To distribute or spread over a wide area.
Experiment: Used to test a hypothesis.
Introduced: Brought to an area from somewhere else.
Native: An organism that arrived to an area without the help of humans.
Observe: To notice something and perceive it as significant.
Organism: An individual plant, animal, or other life form.
Seed: A flowering plant’s unit of reproduction capable of developing into another such plant.
Scientific Method: Processes used by scientists to answer questions or solve problems.
Spores: A fern’s reproductive unit that is capable of developing into another such fern.
Wave Dispersal: Seeds that disperse over water, these seeds are buoyant (Corky hallow, or hairy) floats across water, usually on current.
**Wind Dispersal:** Seeds that disperse over the wind, these seeds are usually light, small, or have appendages such as fluffy tufts or wings to keep it afloat on a breeze longer.

**Wing Dispersal:** Seeds that disperse with the help of birds. These seeds wither hook on to the feathers of birds (hooks or sticky sap), gets stuck in the mud on birds legs, or is eaten by the bird and deposited elsewhere.

**Procedure**

**Dispersal Introduction (45 Minutes)**

1. If students are seated at their stations (previously set up, see preparation) advise them not to touch anything in front of them, as it may be a great distraction. **Hint:** If setting up station early will be a distraction, set up stations elsewhere.

2. Begin by reviewing what a hotspot is and how the Hawaiian Islands were formed. Ask students what Hawai‘i Island looked like when it came up out of the ocean 600,000 years ago. Explain, “Hawai‘i began as a volcano that quickly cooled into lava flows, it was barren, much like what the newer lava flows on Hawai‘i Island look like today. Ask, “What has changed?”

**Hot Spot Notes:** The “hot spot” is deep beneath the ocean floor. The hot spot is stationary under the earth’s bedrock of the ocean floor that moves slowly over it. Molten rock erupts from the hot spot onto the ocean floor and builds a volcano, which grows above the surface of the ocean, forming landmasses.

3. Guide students to describe what differences we see today compared to when the islands were first born. Project as a transparency or pass around printed photos of a *Old Growth Forest* and a *Barren Lava Flow*; ask students to compare the barren lava flow (what it was like when the islands were born) to the forests we have today (millions of years later). This will lead to the big questions of today’s activity, “How did the plants we see today get to Hawai‘i?”

4. Pose the question, “How did the plants we see today get to Hawai‘i?” Take answers and write these on the board. This will give you an idea of the student’s knowledge of this subject.

5. Explain, “The plants that got to Hawai‘i did not come as grown plants, they came as seeds.” Write the following definition on the board. Ask students to copy the definition into a journal dedicated to science or on a sheet of paper.

**Seed:** A unit capable of developing into another plant.

6. Explain, “Native plants of Hawai‘i have gotten here in the form of a seed from other places around the world.”

7. Display a world map or globe and point out Hawai‘i then point out just how far Hawai‘i is from the nearest landmasses. Explain, “The nearest landmass (California) is 2,500 miles away. Give students an idea of how far 1 mile is (Example: 4 times around a school track) then ask them to imagine that multiplied by 2,500, that’s a long way!”
8. Hold up a seed example (any kind) and explain, “This seed has no arms or legs to swim, how could ancestors of the plants we see today have traveled so far?” Take answers [Possible answers: Floated over the ocean, floated on wind currents, eaten by a bird, stuck to a bird’s feathers, stuck to the mud on bird’s legs] (Students may not be able to answer, in this case move to #9)

9. Discuss the three ways (other than human importation) that organisms got to Hawai‘i (wings, waves, and water). Address the 3W’s table below for guidance. Write, “Wings,” “Waves,” and “Wind” horizontally across the board. Under each category, go into detail explaining the characteristics of the seed types that fall under each category and how seeds disperse.

10. Write the italicized characteristics from the table below on the board under the three categories. Explain, “These are characteristics that allow the seeds to travel in these three ways.”

