Lesson 10: Two Beets Or Not Two Beets—What Is Your Question?

Summary
Students use their experience with growing plants in different ways to determine how best to grow new beets (or carrots). Working in pairs, students predict which part of a beet will develop into a new plant, direct an adult in cutting the beet into several pieces, and decide what conditions they need for their experiment. Typically, students divide the vegetable into: leaves, top (leaf stems and part of the “meat”), body, and taproot. Seeds may also be grown for comparison of growth rate.

Objectives
- Students will use the scientific method to test an idea.
- Student will demonstrate their knowledge of plant requirements for life and biological evidence for life.
- Students will identify the structures on this plant capable of reproduction (life cycle).
- Students will present evidence to support a conclusion.

Materials
Per pair:
1 whole beet or carrot (with tops still on—ask grocer or gardening friend ahead of time)
1 blank paper for a “brainstorming page”
1 Student Organizer sheet

For the class:
Newspaper
Variety of planters/cups/pots
Potting soil or other media
Water source

Making Connections
On the Big Island, we are very conscious of our sugarcane heritage. Today, about 1/3 of the world’s sugar and almost all organic sugar, comes from sugar beets! Beets and beet greens are also packed with vitamins and minerals. Carrots are another root crop even kids will eat and their Vitamin A is the reason they are so good for your eyesight. Root crops are fun and easy to grow in Hawaiian soils and climates: just watch the kids’ eyes pop when they pull their first carrot out of the school garden!
Teacher Prep for Activity

1. Talk to your grocer, gardening friend, or farmer’s market attendant about getting a large number of beets, carrots, or radishes with the tops on for this activity. The fresher the better, and if you buy organic, you know they are not sprayed with fungicide or growth retardants that can spoil the project.
2. Purchase the vegetables.
3. Photocopy the Organizer sheet: one per student.
4. Assemble potting soil and a variety of pots and containers large enough to hold a carrot or beet cut into several pieces. Yogurt and sour cream tubs are always handy; just add holes for drainage. Ask parents: if you put the word out, it seems most people have a collection of old flower pots under their house.
5. You mean you still have space in your classroom?? This activity will work fine without grow lights, in the classroom.

Background

This activity is, in some ways, a reprise of the introductory activity. It is intended to return to their earlier questions and create some resolution, while assessing student’s comfort level with the scientific method.

Root crops including carrots, beets, radishes, turnips, and daikon are all popular and easy to grow in Hawaii. Pickled daikon appears in different forms as a Japanese garnish, a Korean vegetable side dish, and as an ingredient in many Asian dishes. These are all true roots, meaning the energy stored in sugar is packaged in an enlarged taproot. The ancestors of these plants probably had sugar stores in modestly enlarged edible taproots. Over time, people selecting the largest, sweetest of these developed varieties with greatly enlarged and sweetened produce. The beet, Beta vulgaris, is truly a monster of sugar storage, whether you consider the typical red salad beet or the much sweeter sugar beet. When sugar prices spiked during the Civil War, the sugar cane industry became a powerhouse product. At that same time the sugar beet also got its chance to take a bit of market share and today makes up a third of the world’s sugar supply. The primary function of these monstrous roots is storing energy to take the plants through the winter. At harvest, they are covered with fine, hair-like rootlets, which are responsible for water and soil nutrient uptake. Unlike the corms (modified stems) of taro, these true roots do not have any growth nodes and are not involved in reproduction. Instead, there is a flattened, disk-shaped stem sandwiched between the leaves and the root. This stem is capable of producing new roots and leaves, and is the part of a root vegetable that can be used to produce a new plant.

Unlike many food plants, all of the parts of the beet are edible, including the tasty greens. In fact, some types of beets are specifically cultivated for their greens and are known as leaf beets or Swiss chard. The colorful stems and rich colors of the leaves also sometimes play a role in ornamental gardens. Beets are a great source of folate, the B-vitamin known for its role in preventing birth defects in growing fetuses. The root of the beet is also a good source of iron, potassium and magnesium, although an abundance of nutrition actually lies in its leafy greens. A half-cup of beet greens, cooked, supplies upwards of 92% of your daily need for vitamin A (as beta-carotene). Beet greens are also higher in potassium, magnesium, vitamin C, thiamin, riboflavin, and vitamin B6.
When selecting beets to eat, look for firm, healthy specimens with no sliminess or discoloration and store them under refrigeration. If the beets come with greens attached, remove the greens and cook them up like spinach.

Procedure
1. HAVE THE STUDENTS GATHER AT THE RUG (you may want to assign partners).
2. PASS AROUND THE ROOT VEGETABLES you have brought in. Can the students identify them?
3. ASK THE STUDENTS TO DESCRIBE what you are showing them—
   a. What is it?
   b. Is it a whole plant or just a part?
   c. Is it alive?
4. HOW DO YOU KNOW?

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a. Ask the students to tell you how they know what it is. How did they decide? How do they know it is alive/dead?

b. Refer them to their chart from the first week. Have the students reached any conclusions in the past few weeks about how we decide if a plant is alive?

5. HOW CAN WE FIND OUT FOR SURE?
   a. How can we find out if these veggies are alive? Have the kids “think-pair–share” with their partner to discuss how they can find out if it is alive.
   b. Review the list of possible experiments and predictions from before, such as: “Plant them and wait to see if they grow.” Prediction: “they will grow” or “they won’t grow” or “some will grow.”
   c. Ask the students if they agree that growth is evidence that a plant is alive. (Remind them that being green, or wet, or colorful is not alone evidence for life).

