NUTRIENTS FOR LIFE
FOUNDATION

Ideas Binder

Contents

Ag in the Classroom (Elem Teachers) Workshop

Event: Ag in the Classroom Kentucky Workshops

Audience: 400 elementary teachers

Time: 1.5 hours

Objective:

By the end of the workshop, educators will be able to reproduce several hands-on activities about soil for their classrooms. Emphasis on cross-curricular activities.

Materials:

* Paper Plates

* Magnets 400

* Flashcards (2 sets)

* Seed Packet - 50

* Construction Paper – 400 full pages

* Glue

* NPK Posters

* Apple Posters

* Periodic Table of Elements

* Projector/Speakers/Laptop

* Nutrition Labels

Workshop:

1. Word Scramble Magnet Activity –Language Arts (5 minutes)

2. Foundation and Material Overview (importance of soil nutrients/fertilizer) (15 minutes)

3. Beach Ball Flashcard Quiz (8 minutes)

4. Elementary Curriculum Overview (12 minutes)

5. Lesson 4: Seed Packet and Garden Planning Activity – Math and Graphing (10 minutes)

6. Nutrition Label – Health (10 minutes)

7. Phosphate Video and Activity - Takeaways (20 minutes)

8. Paper Plate Chains – NPK (10 minutes)

Agriculture Educators Presentation Agenda

Event: NAAE – National Assoc. of Ag Educators

Audience: 15-50 Ag Educators

Time: 1-2 hours

Objective:

By the end of the workshop, participants will be aware of the many activities and resources available to them from the Nutrients for Life Foundation.

The Nutrients for Life Foundation offers the Helping Communities Grow Award Program, free curriculum and educational materials. Participants will learn how their FFA Chapter can engage in the Helping Communities Grow award program that offers $5,000 for first place, $3,000 for second place, $1,000 for third place and $500 for participating. Hear what other FFA Chapters have done in the program and see how easy it is to get involved. The Foundation has a wealth of free resources including elementary, middle and high school curriculum. Workshop participants will see highlights from the curriculum and will engage in hands-on activities that use the free resources that the Nutrients for Life Foundation has to offer.

Description:

Materials:

FFA bookmarks

FFA one-pagers

PowerPoint Helping Communities Grow

Curriculum

Magazines

Biographical Sketch:

Dee McKenna, Nutrients for Life Foundation, FFA Coordinator. Dee has a bachelor's of science degree in Agricultural Education from Iowa State University and a master's

of science degree in Agricultural Education from Texas A&M University. She taught high school agriculture in Iowa and then worked for Texas Cooperative Extension before taking on her role at the Nutrients for Life Foundation.

Elementary Earth Day Agenda

Event: Earth Day Presentation in classroom

Audience: 25-30 students in 3rd grade

Time: 1 hour

Materials:

Beach ball globe

Apple/knife/cutting board

Tootsie rolls

NPK Activity Booklets

Materials for Garden Monsters

Workshop:

(Parts added from Joan Kyle)

Good Morning. My name is Mrs. Siergiej.

Does anyone know what was celebrated yesterday?

Earth Day! That's right

Earth day was created in 1970, and now more than 175 countries celebrate earth day each year. Let's take a look at our earth. I have a globe, and I want you to pass this a few times around the room. If you catch it….tell me if your LEFT thumb lands on water or land.

The earth is 75 percent water…but salt water from the ocean. Is this the water we drink? No, we drink fresh water which is why it's important to conserve our water. What do I mean by conserve?

Do tootsie roll experiment: (adapted from Illinois AITC and Utah)

Divide the class into three groups. Give each student a Tootsie Roll. Instruct each group as follows:

Group 1: These students are to eat the Tootsie Roll immediately. – (consumption)

Group 2: These students may unwrap the Tootsie Roll but they may only lick the candy, they cannot eat it. (Conservation)

Group 3: These students may not unwrap their Tootsie Roll during this activity. They may look at it, smell it, measure it, but NOT eat it. (Preservation)

We also need to take care of the land. Why do we need to take care of the land? What does the land give us?—the soil…which gives us a base to build our houses on and a place to live, but also our FOOD!

How many of you have heard the word Agriculture? Agriculture is when the farmers grow food and raise animals on their land. Did you know that our farmers send food to grocery stores and they send food all over the world……we feed the world.

So when we think about food, we think about agriculture.

Do Apple experiment—that's all we have to grow our food on.

Why do we need food……. to grow and to be healthy…

Humans need essential vitamins and nutrients that are found in the plants – we eat those plants that the famers grow for us to get those vitamins and nutrients necessary to be healthy and strong.

Next ask "so how does we get these nutrients?.....from plants ……..

Did you know most of our food comes from plants that are grown by the farmer? Can you name some of the plants that are fruits and vegetables grown in Illinois? We eat those plants to be healthy like: green beans, corn, lettuce, strawberries, and grain products like bread and cereals. We eat all kinds of fruits and vegetables to stay healthy.

How do plants get their food? They do not have mouths and teeth……..

They get their food through their roots in the soil, plants take up water and nutrients needed for growth

The farmer feeds plants with nutrients by putting fertilizer in the soil.

There are many nutrients that plants need (17 of them), but there are 3 major nutrients needed by plants represented by the letters N, P, & K.

So let's talk about the 3 major nutrients. Show the Plant Nutrient Team booklet– cover

Mr. N, Mr. P, and Mr. K …… Everybody say NPK

Let's turn to page 1 and find out what these letters stand for. These are nutrients and they help the farmer produce healthy plants – Nitrogen, Phosphorus, and Potassium – Have the kids repeat names

Go to Page 4 This is a picture of the farmer and his helper and the tools that are needed to test the soil to make sure the plants have the right amount of food /nutrients so the plants will stay healthy

Go to Page 7 Let's find out what NP & K do for the plant. Each nutrient has a job that cannot be done by another nutrient

Nitrogen is a part of protein we get from food. Nitrogen is needed for leaf growth and green leaves – the muscle of the plant

Page 9: Phosphorus helps catch the sun's energy and is needed for healthy roots in the plant.