### 3W’s Table:

<table>
<thead>
<tr>
<th>Wings</th>
<th>Waves</th>
<th>Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeds with <strong>hooks</strong> or <strong>sticky sap</strong> will stick to the feathers and legs of a bird.</td>
<td>Seeds that can <strong>float</strong>, those less dense than salt water (<strong>corky, hollow, or hairy</strong>) will float across water, usually on a current.</td>
<td>Seeds with <strong>tufts, wings</strong>, or are extremely <strong>small</strong> such as fern spores will float on wind currents and land in a different area.</td>
</tr>
<tr>
<td>Seeds that are delicious such as berries that are <strong>colorful, fleshy</strong>, or <strong>small hard seeds</strong> are eaten by birds and deposited in a different area.</td>
<td>Seeds that <strong>float</strong> long distances or spend a long time on the water will need to have a sealed seed coat so no salt water can get in and kill the embryo.</td>
<td></td>
</tr>
<tr>
<td>Seeds that are <strong>small</strong> and <strong>lightweight</strong> may get stuck in the mud on bird’s feet as it dries.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. Leave these characteristics written on the board, as it will help students hypothesize the method of dispersal of each seed type during the activity.

12. Introduce the terms **native** and **introduced**. Write the definitions for these terms on the boards and ask students to copy them into a journal dedicated for science or on a sheet of paper.

**Introduced:** *Brought to an area from somewhere else.*

**Native:** *An organism that arrived to an area without the help of humans.*
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Explain, “Organisms that get to an area on its own [without the help of humans] are native. Organisms that were brought to an area with the help of humans are called introduced.” Explain, “Native plants that have gotten to the Hawaiian Islands on their own came by one of the three W’s.”

13. Pass out the story titled Annie’s Big Adventure. Explain, “I will now read a story titled Annie’s Big Adventure, this story is an example of how one seed made its way to Hawai’i. Listen and see if you can pick out the dispersal ‘W’ in the story.” Read the story Annie’s Big Adventure. Discuss. You may use the following questions below to lead discussion.

<table>
<thead>
<tr>
<th>Question</th>
<th>Possible Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is Annie in the story?</td>
<td>Annie is a Seed.</td>
</tr>
<tr>
<td>Where is Annie from?</td>
<td>California</td>
</tr>
<tr>
<td>How did Annie get to Hawai’i?</td>
<td>Waves, she floated.</td>
</tr>
<tr>
<td>What characteristic allowed Annie to float?</td>
<td>She was spongy.</td>
</tr>
<tr>
<td>What did Annie do when she got to Hawai’i?</td>
<td>Reached her roots into the ground. She grew and made Hawai’i her home.</td>
</tr>
</tbody>
</table>

**Dispersal Activity (1 Hour)**

1. Explain, “Today we will be working as detectives to solve the mystery of how three particular seeds got to Hawai’i, much like Annie the seed did.” Ask, “What is a detective?” “What do they do?” List these answers on the board. Try to get answers as specific as possible. Some answers you are looking for may include: they look for clues, they find things out, they answer questions, they look for evidence, or they ask questions. This will be a great introduction into the scientific method.

2. Explain, “Being a detective is much like being a scientist, where scientists also aim to answer questions by being observant, looking for clues, and asking questions. To do this scientists use the scientific method.” Write the term “Scientific method” on the board.

3. Explain, “The scientific method is similar to baking a cake. Like baking a cake, scientists also follow steps to reach an end product, an answer to a question or to solve a mystery.”

4. Display the document termed The Scientific Method either as a transparency or a printed document with an ELMO. Go over each step, explaining it with the example provided.

5. Explain, “Today you will be using the scientific method to find out how the seeds you have before you got to Hawai’i.”

6. Pass out The Plant Detectives worksheet. Explain, “The three numbers in the first column represent the three labeled seed types we will be working with today. For example, in the first row you will write the information for the seed type in the cup labeled “1,” and in the second row we will write the information for the seed type in the cup labeled “2,” and so on.

