Is Soil At Island School Field Site “Lepo Momona” or “Lepo Momona Ole”

What we will doing over the next three meetings

Brainstorming Web – What Do I Know Now About Soil?

What is soil? Solids, liquids (soil solution), gases (soil atmosphere)

Soil Texture – refers to size of soil particles
- Size classes – Sand, Silt, Clay (use diagram)
  - How do you know what type of soil you have? “Feel” and ribbon Test (sand, flour, modeling clay)
- Why does size matter?
  - Porosity
    - Drainage Test
    - Air
    - Surface Area
      - Boxes
      - Cinder block smashing
- How things “stick” to soil
  - Charge of soil particles
  - Charge of solutes, ions
    - Magnets (ions) – Jenny as potassium

Soil pH
- Soils have a certain pH
  - Measure of acidity “sourness” or alkalinity “sweetness” of a soil
  - Amount of H_30 [H^+] or OH^- in solution
  - Draw pH scale
- Acidifying/Basing reactions w/ students
  - After each reaction have students guess where pH might be
- Why is this important?

Soil Nutrients
- What do plants need to survive?
  - Minerals?
  - Macronutrients – H, C, O, N, P, K, S, Ca, Mg
  - Micronutrients – Cl, B, Fe, Mn, Zi, Cu, Ni, Mo
- Can plants pull minerals from the air?
- Why do they have roots?
- Can roots pull nutrients off soil particles?
- Need soil solution of correct pH
  - Nutrient/pH scale
- Are there nutrients in the soil?
- Nutrient Maze

LEPO MOMONA: IS THE SOIL AT ISLAND SCHOOL FERTILE?

OBJECTIVES

- To introduce concepts of soil texture, soil pH and soil nutrients in anticipation of soil testing activities
- To have students observe and participate in demonstrations of previously mentioned concepts
- To have students identify importance of fertile soil for plant growth
- To familiarize students with concepts of soil science

SKILLS DEVELOPED

- Observation
- Analytical thinking
- Critical thinking
- Hypothesis generation
- Cooperation
- Communication
- Logic

STANDARDS ADDRESSED

STRAND	CONTENT STANDARD
DOMAIN I	
Science as Inquiry	Doing Scientific Inquiry
Habits of Mind	Living the Values, Attitudes and Commitments of the Inquiring Mind
Habits of Mind Safety	Using Unifying Concepts and Themes Doing Safety
DOMAIN II	
Historical Perspective	Malama I Ka Aina
Organisms and Development	Unity and Diversity
Organisms and Development	Interdependence
Organisms and Development	Cycle of Matter and Energy Flow
The Physical Environment	Energy, It's Transformation and Matter
Earth Systems and the Universe	Forces of the Universe
Earth Systems and the Universe	Forces that Shape the Earth

Activity 1: Brainstorming Web

Individually, students create a brainstorming web on what they currently know about soil. They will have approximately 4 minutes to create their webs. When finished they will have an opportunity to share their webs with other students. In order to encourage discussion, a number will be randomly assigned to each student. When the number is called each student with that number will form a group and discuss their web. Students will have approximately 2 minutes to discuss their webs. Music can be played in the background in order to make groups feel more comfortable and not be intimidated by other group discussions. Stopping the music will signal that the activity is over and students are to return to their tables. Students will be asked to share what they know.

Activity 2: What is Soil?

Science partner poses question to class and creates concept map on board based on student input. Discussion leads into brief talk on soil texture.

<u>Demonstration 1: Using the feel and ribbon test to determine soil particle size</u>

<u>Materials needed:</u>

- 10 large ziplock baggies (2 baggies x 5 tables)
- Coral Sand
- Flour or talcum powder
- Modeling clay
- Water
- 5 plastic spoons (1 per table)
- Cups with water

Two baggies will be filled ¼ - ½ way with either sand or flour. Modeling clay can be distributed to students directly from its own packaging. Students are allowed to feel each “soil type” (approx. 1 minute). Following this, students will perform the feel test to determine the type of “soil” present. To conduct the feel test, students wet their index finger by dunking into cup of water. Next, they dab their finger into the sand or flour and rub it between their fingers. Students should try the feel test on each “soil” type, noting any differences. Ask students for their descriptions.