Page 10: Photosynthesis is the way plants use sunlight to make energy for themselves so they can grow. Green plants use yellow sunlight to make minerals in the brown soil into food.

Page 11 Potassium protects our Plants against diseases and helps the plant when it is cold or dry. It also helps the roots stay in place and helps the food to transfer in the plant

What happens to nutrients in the soil? Page 13

As plants grow the healthy roots take up the N-P-K and other needed nutrients as well as air and water from the soil. The plant acts like a vacuum cleaner.

Every time we harvest a crop, the nutrients go with that food and then we eat the food that gives us more nutrients. So nutrients are in the soil but sometimes there is not enough nutrients in the soil to feed a plant. That is why farmers have to add nutrients back to the soil the plant gets just the right amount of nutrients to stay healthy.

When you go home today I want you to show this book to your family. Tell them what you learned about NPK that we put nutrients NPK, (Nitrogen, Phosphorus and

Potassium) in the soil to grow healthy food that we eat so we can get the same nutrients that our bodies need to be healthy.

Next we are going to do an activity. We are going to make Garden Monsters! Show the monster, ask students where the grass is getting its nutrients from…in the soil!

Pass out activity—work in pairs.

Audience: High School FFA Students

Time: 45 minutes

Description: This presentation was with students, not teachers.

Materials:

Flash cards

Magnets

All participants got an NFL bag with bookmark, hairy grass guy, highlighter, one pager, magazines, comic books, etc.

Workshop:

Flash Cards: I used four decks of flash cards. When they walked in, everyone got a card. Once the workshop started I asked them to get up and find the other people in the room that had a card like theirs. Once they found their pair, I asked them to read and answer the card as a pair. Once everyone was matched up we discussed how this could be a game they could play in their community, etc.

Magnets. I asked them to create an agricultural awareness sentence from the magnet. I had five people come forward and read their sentences. We discussed the importance of being positive Agvocates.

I then presented a power point on the HCG program.

Next the top FFA chapters came forward and talked about their programs. We had one FFA member and their advisor speak!

Concluded with questions.

Environmental Educator Agenda

Event: MAEOE Conference (Maryland Association for Environmental and Outdoor Education)

Audience: Mainly Elementary Educators

Time: 60 minutes

Objective:

By the end of this workshop, participants will be able to lead their students in hands-on activities that teach about soil science, like a soil properties separation activity. By the end of this workshop, participants will comprehend the connection between feeding the world and healthy nutrient-rich soil. By the end of this workshop, participants will be equipped with lessons, activities, posters, and flashcards to make their soil science units effective and meaningful.

Materials:

* Farmer George Plants a Nation

* Post-It Chart Paper

* 2 Markers

* Apples

* Knives

* 4 Paper Bags

* Sharpies

* Rocks

* Dried Grass

* Dish with water

* 18 plastic cups

* ½ measuring cup

* Potting soil

* Sand- Rhoda

* Local Soil- Rhoda

* Vermicomposting materials - Rhoda

* CD cases*

* Food Coloring*

* Celery*

* Cup* Flashcards (35)

* NPK posters (30)

* Rubber bands for posters

* Highlighters (2 packages)

* Order Forms (30 copies)

* Curriculum (20 copies of each)

* Magazine (30)

* Gum (30)

Workshop:

1. Foundation and Curriculum Overview - 10 minutes

2. Apple Activity – 10 minutes

3. Soil Separation Activity – 15 minutes

4. Curriculum Overview – 10 minutes

5. Hands-On Soil and Air Space (elementary) – 5 minutes (page 78)

6. Celery Activity – 5 minute

7. Vermicomposting – 5 minutes (Rhoda's part!)

Science Teacher Workshop Agenda

Event: NSTA 2013 San Antonio

Nutrients for Life Exhibitor Workshop

What's Soil Got to Do with It?

Audience: Science Teachers

Time: 1.5 hours

Objective:

By the end of the workshop, teachers will be aware of the many activities and resources available to them from Nutrients for Life. By the end of the workshop, teachers have familiarity with the Nourishing the Planet in the 21st Century elementary curriculum and the Foundation's new phosphate mining video.

Brief description:

How do plants grow? Plant seeds of success and teach biological concepts through hands-on activities by growing plants in your classroom. The standards and inquiry-based Nutrients for Life elementary curriculum and supplemental materials will be provided as we explore properties of soil and how plant growth affects soil.

Preparation:

1. NSTA team conference calls

A. Tues, March 19, 2013 4:30PM EST

B. Thursday, April 4, 2013 4:30PM EST

Promotion:

1. Tabletop stand-up sign

2. Booth promotion – Hand sanitizer (booth handout), social media posts, e-mail blast, and NFL teacher e-newsletter, blog post

3. Raffle with Panera/ Starbucks gift cards?

Visuals:

1. Pull-up Banner at the door

2. Sample Material Table

3. Poster Table with rubber bands

4. Two sets of laminated posters around both sides of the room

5. PowerPoint slides with text from Paper Manipulative and spliced video for Reclamation section of Paper

Manipulative (see activity instructions #4 – c)

6. Videos (MOTS, elementary and Phosphate) –

On flash drive to be given to Nancy in Denver

Materials:

Teacher participants must sign-in to receive free materials (use of the 2 iPads or sign-in sheets)

1. Ziploc bags (500)

2. Single pull-up banner stand for hallway (ordered)

3. Panera Cards/Starbucks Cards (9 cards presently – Julie's office)

4. Projector/cords (Justin), laptop (Nancy)

5. Phosphate rock

6. Plastic disposable bowls (like for picnics) (200)

7. Tablecloth

8. Curriculum Binders 150 elementary, 5 middle school, 5 high school, and 200 flash drives

9. Note taking paper and pens

10. Soil samples (2 kits for giveaways)

11. DVD/flash drives of phosphate video and virtual classroom (50 each)

12. Apple (200)

13. NPK (200)

14. Periodic Table of Elements Posters (200)

15. Construction paper pre-cut (3 different colors, 6 inch strips then 200

full pages)