7. Explain, “We will begin by filling out the first two columns titled ‘Hypothesis’ and ‘Characteristics.’” In the first column [hypothesis] have students circle one of the three options
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according to how they believe each seed has gotten to Hawai‘i using what they have just learned. In the second column [Characteristics] students will write the characteristics that lead them to the hypothesis they choose.

**Example:**

**Hypothesis:** Waves  
**Characteristics:** It is light. It is corky.

8. Give students time to fill out these two columns of their worksheets for each of the three seed types. Explain, “Take time to observe each of the three seeds [allow students to use magnifying glasses] and fill in the first two columns of the table accordingly.”

<table>
<thead>
<tr>
<th>Seed Number</th>
<th>Hypothesis</th>
<th>Characteristics</th>
<th>Experiment</th>
<th>Support?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wings</td>
<td>Seed has little hooks all over it.</td>
<td>I put the seed on the felt bird and it stuck to it.</td>
<td>Yes, it supports my hypothesis.</td>
</tr>
</tbody>
</table>

9. Split them up into groups and have them attend their stations. Set the following rules; this activity may be messy without them.

**Activity Rules:**
- a. Keep workstation clean.
- b. No splashing water or mud on anyone or anywhere.
- c. You will have a limited time, be sure not to waste it.
- d. You may not touch the mud, as it is not necessary.

10. Explain to students how to test their hypothesis by experimenting (Use the information in the table below). This table explains how to use the tools supplied. It may be helpful to go through the motions with a sample seed using the different tools.

<table>
<thead>
<tr>
<th>Hypothesis:</th>
<th>Tools:</th>
<th>How to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind</td>
<td>Paper Fan</td>
<td>Fan seeds to see if they will lift off of the table.</td>
</tr>
<tr>
<td>Water</td>
<td>Tub of Water</td>
<td>Place seeds in tub of water to see if they float.</td>
</tr>
<tr>
<td>Water</td>
<td>Tub of Water and Wood Piece</td>
<td>Place wood piece (represents log and rafting) and place seeds on top of wood piece to see if it will float. All seeds will be able to do this.</td>
</tr>
<tr>
<td>Wings</td>
<td>Felt-shaped bird</td>
<td>Place seeds on felt-shaped bird and see if they will stick the to felt which represents the feathers of a bird.</td>
</tr>
<tr>
<td>Wings</td>
<td>Pipe cleaner bird feet and tub of mud</td>
<td>Place pipe cleaner bird feet in tub of mud so that the foot is coated and stick seeds to mud to see if it will stick.</td>
</tr>
<tr>
<td>Wings</td>
<td>Observation</td>
<td>Look at seeds (berries), are they colorful, do they look edible. Here there is no way to test in classroom but observation and deductive reasoning is great!</td>
</tr>
</tbody>
</table>
11. Explain, “You may only test the hypothesis you circled. For example, if you circled “Waves” you may only experiment by placing the seed into the tub of water. If you circled “Wings” you may only experiment with the felt bird, the pipe cleaner feet and mud.” And if you circled wind you many only use the fan to see if your seeds will blow off the table. Scientists will form a hypothesis then test it, if the result does not support what was hypothesized, they will form another hypothesis and test it again. Ask, “If you tested to see if a particular seed came by waves, then placed the seed in water and it sank, what could you do?” [You would form another hypothesis and test it another way]

12. Once students have filled out the first two columns of their worksheet, discuss how the third and fourth columns need to be filled out. Explain, “In the third column titled ‘Experiment’ you will write what you did in your experiment. [Experiment: I placed the seed in tub of water to see if it floats, it floated.] To fill out the fourth column, “Support?” instruct students to write either “Yes” or “No” in the block, depending on what happened when they experimented. [Example: 

13. Allow students time to test their hypothesis, about 5 minutes per hypothesis. Have students fill out the last two columns on the worksheet “Experiment” and “Support” as they experiment.