Sand particles	Feel grainy or gritty
Silt particles (in our case flour)	Feel smooth or silky
Clay particles	Feel sticky and can be squeezed into little “dirtballs” between the fingers

After performing the feel test students are instructed to wet the sand and flour then mix thoroughly. The clay does not need to be wet. After mixing, the science partner models the ribbon test.

To conduct the ribbon test a small handful of "soil" is needed. Students try to rub out a ribbon of soil by squeezing the soil towards their thumb and forefinger. The forefinger is moved back and forth in order to push out a ribbon (approx. 2 minutes). The science partner will model the process first, then ask students to attempt ribbon test. Certain soils, especially clayey soils, will produce ribbons more readily than silty soils. Sandy soils do not produce ribbons.

Activity 3: Why is Soil Particle Size So Important?

The next group of discussions and demonstrations deal with the importance of soil particle size. The science partner will start off by asking, "Why should soil particle size matter?" After student discussion (approximately 5 min.) the science partner performs a demonstration on the effect of soil particle size and water-holding capacity. Those demonstrations are followed up with a brief talk on surface area and two more demonstrations.

<u>Demonstration 2: Why does soil size matter?</u>

<u>Materials needed:</u>

- 2 clear, plastic, empty 2-litre soda bottles
- 1 ring stand
- 2 clamp- or screw on rings (10 cm diameter)
- Cinder rocks (coarse texture)
- Fine textured sand or red dirt
- 2 graduated cylinder
- 2 beakers
- 2 trays
- Water
- Stopwatch

<u>Procedure</u>

Cut off bottom portion of soda bottles. Place bottles on ring stand, using rings, so that the cut portion is facing up. To keep the sand or clay from draining out of the bottle place a piece of plastic mesh at bottom of bottle. Fill one bottle with coarse cinders, the other with sand or red dirt. Make sure both bottles are filled to the same level. Tell students to pretend they have been shrunk to the size of an ant. From this perspective, the cinders represent coarse sand and fine textured sand or red dirt represents clay. Allow students to observe materials in each bottle. Ask them to compare size of "particles" and spaces between each particle. Ask students, "Which "soil" will hold water the best?" This question leads to demonstration 2.

Procedure:

Place a tray under each bottle; this will be used to prevent spills. Next, place a beaker directly under each bottle spout but inside the trays. Have a student fill each graduated cylinder with 300mL of water. Allow student to slowly pour the water from one graduated cylinder in to each bottle. Select another student to act as a timekeeper. Remove bottle caps and allow water to drain from each bottle into the beakers for 1min. When time is up re-cap the bottles and pour water from one beaker into one graduated cylinder. Allow students to determine how much water was collected from each bottle. Student then answer the previous question.

Follow up by asking, "Which soil has better air circulation?" This can lead into a quick discussion on porosity, water-holding capacity and air exchange within soils and what soil conditions are best for plant growth.

Demonstration 3: Soil particle surface area: Why bigger is not always better.

Soil particle surface area is another important feature of soil texture. Generally, when comparing the same volume of larger soil particles to smaller soil particles, the smaller particle size will have greater surface area. Ask students whether the cinders in bottle 1, representing sand, will have a greater or lesser surface area than the "clay" in bottle 2.

Materials needed:

- 8 cubes (can be boxes, floral foam, etc, sides must be equal in length)
- Ruler

Procedure

Stack individual cubes 2 high and 2 deep to form 1 cube. This cube represents a particle of coarse sand. Measure the height and the width of the stacked cubes as one cube. To get surface area of the cube: 1) multiply its height x width, 2) multiply this value by 6 (a cube has 6 faces). The product equals surface area.