16. Glue

17. Big Box o'Markers

18. Rubber bands (200)

19. Laminated Posters

20. Tape for laminated posters

21. Full Sign

22. Black Logo Bags for Bundling (200) – temporary hire will pre-bundle these in office- to be shipped ready to go.

a. Highlighters (4 bags – 200)

b. "Garden Monster" Kits – (200)

c. There's What in My Food? (200)

d. Fun with the Plant Nutrient Team (200)

e. Word Magnets (200)

f. Rulers (200)

g. Teacher Trading Cards (200 cards)

h. Flashcards (200 sets)

i. Magazine (200)

Workshop: 1 ½ hour

1. As people filter in, Man on the Street video is playing at the front with low sound (Lights on)

2. Disperse bundled materials to educators before workshops begin.

3. Housekeeping – No posters in bags, but back in the room- welcome to roll up posters and take them with you. Mention binder or USB flash drive choices, feel free to take notes. Nancy or Joan

4. Ask teachers to work in pairs with word magnets: Ask teachers to take __ minutes and create at least two sentences about agriculture and/or soil science (however you want to word this), share a few sentences and link to Foundation Overview. During this time, circulate sign-in sheets and iPads. (10 minutes) Nancy or Joan

5. Foundation Overview by NFL team member – Joan (10 minutes)

6. Materials Available, including (10 minutes) - Joan

a. Virtual Classroom

b. Blog (learning garden)

c. Mention what is included in black bags

d. Introduce Nancy

7. Amy Andrews Video (6:25 minutes)

8. Elementary Curriculum Overview – Nancy Bridge (5 minutes)

9. Hands-on activity from elementary curriculum: (15 minutes)

a. Soil separation (wet and dry);

b. Air Space Activity;

c. Pea Seed Growth (paper towels in a cup);

d. Analyzing seed packets (graphing); or

e. Planning a garden model

10. Nancy Bridge – Phosphate Rock search with shark's teeth in small bowls (and any other activities and experience/sharing) (10+ minutes)

11. Play Phosphate Video (6:00 minutes)

12. Phosphate Activity - Paper Manipulative – Nancy Bridge (22 minutes)

13. Open Floor for Questions for team (2:75 minutes)

Pre-Service Teacher Agenda

Event: Clemson University, 2013

Audience: Pre-Service Teachers

Time: 5 hours 43 minutes (doesn't include Renee's parts)

Description: This workshop was for pre-service Ag teachers

Materials: plenty of free NFLF materials, magnets, apples, construction paper, scissors, markers, glue

Workshop:

1. Renee: Web Soil Survey and Soils CDE PowerPoint

2. Housekeeping – No posters in bags, but back in the room- welcome to roll up posters and take them with you. Mention binder or USB flash drive choices, feel free to take notes.

3. Man on the Street video (4:15 minutes)

4. Ask teachers to work in pairs with word magnets: Ask teachers to take __ minutes and create at least two sentences about agriculture and/or soil science, share a few sentences and link to Foundation Overview. (5 minutes)

5. Foundation Overview by NFL team member – (10 minutes)

6. Materials Available, including (10 minutes)

a. Blog (learning garden)

b. Mention what is included in black bags

c. Norman Borlaug section

7. Mention of Helping Communities Grow (10+ minutes)

8. LUNCH

9. Renee: After lunch, Soil Texture Lab: 30 minutes

10. High School Curriculum Overview (5 minutes), pre-post test

11. Hands-on activity from high school curriculum:

a. Periodic Table

b. Virtual Classroom Video (5 minutes)

c. Apple Activity (10 minutes)

12. Play Phosphate Video (6:00 minutes)

13. Phosphate Activity - Paper Manipulatives – (10+ minutes)

14. Renee - NPK Test Kit: 45 minutes (also return to room and work through some math on results)

15. Renee - Erosion & Percolation Demo along with Food Land & People Lessons: 45 minutes

Event: 2014 NSTA Boston Teacher Workshop Draft

"Digging through the layers of soil science"

Audience: High school and middle school teachers (50-100 participants)

Time: 60 minutes

Workshop:

Session Demographics

National Standards Focus: Science Content Standards – developing the knowledge and skills identified in the Standards in the context of the teaching and assessment standards.

Summary of proposal

* My session will address my chosen National Standard by sharing knowledge and activities to enrich educators' lessons on soil.

* Session Abstract:

Need to add life to your soil science lessons? Soil is essential to a plant's success and plays a huge role in feeding the world, but how do we show that to our students?

In this workshop, attendees will review twelve hands-on soil science activities that are ready for the classroom. Lessons and activities will include students taking on the role of 'plant doctor,' making and using a soil percolator, case study of environmental law, examining soil properties, and a soil horizon activity. Plant the seeds of success with this collection of activities, which are sure to encourage inquiry and learning for middle and high school students.

Attendees will get a first look at the updated edition of the Nutrients for Life Foundation Nourishing the Planet in the 21st Century High School curriculum written with BSCS and favorable reviewed by the Smithsonian Intuition and other lesson plans and materials. Additionally, attendees will participate in as many of the soil science hands-on activities as we can fit in one hour.

The Dirty Dozen:

1 to 6 – Lessons for the new edition of the high school curriculum

7. Soil Percolator

8. Garden Monsters

9. Phosphate Video/ Potash Video

10. AP Environmental Activity

11. iPad App

12. The importance of pH/Soil Testing

Others: Magnet Activity

Other titles:

Get to the core of soil science

Digging through the layers of soil science

Interest Approach

Beach Ball Quiz

Time: 10-15 minutes

Get your students thinking by answering soil science questions with a beach ball! Number the beach ball on all of the different sections from #1-18. When you toss the numbered ball to a student, he or she should read the number where their right thumb landed on the ball. Ask the question with the corresponding number. After the student answers correctly, have him or her to toss the ball to another person and proceed with another question.