14. Ask students what they hypothesized for each seed (go by number), and discuss the reasons for their hypothesis. Students may all have different answers; this is all right as no answer is incorrect. Explain, “It is a good idea to experiment in different ways.” You may want to place answers on the board in a table similar to their worksheet or write their answers on student worksheet printed on a transparency.

15. Explain, “These plants have been growing in Hawai‘i for a really long time, so it is impossible to be sure exactly how these plants got to Hawai‘i, because we were not there when they arrived, but we can form hypothesis and test them, as you have done, and form an idea on how these plants have gotten to Hawai‘i.

16. Pass out homework *A Story of a Seed*, explain the homework assignment.

**Assessments**
*The Seed Detectives* worksheet  
Discussion Sessions  
*A Story of a Seed* Homework Assignment

**Resources**
Plant Identification Terminology Second Edition  
An Illustrated Glossary  
By: James G. Harris and Melinda Woolf Harris  
Spring Lake Publishing

Hawaiian Natural History, Ecology, and Evolution  
By Alan C. Ziegler
Extension Activities

Field Trip: A trip to the beach! Plan a short field trip to the nearest beach. Have student search for seeds, either on the ground, near the sand, or still attached to the tree. Have students sit in a nice shady area and share what they have found. Look at the seeds together and determine as a group if they are wave dispersed. Some plants near the beach may be a part of the planted landscape, and may not be wave dispersed, its up to the class to figure it out. Have them look at the characteristics to see if they match the characteristics of a wave-dispersed organism. (See 3W’s Table for characteristics)

Reinforcement Activity: Cut out and laminate Seed Photo Cards and place adhesive magnetic strips on the back of these. Place “wings, water, and wind” terms across the board. Pass out Seed Photos to students. Depending on the amount of students in your class they may have more than one card. Have students use what they have learned from the lesson and come up and put each photo in the category that they believe they seed may have came to Hawai`i by. This may lead a great discussion. You may allow other students to switch around photos within the categories, but only if the entire class agrees. No answer is wrong, as we were not here to witness these seeds arrival in the islands, but guesses should have reasoning behind them.

Literature Connection

Research Project: Go more in depth with Polynesian introduced plants and why each were brought to Hawai`i. Discuss uses and the importance of bringing these plants. See Table From the Canoe to You Pg. 25-26.

Art Connection

Super Dispersing Seed: Have students draw or paint a super dispersing seed! Now knowing many of the ways that seeds disperse and what adaptations they use to disperse successfully (floating, sticky sap, or fluffy tufts) have students create a seed that has a super dispersing ability, tell students to be creative and to not use motorized, electrical, or other non-natural parts.

Math Connections

Going the Distance: Have students test wind dispersed seeds and determine which seeds disperse further than others. This activity can be included in the lesson if time permits or used in later in math. Collect a pinch of three different kinds of seeds (2 wind dispersed [tiny seeds or spores] and one not [larger seed]) for each group, (see Obtaining native seeds in east Hawai`i table or use garden seeds), however you decide to split class into groups. Give each group a large piece of white paper ~ 11 X 14 (Hint: Cutting chart paper in half, taping paper together) and each student a drinking straw. Have each group place each pinch of seeds at the edge of the paper (long way) spaced apart as much as possible. Have students put the end of the straw in front of the seed pile with the straw touching the paper and blow a puff of air. Have students do this for each seed type. Have students measure from the edge of the paper (where seed piles were placed) to the furthest seed that was blown to see which seed blew the furthest. Have each student measure and report in centimeters and millimeters, have each student note which seed blew the furthest.
**Literature Connections**