6. WHICH PART OF THE PLANT WILL GROW?
   a. If the real goal is to grow a new beet to eat, which part should they plant?
   b. Should they plant the whole thing?
   c. Just pieces, like taro? The root, like a white potato? What would a farmer do?

7. DESIGN EXPERIMENT WITH A PARTNER.
   a. After a few ideas have been tossed around, tell the students you want them to work with their partner to come up with their own experiment. The experiment should solve the answer to this question: Which part of this vegetable will grow into a new plant?
   b. Note: you need to drum this question in, since you were just discussing alive/dead, but now are on to what parts of a plant grow!
   c. Tell the students they can decide how much and which parts of the beet they want to plant, and that they will direct you in how to cut up their beet-if they want it cut at all.
   d. Solicit any questions or concerns; then send students back to their desks to work on the organizer sheets and come up with their own experiment.

8. CIRCULATE around the room, keeping students focused on each step of the organizer sheet.
   a. Did they correctly identify the question?
   b. Does their plan make sense?
   c. How will they care for their project until they see results?
   d. What outcome do they predict?
   e. Ask the students what they would conclude, if their predictions came true. And what they would conclude if they don’t come true! [“We predict that the leaves are the part that will grow into a new plant. If they do, then we know we are right. If not, then we were wrong” can be improved to “if not, then we can see which part did grow into a new plant”].
   f. If all the students want to do things the same way, you might persuade a few to try something different.

9. GATHER MATERIALS AND CUT BEETS:
   a. When the students have a satisfactory plan, including materials list, have one student gather the materials while you cut the beet as directed.
   b. Blot excess moisture on the newspaper or paper towels for a few minutes before planting.
c. In the most humid parts of the islands, you may have some problems with rotting. The solution is to cure the cut pieces in a sunny window for at least an hour before planting, and try to keep the projects cool throughout development.

10. STUDENTS SET UP PROJECTS:
   a. Allow students to set up their projects and show them where to store them.
   b. Have students tape brief care instructions to their projects, in case of absence, and share ideas with others.
   c. Keep out of harsh light and heat until roots develop.
   d. They will do fine inside for a few weeks; then living parts should be transplanted outdoors.

11. CLEAN UP: Have students clean up their work areas and return to their desks.

BREAKPOINT

12. DAILY OBSERVATIONS: Have students check on their project each day or two, and write down observations when they notice anything interesting.
   a. As parts of the plant wilt or rot, they can be removed.
   b. If the students observe anything about their experimental design that they think they should have done differently, discuss the merits of continuing with the plan, or changing strategies.

13. FINAL RESULTS: When students find enough evidence to conclude that part of the vegetable is growing (roots or fresh leaves appear), they can fill out the last sections of their organizer sheet. Be sure to emphasize the “I wonder” section!

14. DISCUSS RESULTS AND CONCLUSIONS:
   a. Meet with all the students on the rug to discuss results and conclusions.
   b. What experiments or questions would be worth pursuing further?
   c. What part of the beet grew into a new plant? [Only the top—this is really a flat stem sandwiched between the giant root and leaf]
   d. What part is eaten by people?
   e. How can we grow new beets, but still have beets to eat?
   f. Does anyone know if beets make seeds? How could we find out?

Assessments
Organizer sheet should contain a realistic experimental design, reasonable predictions, good observations and clear description or drawing of what occurred. Students should state or draw which part of the beet “worked” to make a new plant, and pose future research to pursue.

Resources
Beet facts and recipes:
www.lifescript.com
www.wisegeek.com

Diagram of a sugar beet factory (and a cool agriculture case study for older students):
http://www.sbreb.org/brochures/SugarCoop/dataflow.gif

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Extension Activities

To the Garden! When plants have developed roots and new leaf buds, they can be moved to a school garden or taken home. Beets thrive in most areas, but in Hawaii, they should be grown as a winter crop—warmer temperatures of summer spoil the taste. They need deep, well-turned soil with excellent drainage (lots of compost). They also appreciate regular watering on a consistent schedule, as infrequent watering may cause the roots to crack. These instructions apply to any of the root crops mentioned in this activity—try growing a variety!

Why start veggies with tops? It gives them a head start! Try planting some seeds at the same time as the tops to observe how slowly they go. While the leaves of some root crops are eaten, most tops are tossed into the compost, so it makes sense to plant them instead, and get your new vegetable faster. If the plants are left in the garden long enough, they will flower and develop seed.

Veggie Chips: Beets, carrots, and sweet potatoes can all be made into chips. Slice thinly (use a mandolin if possible); blot extra moisture on paper towels, toss in olive oil, and bake at 350 degrees until crisp. Salt and serve immediately.

Art/Math/Literature Connections

Math: Picture Fractions. The results section of the Organizer Worksheet shows students how to depict their results as a fraction. The number of pieces created goes in the denominator, and the number that actually grew goes in the numerator. Then they record the number that did not grow as the numerator over the same denominator. Worksheet follows.
Organizer Sheet – Two Beets or Not Two Beets?

Name: ___________________________ Date: __________________

1. Question: ___________________________

____________________________________

____________________________________

____________________________________

2. I will need:

____________________________________

____________________________________

3. Draw what you will do to answer your question:

   __________________________________

4. This is what I did:

   __________________________________

   __________________________________

   __________________________________

   __________________________________

   __________________________________

   __________________________________

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5: Draw what happened:


6: Tell what happened: (I noticed...)

________________________________________

________________________________________

________________________________________

________________________________________

7: Why do you think this happened?

________________________________________

________________________________________

________________________________________

________________________________________
Count the number in each box that can make a new plant and write the number above the line.

Count how many objects are in each box, and write that number below the line.

Some of the objects below can produce new plants.