(Most of the questions below are from the Elementary and Middle school Nourishing the Planet in the 21st Century lesson pre and post-tests.)

1. How many different elements do plants need to be healthy? Answer: 17

2. Nutrients enter root cells through what process? Answer: Diffusion

3. True/False: Soil contains both organic and inorganic mater. Answer: True

4. Plants primarily extract nutrients from where? Answer: Soil

5. Approximately what percentage of land is devoted to farming? Answer: 11%

6. Fertilizers help increase or decrease food productivity? Answer: Increase

7. Plants transport water from the roots through the _____? Answer: Xylem

8. Plants transport food from the leaves through the _____? Answer: Phloem

9. True/False: Soil serves as a nutrient bank for plants. Answer: True

10. What do plants primarily use to absorb water? Answer: Root hairs

11. What are the 3 essential components of most fertilizers? Answer: N-P-K

12. Soils _____.

a) Serve as a nutrient bank for plants

b) Contain both organic and inorganic material

c) Differ in their ability to hold and transmit water

D) all of the above

Answer: D

14. What country did Dr. Borlaug leave the U.S. to work as a geneticist and plant pathologist? Answer: Mexico or India

15. Soils have _____ nutrients in them after plants grow.

a) More b) less c) the same amount

Answer: B

16. Fertilizers

a) Make soil change color

b) Keep soil moist

c) Remove nutrients from the soil

d) Add nutrients to the soil

Answer: D

17. True/False Soil includes nonliving things and living microorganisms. Answer: True

18. Plants require similar or different essential elements to humans. Answer: Similar

On Target with the Periodic Table

Time: 5 – 10 minutes

Nothing encourages workshop participation more than a little healthy competition. Add a fun spin to assessing workshop participants' knowledge by using the dartboard at the beginning of your workshop.

The poster highlights the elements essential to plants, such as the primary macronutrients, secondary macronutrients, and the micronutrients. Use an easel to prop up the dartboard and your workshop attendees will be ready to take aim at soil science. Use questions from the NFL flashcards to quiz participants. For a correct answer, the participant gets to throw a dart at N, P, or K. Participants can take home their own poster or request the periodic table of elements poster, Nourishing the Planet in the 21st Century curriculum, and corresponding flashcards by e-mailing info@nutrientsforlife.org.

Classroom version: After teaching lessons on soil and plant science from the Nourishing the Planet in the 21st Century curriculum, teachers can review key concepts, quiz questions or use our curriculum-based flashcards to supply questions. Place students in heterogeneous teams. With masking tape, mark a standing line four to twelve feet from the board from which students can throw darts. Assign one student from each team as the official Line-Watchman; it is the Line-Watchman's important duty to referee the other team so they do not step over the line. When a student answers a question correctly, he or she gets to throw a dart. Nitrogen (N), Phosphorus (P), or Potassium (K) serve as the bull's-eye of the game. If a steady handed student lands on one of those elements, they earn 10 points for their team. Landing on secondary macronutrients earns the team a decent 8 points. If the contestant hits a micronutrient element, the team earns 5 points. Finally, any other element on the periodic table earns the team 1 point. May the sharpest student win!

Find Your Partner in a Flash Flashcard Matching

Time: 5-8 minutes

Materials: 1-2 sets of the NFL Flashcards

This can be a great opener for a group of Ag or Science teachers or a great quiz if working with students. Depending on the group size, use one or two sets of the Nutrients for Life flashcards and glue cardstock to cover the answers on half of the cards and the questions on the other half. Ask the participants to find their "match" and sit or line up. When finished, or time is up, review the questions and answers and correct them if needed.

*There are multiple questions that have the answer "nitrogen," etc., so make sure the participants know to keep looking for their match until it is one question with one answer.

Norman Knows

Soil Quotes Activity

Grade Levels: 5-12

Time: 15 minutes

Group Size: 30

Brief Description:

Norman Borlaug is:

* A man that's been credited with saving hundreds of millions of lives from starvation.

* A man that's earned the Nobel Peace Prize for his work in agriculture.

* A man who ultimately is regarded as one of the "100 most influential individuals of the 20th Century."

This activity can be used as in a workshop by using the described procedure below. For classroom use, teachers can use the same procedure OR display the quotes on a projector. Have students write a paragraph about the quote. The questions can be used as writing prompts. Students may need to be guided to realize the common theme between all the quotes is that soil is important.

Subjects Taught: Language Arts

Objectives: Students will learn about the importance of soil through written quotes.

Materials Needed: Quotes printed out on cardstock.

Procedure:

1. Hang soil quotes around the room

2. Have students read them and then stand by the one that they like best

3. Ask them questions about the quote

a. What does this quote mean to you?

b. What do you think it meant to the author

c. Is this quote still relevant in today’s world?

d. What do you like about this quote?

e. What is the author’s tone?

f. What does the quote remind you of?

Adapted from IAITC Say It With Soil developed by the mAGic writing team for the Soil mAGic kit www.agintheclassroom.org

"Civilization as it is known today could not have evolved, nor can it survive, without an adequate food supply."

—Norman Borlaug

"There are no miracles in agricultural production."

—Norman Borlaug

“I am but one member of a vast team made up of many organizations, officials, thousands of scientists, and millions of farmers—mostly small and humble—who for many years have been fighting a quiet, oftentimes losing war on the food production front.”

--Norman Borlaug

"Almost certainly, however, the first essential component of social justice is adequate food for all mankind”

—Norman Borlaug."

“A nation that destroys its soil, destroys itself.”

--Franklin D. Roosevelt; 1937

“We know more about the movement of celestial bodies than about the soil underfoot.”