*Annie’s Big Adventure Activity:* After reading *Annie’s Big Adventure* have students write their own story of how a particular seed got to Hawai‘i. Ask students to choose a seed, when doing so advise them to think about the seed they choose and its’ mode of transportation (waves, wings, wind). To make this easier print up *Seed Example Cards*, cut into cards and have students choose one each. Pass out *A Story of a Seed* work sheet to each student. This worksheet is designed to help students create a story similar to *Annie’s Big Adventure* with the seed card that they have. As there are different types of seed cards students should create different adventures, taking into account the seed’s method of dispersal. When students have completed the worksheet have them take out a separate piece of paper and write out their story using the worksheet as a guide, but extrapolating each idea and writing in detail. This activity could be used as a tool to improve student’s writing skills and promote creativity.
Annie’s Big Adventure
By: Anya Tagawa

It was a beautiful day in sunny California. The sun was shining and a light cool breeze was blowing along the sandy coast. Hanging from her mothers’ branches Annie the seed longed for adventure, for she spent her entire life in just one spot. “I have seen surfers walk by, sand crabs shuffle into their holes, and pelicans fly over head, but I want to see the world” she said. Annie began to swing back and forth from her mothers’ branches, she swung faster and faster until “SNAP!” The stem from which Annie hung on her mother broke in midair. Annie flew through the air soaring above the sand squealing with delight, for she was now free alas! Free to find adventure. She landed with a loud “thump” into the soft white sand, and without time to rub her sore bottom on which she landed on, she began to roll. Faster and faster Annie rolled, and as she did she became dizzy. The sky above her and the sand below her began to blur into one, Annie could no longer see where she was rolling.

Then suddenly, with a “KERPLUNK” and a large splash Annie found herself in the ocean. Although the cool salty water felt nice on her skin, she was afraid. Annie had left her mothers’ branches for the first time did not know how to swim. Luckily her thick spongy skin kept her afloat. Bobbing up and down on the ocean’s small waves, she began drifting further and further from the sandy shore she called home. Annie was caught in a current. She floated for hours, hours turned into days, and days into weeks, but she was happy for she finally found the adventure she was looking for. Some days she put her face into the water and watched the schools of silvery fish swim by; once a sea bird landed in the water beside her and said “Hello.” Most days she just floated on her back and looked up at the sky finding pictures in the clouds.

One day while deciding if the cloud above her looked more like a rabbit or a duck, she was startled by a burst of water that shot up to the sky. “What was it?” she thought, as she watched all that water come crashing back down around her. Without time to figure out what had just happened, the water around her began to ripple and move, and suddenly a large fish emerged above the oceans surface, the largest fish Annie had ever seen. “Aloha, I am Kohola” it said with a loud, deep voice. Puzzled, Annie replied “Aloha.” Kohola smiled, “It means hello in Hawaiian,” said the large fish. “Are you from Hawai’i,” Annie asked. Kohola nodded, causing large waves that tossed Annie up and down making her giggle with delight. “I have never seen a fish as big as you are”, she said, “Are all fish in Hawaii so big?” “No,” Kohola replied, “Just the other whales like me.” “Wow, a whale,” thought Annie, she had heard about these large fish-like...
mammals from her sea bird friends, but never has she seen one. “Would you like to join me on my journey?” asked Kohola interrupting her thoughts. “Oh, yes!” she replied.

The two friends traveled together, both happy to have each other’s company. They talked for hours. Kohola told tales of his journeys to between Hawai‘i and Alaska and of the friends he made along the way. Annie told Kohola of the stories she heard the local surfers tell each other as they rested on the beach. They laughed and had such a great time; they didn’t realize that they had reached their destination.

Annie saw large green islands that seemed to float in the distance. Annie heard a call from above; looking up she saw graceful tropicbirds with beautiful long red tails soaring in the warm breeze. Excited to see this new land, she swam closer. “I am afraid this is where we part,” said Kohola. “I belong in the deep ocean.” Sadly Annie said goodbye to her new friend that she had grown so fondly of, and continued on her way.