Next, separate the stacks of cubes by a few millimeters. Separating the stacks allows students to visualize smaller soil particles. Each cube now represents a grain of silt or clay. Measure the height and width of one cube (remember to have cubes of equal size). To get surface area of all cubes: 1) multiply the height and width of one cube, 2) multiply this value by 6, 3) multiply this value by 8 (the total number of cubes). The product equals total surface area.

Put all measurements and calculations on the board, side-by-side, for student comparison.

Demonstration 4: Cinder block smash!

Materials needed:

- 1 cinder block (hollow tile)
- hammer
- safety glasses
- tarp or throw cloth

Procedure

Place cinder block on stool. Tell students cinder block represents a grain of sand. One at a time, have students come up a place one hand on each surface of cinder block (about 6-8 students total). Note how crowded it gets when more students are added and not much more space is left on cinder block. Have students take their seats. With hammer break cinder block into pieces on top of tarp. This represents the weathering process. Allow students to come up and place hand on exposed surfaces of small pieces. How many more students can be accommodated with the smaller pieces? What happens if smaller pieces are broken down further? As more surface area is exposed more things (i.e. nutrients, water) can stick to soil.

Activity 4: How Things Stick to Soil?

Using magnets, the science partner, will briefly describe how water and nutrient ions bind to soil particle surfaces.

Activity 5: How Does Soil pH Work?

The science partner will lead a brief discussion on what acidity/alkalinity and pH are. All students participate in a demonstration of changing pH in soils.

Materials needed:

- Poster board cut into 30 pieces

  Write the letter(s): H on 15 pieces; O on 8 pieces; N on 2 pieces; S on 1 piece; Cl on 1 piece; Ca on 1 piece; Na on 1 piece; and K on 1 piece. These will be used to create molecules.
- 30 pieces of string or yarn cut into 18" pieces (Use these pieces of string to make a necklace that will hold each piece of poster board).

Procedure

Students randomly select one piece of poster board and place it around their neck. Each letter refers to one element on the periodic table (e.g.: H=hydrogen; O=oxygen; N=nitrogen; S=sulfur; Cl=chlorine; Ca=calcium; Na=sodium; and K=potassium). The science partner will assist the students in forming various molecules that have acidic and basic properties. Having students lock their arms together forms each molecule. Molecules to be formed are:

H_20	$NaOH$
H_2SO_4	KOH

HCl NH_3

NH_4^+ $Ca(OH)_2$

With the exception of water, each molecule "binds" to a soil particle. The blackboard can represent a soil particle surface. The students playing the role of water interact with each molecule to form acidic or basic conditions in the soil solution. This also represents chemical weathering. Assisted by the science partners, the following "reactions" take place:

$H_2SO_4 + H_20$	$\rightleftarrows$	$H_30 + HSO_4$
$HCl + H_20$	$\rightleftarrows$	$H_30 + Cl^-$
$NH_4^+ + H_20$	$\rightleftarrows$	$H_30 + NH_3$
$NH_3 + H_20$	$\rightleftarrows$	$OH^- + NH_4^+$
$KOH + H_20$	$\rightleftarrows$	$K^+ + OH^- + H_20$
$NaOH + H_20$	$\rightleftarrows$	$Na^+ + OH^- + H_20$
$Ca(OH)_2 + H_20$	$\rightleftarrows$	$Ca^{2+} + OH^- + H_20$

The liberated ions will also bind to the soil surface. Students are to determine if the reaction that took place produced acidic conditions or basic conditions. During the course of the reactions nutrient ions will be liberated. Have the students representing nutrient ions stick to the board again. This will lead into a discussion of plant nutrients and the effect of pH on nutrient availability.

Activity 6: Plant Nutrient Maze

Students complete a plant nutrient maze provided in the Nitty-Gritty soil testing kit.