--Leonardo daVinci; 1500’s

Soil Nutrient Cadence – Get your troops moving!

Time: 3 minutes, including instruction time

Get your workshop attendees into line with this fun military cadence activity. Have your attendees march in place, around the room or, weather permitting, outside while practicing this fun call-out and answer activity:

Teacher: Students:

Well, I don't know what you've been told Well, I don't know what you've been told

Phosphate is really old Phosphate is really old

Nitrogen will keep plants green Nitrogen will keep plants green

Potassium and that's the team Potassium and that's the team

Sound off 1, 2

Sound off 3, 4

Well, soil isn't all just muck Well, soil isn't all just muck

Even when it's muddy and yuck Even when it's muddy and yuck

Plants need nutrients from soil Plants need nutrients from soil

It's worth more than even oil It's worth more than even oil

Now we need the world to know Now we need the world to know

Without good soil, our food won't grow! Without good soil, our food won't grow!

Lead in Lead in

Lead out Lead out

Blueberry, strawberries and apple pie Blueberry, strawberries and apple pie

Won't be around if the earth goes dry Won't be around if the Earth goes dry

Let's help our farmers with this song Let's help our farmers with this song

We need nutrients to grow strong We need nutrients to grow strong

Nutrients for Life and teachers show Nutrients for Life and teachers show

Everything plants need to grow! Everything plants need to grow!

Magnet Word Scramble

Time: 5 – 10 minutes

This is a nice activity to get workshop participants' minds on soil and agriculture. Cross-curricular lessons are an important part of learning in today's classroom. Teachers are always looking for ways to link one subject area to another. At Nutrients for Life Foundation, we redesigned our Word Magnets to be a ready-to-go cross-curricular activity, bringing an English lesson into your workshop and the science classroom.

On the magnet, each agriculture-themed word is color coded for various parts of speech, such as noun, verb, or adjective. Workshop attendees can work individually or in groups to create as many sentences as possible in five minutes. One workshop participant in the group should record each complete sentence to share with the class. As groups present their sentences to the class, the presenter should facilitate discussion about world food supply and agriculture. This activity goes nicely with Nutrients for Life's middle school curriculum, Nourishing the Planet in the 21st Century, Lessons 5 and 6.

Activities

Nourishing the Planet in the 21st Century

Excerpt from Lesson 5

“The Big Apple”

Grade Level: 7th to 12th

Common Core: Includes Mathematics/Fractions

This activity uses an apple as a model of Earth. Students discuss the various ways people use land and make predictions about what percentage of Earth’s land is needed to grow our food.

1. Explain to the class that this activity is concerned with how we as a society use land. The amount of land on Earth stays the same, so as the world’s population gets larger, it becomes even more important that we make wise decisions about how it is used.

2. Explain that land is used for many different reasons. Ask, “What are some of the most important uses for land?” Write students’ responses on the board or on chart paper.

Students’ responses may include the following:

* Farming.

* Homes.

* Industries or places where we work.

* Pastures or land for livestock.

* Parks, sports, and recreation.

* Wildlife habitat (wetlands, mountain ranges, forests, deserts, beaches, and tundra).

If a student does not mention one of these uses, ask guiding questions to encourage this line of thought. A student may point out that some land such as a desert has no use. Of course, any land that is not being used by humans can be considered a habitat for wildlife and provides a variety of other economic services for people. For example, wetlands help remove nutrient pollution from rivers, lakes and estuaries.

3. Call attention to the apple and the knife. Explain that the apple represents Earth. Ask, “How much of the total Earth’s surface do you think is devoted to farming?”

Students' responses will vary. Some may remember that about 70 percent of the surface is water.

4. Use the knife to cut the apple into 4 equal parts. Set 3 parts aside and hold up 1 part. Explain that the surface of the world is about 70 percent water, so this 1 piece represents that part of the surface that is land. Remind students of the many different uses for this relatively small amount of land.

5. Use the knife to cut the 1/4 piece of apple in half 3 more times, each time discarding 1/2. Finally, hold up 1 of the smallest pieces and explain that it represents 1/32 of the surface of Earth or 1/8 the land where we live. This is the amount of land available for farming. Point out that the skin on this small piece of apple represents the tiny layer of topsoil that we depend on to grow food.

6. Explain that because we put land to so many different uses, the amount devoted to farming has hardly changed during the past 50 years. Scientists are worried about how we will feed the world's growing population in the next 50 years.

Edible Soil Layers Activity

Grade Levels: K-12

Time: 15 minutes

Group Size: Any

Brief Description: Soil has many layers. Each layer is different and has certain distinct characteristics. The composition of soil determines what the soil is used for and why it is important. This edible activity will help students learn about each layer. A description of each layer is listed with each material. Instructor can decide how in detail to go on each layer.

Objectives: Students will learn about the different layers of soil.

Materials Needed:

* Chocolate Pudding

* Crushed Oreos

* Roughly chopped graham crackers

* Butterscotch chocolate chips OR round tan cereal (ex: Kix, Reese's Puffs)

* Green coconut (colored with green food coloring)

* Sprinkles—preferably a mixed variety with three colors

* Gummy worms

* Small clear cups and spoons

Procedure:

1. Prepare or buy chocolate pudding

2. Have students fill their cups in the following order and explain what each ingredient represents:

a. Butterscotch chocolate chips—represents bedrock. Bedrock is usually a light tan color and is made of rock from the compressed layers of soil above it. Plant roots do not reach this layer.

b. Chopped graham crackers—represents a layer of parent material. A layer of parent material exists between bedrock and subsoil and can contain rocks. Organisms don't exist, and chances of plant roots entering it are low. This can be found 5 feet below our feet, but it varies on location.

c. Chocolate pudding—represents subsoil. Subsoil contains some nutrients but is also rich in clay. Subsoil can be found 2-4 feet below are feet.

d. Crushed Oreos—represents topsoil. Topsoil is rich in nutrients, such as Nitrogen, Phosphorus and Potassium. Topsoil is essential for plant growth. Topsoil can be as deep as 2 feet.

e. Gummy worms—represents gummy worms! The topsoil is alive with organisms and organic matter.

f. Green coconut—represents the grass and many plants that grow in the soil.

g. Sprinkles—represent fertilizer. Plants take nutrients from the topsoil and need to be preplaced with fertilizer. Fertilizers play an important role in keeping the soil healthy and in growing our food.