Soon she found herself floating near the black sandy shore in Ka‘u of the Big Island. Suddenly, a large wave picked her up and gently washed her ashore. As she looked around she saw tall Loulu palms swaying in the breeze, golden Kolea birds searching for worms in the grass, and Green sea turtles basking in the sun. “How beautiful,” she thought. Climbing into sunny spot above the wave wash she found her home. “I have had my adventure, now I would like to make Hawai‘i my new home” she thought as she happily reached her roots deep into the soil.
Scientific Method

**Observation:** Something you observe.

**Question:** A question formed by this observation.

**Hypothesis:** A statement testable by further observation or experimentation.

**Prediction:** What you think will happen in your experiment.

**Experiment:** To test a hypothesis.

- If experiment supports your hypothesis it becomes a theory.
- If it does not support your hypothesis revise hypothesis and test again.

**Example:**

**Observation:** Lily has cavities.

**Question:** How did Lily get cavities?

**Hypothesis:** Because people say, “If you don’t brush and floss your teeth, you will get cavities”. I hypothesize Lily does not brush or floss her teeth.

**Statement:** Lily got cavities from not brushing or flossing her teeth.

**Prediction:** If this hypothesis is correct, by not brushing or flossing your teeth you will get cavities.

**Experiment:** To test if not brushing or flossing your teeth will give me cavities, I will not brush my teeth for a year.
If I get cavities it supports my hypothesis.
- If I do not get cavities it does not support my hypothesis. I need to revise it and test again.
## The Case of the Traveling Seeds

Get ready detectives! We have a mystery to solve. We need to figure out how these seeds got to Hawaii. Be very observant: look at color, shape, size, and even texture. Let’s get started!

### Hypothesis (1 Point)
How do you think the seed travels? Circle one: by wind, waves, or wings.

### Characteristic (2 Points)
What characteristic makes you think that the seed travels by what you hypothesized? Write at least two characteristics.

### Experiment (2 Points)
Describe in detail what happened when you tested your hypothesis. Did it float, sink, stick to me, blow in the wind?

### Support (2 Points)
Did the experiment support your hypothesis? Yes/No. If no, what would you do next?
### Partnerships for Reform through Investigative Science and Mathematics

#### A Dispersing Knowledge

<table>
<thead>
<tr>
<th>Seed Number</th>
<th>Hypothesis (1 Point)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>How do you think the seed travels: by wind, waves, or other?</td>
</tr>
</tbody>
</table>

#### Waves

<table>
<thead>
<tr>
<th>Hypothesis (1 Point)</th>
<th>Characteristic (2 Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What characteristic makes you think that the seed travels by waves?</td>
</tr>
</tbody>
</table>

#### Wind

<table>
<thead>
<tr>
<th>Hypothesis (1 Point)</th>
<th>Characteristic (2 Points)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>What characteristic makes you think that the seed travels by wind?</td>
</tr>
</tbody>
</table>

#### Experiment (2 Points)

<table>
<thead>
<tr>
<th>How did the experiment work? (Did it float, sink, stick to the beach, blow in the wind?)</th>
</tr>
</thead>
</table>

#### Support (2 Points)

<table>
<thead>
<tr>
<th>Did the experiment support your hypothesis? (Yes/No)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support your hypothesis with two characteristics.</td>
</tr>
</tbody>
</table>

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**Partnerships for Reform through Investigative Science and Mathematics**