Farm Board

Level: Elementary School

Learning Activity: Stations Activity

Objective: Students will comprehend that plants need healthy soil. Students will recognize N, P, and K as essential nutrients. Students will recall basic benefits of each nutrient in the soil.

Nutrients for Life Foundation is often invited to Ag Days or other special events where students, particularly elementary, participate in 15-20 minute stations agriculture. There's need for a quick and direct education visual for farm tours, you-pick-it farms, and educational field trips to the farm.

The Foundation has created visual boards with the three N, P and K characters from the Plant Nutrient Team book. In the station, regional representatives, station attendants, or farmers can pass out stick-on NPK and soil items from the board. Students hold these items throughout the lecture/discussion and then place their item in the correct spot, where it pertains to the content. For instance, one child will place "'Mr. K" so that it help cure the crop disease blob on the board. Since so many elementary school children attend pumpkin field trips in the fall, we incorporated pumpkins throughout the visuals.

Garden Monster Activity

Grade Levels: 2-6th

Time: 15 minutes

Group Size: Any

Brief Description: Students will make a garden monster, similar to a chia pet. If presenting at a workshop, teachers can each make one or simply have one teacher volunteer to help demonstrate.

Materials:

* Potting soil

* Grass seed

* Recycled lids

* 10”x10” nylon net or women’s sheer toe stocking

* Wiggle eyes

* Nails

* Double sided tape

* Tiny zip ties

Instructions:

1. Heap a spoon full of grass seed on center of netting or at bottom of stocking

2. Put a scoop of potting soil directly on top of seed grass (pair with picture)

3. Gather up netting at corner and create a solid tight ball or form stocking into a ball (pair with picture)

4. Pull zip-tie tight to hold ball or tie end of stocking in a knot

5. Trim zip tie and netting (pair with picture)

6. Soak the monster in water and then set the garden monster in a container for continuous water supply.

7. Decorate! Attach wiggle eyes, use construction paper to make clothes, or add a bow to the soon to be “hair.” Don’t forget to give you monster a haircut every once in awhile!

Helpful tips:

* If using stockings, make sure to use the sheer toe

* It helps to place stocking over a cup or a cut poster tube to make it easier for the students to add the soil

* Make it a recycling activity and have students reuse something for the container (milk carton, yogurt cup, etc.)

* Make it an experiment! Will your monster grow better or worse using fertilizer?

Learning from Soil

Age: 4-5 grade

Time: 15-20 minutes

Group Size: any

By the end of this activity participants will identify nutrients that are in the soil and the importance of soil testing.

There are many types of soil and nutrients are naturally found in soils. Knowing what nutrients are in the soil help farmers only applying additional nutrients that are necessary for their plants to grow healthy. It is just as important for people to understand their lawn own soil and what is necessary to maintain their lawn.

Materials needed:

* Sample soil test results

Instructions

1. Have participants to take a minute and review the soil test results from the residential soil test.

2. Ask participants to find the answers. (In a large group or small groups)

a. What crop is the soil test for? (Lawn Maintenance – Bermuda, Zoysia fescue)

b. What nutrient does the lab recommended to apply? (Lime)

c. How many pounds per acre of Potassium do the results show in the soil? (97 pounds per acre)

3. Have participants to review the agriculture soil test results.

4. Ask participants to answer the following:

a. What crops are the soil tests for? (Answer: Corn and soybeans)

b. What nutrients do the lab recommended to apply with sample 1C for soybeans next year? (Sulfur, Manganese, and Boron)

c. Why does this farmer switch corn to soybeans in different seasons? (Explain benefits of crop rotation)

d. What is the pH of the soil in sample 3P? (4.8 pH)

e. Why is pH important? The correct pH for the correct crop allows the plants to take in nutrients.

f. How many pounds per acre of potash do the results recommend with sample 4C for growing soybeans? (50 pounds per acre)

Discuss with the participants the benefits of know what nutrients are in the soil and what crop will be growing in the soil. A few things that can be discussed:

1. Nutrients are already in the soil. From test results we know the fertilizer and amounts to apply to a field. Only what is necessary. This limits waste and costs.

2. Different crops require different amount of nutrients for optimal growth. It is important to know the soil to have the best yield results from the crop. This allows farmers to produce more food on fewer acres and is key to feeding our global population.

Seed Logic Puzzle

Students in Mr. Nitrogen's class learned the importance of soil, soil testing and fertilizer. After carefully planning the school garden, each student was assigned seeds to plant. To find out who planted what, use the clues and seed packet information below to fill in the chart. When you find a match, write **yes** in the appropriate box. If it doesn't match, place an **X** in the box.

Student	Planted Peas	Planted Bell pepper	Planted Fennel	Planted Parsley
Emily				
Rick				
Debra				
Jerry				

Clues:

- Jerry planted his favorite vegetable.
- Emily was disappointed with what she was assigned because the seeds had the longest germination time, and she was afraid they wouldn't germinate before school let out for summer.
- Rick planted an herb, and his seeds were a little bigger than Emily's.
- Debra received the largest seeds to plant.

Seed Packet Information:

Seeds/Plants	Seed Size	Approximate Germination Time (Days)
Peas	Large	3-5 days
Radishes (2 varieties)	Medium	4-7 days
Carrots (short variety)	Small	10-25 days
Fennel	Small/medium	14 days
Beets	Medium	5-25 days
Coriander (cilantro)	Medium	7-10 days
Parsley	Small	21-28 days
Bell pepper	Medium	10-12 days
Lettuce (leaf)	Small	7-14 days
Lettuce (romaine)	Small	5-10 days
Chives	Small	8-12 days
Chard	Small/medium	10-15 days

Logic Puzzle Answer Key:

Student	Planted Peas	Planted Bell Pepper	Planted Fennel	Planted Parsley
Emily	X	X	X	YES
Rick	X	X	YES	X
Harriet	YES	X	X	X
Gerry	X	YES	X	X

What: Board game on the nitrogen cycle

Level: High School, including Advanced Placement, Honors, and International Baccalaureate Classes

Time: 15 minutes with educators

Make the sophisticated concept of the nitrogen cycle fun for students with this engaging board game activity!

The Nitrogen Cycle Game,

from *It's All about the Food*

Although 78% of the air we breathe is nitrogen (N) and although there is much nitrogen tied up in the organic fraction of the soil, plants are unable to use this nitrogen for their growth. A process known as nitrogen fixation – biological and synthetic industrial fixation – must occur for nitrogen in the air to be converted to forms plants can use. Use the following game after a discussion on nitrogen fixation, ammonium, volatilization, nitrate and denitrification.

It's All about the Food is a high school teacher's resource manual focuses on problem solving and critical thinking in relation to food. *It's All about the Food* is divided into three sections to teach students about food production, plant nutrients and fertilizer.

Procedure

Read the rules as a class and distribute the envelopes containing the game. Give the students a designated amount of time to play. If students in their individual group have a winner prior to the end of the designated time, let them play the game again. At the end of the allotted time for the game, have students return the game components to the envelope and review nitrogen cycle terms, which are found on the "Student Fact" page. Finally, distribute nitrogen cycle assessment questions to assess learning.

Game Directions

Number of players per group: 2 to 6

Rules

1. Players will decide who will play first, second, third…sixth.
2. Players will place their markers in the space labeled **Atmospheric Fixation, Biological Fixation** or **Industrial Fixation**. Up to two markers may be placed on each of the labeled spaces for entry into the given pathways.
3. Players will take turns spinning the spinner and moving their markers according to the directions designated by where the pointer of the spinner stops. Players must move their markers in the direction indicated by the arrows on the game board.
4. If a player lands on a labeled **Kickstart** space, he or she will advance his or her marker 10 spaces. **Kickstart** spaces help equalize distances of pathways comprised of a greater number of spaces.

Winning the Game

The first player who returns his marker to "Atmospheric Nitrogen" will explain his or her point of entry (meaning of atmospheric fixation, industrial fixation, or biological fixation) and will describe the pathway followed. Once the player has successfully completed the explanation, that student is declared the winner.

An alternate version of the game can be extended over several days or played when students have ample time for playing: The player who progresses through the cycle the greatest number of times following different pathways is the winner. Each player must explain points of entry (meaning of atmospheric fixation, industrial fixation, or biological fixation) and describe pathway each time he or she completes the cycle.

Completed cycles are counted. To prevent confusion, one student needs to be responsible for recording on paper the name of each student and a brief description of each student's completed cycles. If playing the game will continue on another day, students should attach their markers to the game board with removable-magic™ tape.

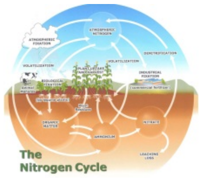
Assessment:

Students should be able to answer the following questions:

1. What is nitrogen fixation?
2. Why is nitrogen fixation necessary?
3. What are the two major ways that nitrogen fixation occurs?
4. What are legumes and what do they have to do with nitrogen fixation?
5. Why is industrial fixation of nitrogen necessary?
6. Draw the nitrogen cycle. Include atmospheric, biological, and industrial fixation.

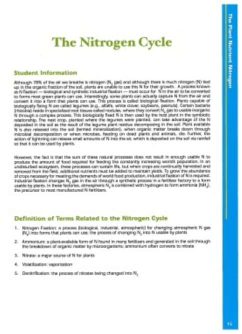
Do you know any great soil science games? We would love to hear about them! Tell us all about it at info@nutrientsforlife.org.

(Attach the following images to this article are available in *It's All About Food*: Nitrogen Cycle, Nitrogen Cycle Board, Nitrogen Cycle Wheel and Player Pieces, and Student Fact Page)







The Nitrogen Cycle

Student Information

Although 78% of the air we breathe is nitrogen (N_2 gas) and although there is much nitrogen (N) tied up in the organic fraction of the soil, plants are unable to use this N for their growth. A process known as N fixation — biological and synthetic industrial fixation — must occur for N in the air to be converted to forms most green plants can use. Interestingly, some plants can actually capture N from the air and convert it into a form that plants can use. This process is called biological fixation. Plants capable of biologically fixing N are called legumes (e.g., alfalfa, white clover, soybeans, peanuts). Certain bacteria (rhizobia) reside in specialized root tissues called nodules, where they convert N_2 gas to usable inorganic N through a complex process. This biologically fixed N is then used by the host plant in the symbiotic relationship. The next crop, planted where the legumes were planted, can take advantage of the N deposited in the soil as the result of the legume plant residue decomposing in the soil. Plant available N is also released into the soil (termed mineralization), when organic matter breaks down through microbial decomposition or when microbes, feeding on dead plants and animals, die. Further, the action of lightning can release small amounts of N into the air, which is deposited on the soil via rainfall so that it can be used by plants.

However, the fact is that the sum of these natural processes does not result in enough usable N to produce the amount of food required for feeding the constantly increasing world's population. In an undisturbed ecosystem, these processes can sustain life, but when crops are continually harvested and removed from the field, additional nutrients must be added to maintain yields. To grow the abundance of crops necessary for meeting the demands of world food production, industrial fixation of N is required. Industrial fixation changes N_2 gas in the air through a synthetic process in a fertilizer factory to a form usable by plants. In these factories, atmospheric N_2 is combined with hydrogen to form ammonia (NH_3), the precursor to most manufactured N fertilizers.