**A Dispersing Knowledge**

19
Wings, Waves, and Wind Labels

Wind
Waves
Waves
Wings
Wings
Wings
Wings
<table>
<thead>
<tr>
<th>Wind</th>
<th>Where to find</th>
<th>Seed description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind, Waves</td>
<td>Moves seeds away from parent plant</td>
<td>Orange to red-brown, round to oval</td>
</tr>
<tr>
<td>Wind, Waves</td>
<td>Moves seeds away from parent plant</td>
<td>Red-brown, flat, or kidney-shaped</td>
</tr>
<tr>
<td>Waves</td>
<td>Moves seeds away from parent plant</td>
<td>Black or brown, round to oval</td>
</tr>
<tr>
<td>Waves</td>
<td>Moves seeds away from parent plant</td>
<td>Black or brown, oval to kidney-shaped</td>
</tr>
<tr>
<td>Waves, Tide</td>
<td>Moves seeds away from parent plant</td>
<td>Black or brown, round to oval</td>
</tr>
<tr>
<td>Waves, Tide</td>
<td>Moves seeds away from parent plant</td>
<td>Black or brown, oval to kidney-shaped</td>
</tr>
<tr>
<td>Tide</td>
<td>Moves seeds away from parent plant</td>
<td>Black or brown, round to oval</td>
</tr>
<tr>
<td>Tide</td>
<td>Moves seeds away from parent plant</td>
<td>Black or brown, oval to kidney-shaped</td>
</tr>
<tr>
<td>Tide, Current</td>
<td>Moves seeds away from parent plant</td>
<td>Black or brown, round to oval</td>
</tr>
<tr>
<td>Tide, Current</td>
<td>Moves seeds away from parent plant</td>
<td>Black or brown, oval to kidney-shaped</td>
</tr>
</tbody>
</table>

Note: Grow these plants in your school garden to see seeds in action. Choose a local native plant and create a seed identification card for each plant. This can lead into a more detailed study of plant biodiversity.
The story of how ______ got to Hawai’i

(Give your seed a name here. Ex: Annie)

1. Where does your seed come from? ___________________________ (Choose a place on a map)

2. Describe what it is like there on the day your seed leaves. (What is the weather like? Breezy, sunny, cold, raining, hot. Be descriptive)

3. Why does your seed leave its tree and how? (Does a gust of wind blow it off its branch? Does a bird eat it? Does it ripen and simply falls off? Remember the different modes of dispersal we talked about.)

4. How does your seed travel? (Does float on the wind? Does stick to the wings or feet of a bird?)

5. What does your seed see on the way? (Trees, animals, mountains, valleys, islands, weather)

6. What friends does it meet? (Other organisms that would be found along the way, what do they talk about? What are they doing?)
7. Where does your seed end up? ________________ (Choose a place in Hawai‘i on a map)

8. How does your seed feel about the journey and the place it ends up?

9. Use what you have written in questions 1-8 and write a story in paragraph form on a separate piece of paper.

Draw a picture of your seed on its way to Hawai‘i. Draw your seed with its characteristics (Example: if you seed blows over on the wind draw it tiny or with a fluffy tuft on top. If you seed came stuck the wings of a bird you could draw your seed with hooks or sticky sap.) Be creative, draw a face, draw what it sees, and who it meets on the way.
# From the Canoe to You

## Polynesian Introduced Plants

<table>
<thead>
<tr>
<th>Name of Plant</th>
<th>Use for Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kalo or Taro</td>
<td>The tender leaves of this plant was cooked and eaten, the root or corm was cooked and eaten whole or pounded into poi.</td>
</tr>
<tr>
<td>2. `Uala or Sweet Potato</td>
<td>The sweet potatoes of this vine was boiled and eaten.</td>
</tr>
<tr>
<td>3. `Ulu or Breadfruit</td>
<td>The large round fruit of this tree was boiled an eaten much like a potato. The light-colored wood was made into surfboards, poi pounding boards, and dance drums.</td>
</tr>
<tr>
<td>4. Mai`a or Bananas</td>
<td>The fruit of this plant was eaten. Fibers obtained from the trunk (Pu mai`a) used in spear practice.</td>
</tr>
<tr>
<td>5. Niu or Coconut</td>
<td>Trunk used for food bowls and for hula and temple drums. Trunk used for small canoes. Leaflets plaited into fans and game balls, midribs used in brooms or used as needles for lei. Husk covering of the nut was used as fuel and braided into cordage. Fruit eaten, milk used in many dishes.</td>
</tr>
<tr>
<td>6. Uhi or Yam</td>
<td>Yam cooked in an imu and eaten hot.</td>
</tr>
<tr>
<td>7. Pia or Arrowroot</td>
<td>Tubers are eaten.</td>
</tr>
<tr>
<td>8. Ko or Sugar cane</td>
<td>Favoried and useful food plant. Stalks were chewed.</td>
</tr>
<tr>
<td>9. `Awa</td>
<td>Portions of the root were chewed or pounded in a wooden bowl with added water and drunken. Drink used in ceremony. Used in medicine, reduces or eliminates body pains and helps with insomnia and anxiety. Given as an offering to the gods.</td>
</tr>
<tr>
<td>10. Hala or Screwpine</td>
<td>Woody trunk of the male tree used in house posts. Leaves were woven into mats, fans, baskets, pillows, sandals, and canoe sails. Sometimes thatched into houses.</td>
</tr>
<tr>
<td>11. `Ohe or Bamboo</td>
<td>Short sections made into musical instruments such as a nose flute or split rattles. Strips of dried bamboo were carved into kapa stamps and liners. Made into sharp knives.</td>
</tr>
<tr>
<td>12. Wauke or Paper mulberry</td>
<td>Bark pealed, soaked, and pounded into kapa or cloth. The fibers of this plant make the softest and finest durable kapa known.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td>13. Ipu or Gourd</td>
<td>Made into a variety of containers. Some used to store kapa or feather work and other possessions. Some used to hold water and food.</td>
</tr>
<tr>
<td>14. Ki or TI</td>
<td>Twisted into lei or anklets, a flag of truce, braided into sandals, used in heiau sacred to the god Lono. Tied to netting to make rain capes for bird catchers.</td>
</tr>
<tr>
<td>15. Olona</td>
<td>Used to make cordage. Cordage used in fishing nets, fine meshed nets in which feathers were tied to form capes for royalty. Knotted to make carrying nets.</td>
</tr>
<tr>
<td>16. Olena or Turmeric</td>
<td>Roots pounded and mixed with seawater and placed to remove kapu restrictions. Juice from crushed roots dropped into ears to cure earache. Juice from root makes a yellow dye, if cooked a deep orange dye.</td>
</tr>
<tr>
<td>17. Kukui or Candlenut tree</td>
<td>Inner bark pounded to make kappa. Gum from trunk dissolved in water and applied to kappa for a resin-like coating. Hard shells of nuts are polished and strung into lei. Flesh of roasted nut pounded with added salt to make a relish. Oil extracted from roasted nuts is burned on a kapa wick as a lamp, a torch or a candle.</td>
</tr>
<tr>
<td>18. Kou</td>
<td>Images carved from wood. Carved into food bowls and platters. Leis strung from the orange flowers.</td>
</tr>
<tr>
<td>19. Milo</td>
<td>Wood made into food bowls. Seeds taken as a laxative. Young leaves eaten raw or cooked.</td>
</tr>
<tr>
<td>20. Kamani</td>
<td>Wood made into food bowls. The nut is whirled by a string producing a whistling sound. Oil extracted and used in massage and waterproofing kapa.</td>
</tr>
<tr>
<td>21. Hau</td>
<td>Smaller branched used for adze handles and massage sticks and lightweight spears for battle practice. Bark twisted into cordage. Slimy sap under bark and a the base of flowers used as a mild laxative.</td>
</tr>
<tr>
<td>22. <code>Ohi</code>a `ai or Mountain apple</td>
<td>Wood used in house posts and rafters. Fruit eaten. Bark yielded brown dye and astringent medicine.</td>
</tr>
</tbody>
</table>

**Information compiled from:**
Resource units in Hawaiian Culture
Revised Edition
By: Donald D. Kilolani Mitchell
Kamehameha Schools Press.