Definition of Terms Related to the Nitrogen Cycle

1. Nitrogen Fixation: a process (biological, industrial, atmospheric) for changing atmospheric N gas (N_2) into forms that plants can use; the process of changing N_2 into N usable by plants
2. Ammonium: a plant-available form of N found in many fertilizers and generated in the soil through the breakdown of organic matter by microorganisms; ammonium often converts to nitrate
3. Nitrate: a major source of N for plants
4. Volatilization: vaporization
5. Denitrification: the process of nitrates being changed into N_2

The Plant Nutrient Nitrogen

15

Nourishing the Planet in the 21st Century Elementary

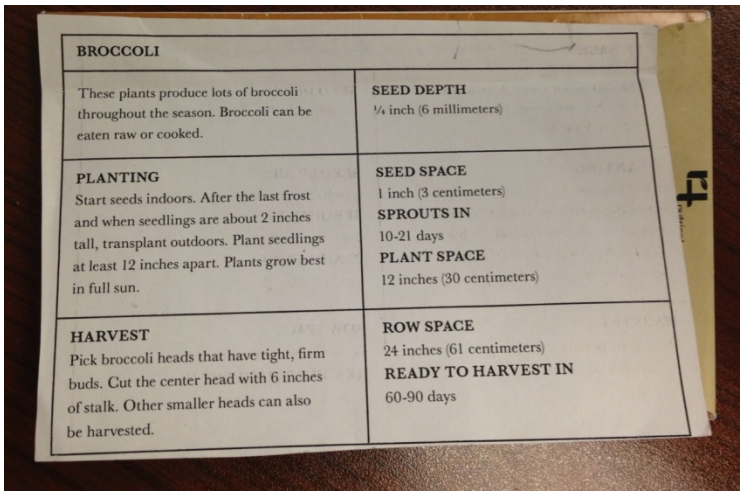
Lesson 4 & 5: Workshop Mode

Level: Elementary

What: Activity from the curriculum

Time: 15 minutes with educators

This workshop activity allows teachers to become more familiar with the elementary curriculum. Students plan a garden based on spacing and nutrient needs in this activity.



BROCCOLI	
These plants produce lots of broccoli throughout the season. Broccoli can be eaten raw or cooked.	**SEED DEPTH** ¼ inch (6 millimeters)
PLANTING Start seeds indoors. After the last frost and when seedlings are about 2 inches tall, transplant outdoors. Plant seedlings at least 12 inches apart. Plants grow best in full sun.	**SEED SPACE** 1 inch (3 centimeters) **SPROUTS IN** 10-21 days **PLANT SPACE** 12 inches (30 centimeters)
HARVEST Pick broccoli heads that have tight, firm buds. Cut the center head with 6 inches of stalk. Other smaller heads can also be harvested.	**ROW SPACE** 24 inches (61 centimeters) **READY TO HARVEST IN** 60-90 days

Materials:

1. Seed packets (optional)
2. Copies of Masters from Lessons 4 & 5
3. Glue
4. Scissors

Directions:

Walk teachers through Lessons 4 & 5 (see curriculum for directions)

Optional: Attach/glue "Seed Packet Information" (Master 4.4) to seed packets for a nice take-home reminder of the lesson (see picture).

A PowerPoint to accompany these lessons can be found here:

L:\Foundation\2013\Curriculum\Elem Lesson 4_5 ppt and files

"What Plants Need" Bracelet Activity

This fun bracelet activity is a great way to introduce the three essential plant nutrients: nitrogen (N), phosphate (P) and potassium (K). As students put the various beads together on the bracelet, they will have a better understanding of what plants need to grow. Also, use Nutrients for Life's elementary activity book, Fun with the Plant Nutrient Team, to enrich the lesson. If using with the booklet, build the bracelet as students work their way through the book. Interestingly, plants do not technically need soil to grow, as seen with air plants and hydroponic setups, but simply the essential plant nutrients (N-P-K).

Grade Levels: 2 to 6 Length: 10 minutes; 25 minutes when used with Fun with the Plant Nutrient Team Group size: This activity works well in both small group and large settings

Objective: Students will be able to recall what conditions plants needs to grow, such as plant macronutrients (in the soil), sunlight, water, and air.

Materials needed: (One per student)

Note: We purchased individual N, P, and K (9mm) alphabet beads at http://www.namebeads.com.

1. Green chenille sticks (pipe cleaners) or green ribbon

2. Green pony beads

3. Clear pony beads

4. Black or brown pony beads

5. Yellow pony beads

6. Light blue pony beads

7. N, P, K 9mm beads (optional)

8. Purple pony beads

9. White pony beads

Procedure: Place each bead on the chenille stick, while reviewing what each bead represents.

1. (Green chenille stick)—Plants: Farmers grow plants that require nutrients from the soil

2. (Black or brown bead)—Soil: Farmers help to protect the environment by testing their soils to learn if the soil contains the right amount of nutrients. If nutrients are missing, the farmer will add more by adding fertilizer. The 3 main nutrients needed for plant growth are N, P, and K.

3. (N bead - optional) — Nitrogen

4. (Green Bead)—Nitrogen helps the plants be green and healthy

5. (P bead - optional) — Phosphorus

6. (Purple bead)—Without Phosphorus, old plant leaves turn purple

7. (K bead - optional) — Potassium

8. (White bead) — Potassium is salt left over from evaporated oceans

9. (Clear bead) — As plants grow, they take up nutrients, as well as air from the soil

10. (Light blue bead) — Water

11. (Yellow bead) --- Sunlight

In Search of Essential Nutrients

Nutrition Label Activity

Grade Levels: 5-12
Time: 45 minutes
Group Size: 30

This activity is a mix of Lesson 1 in the High School/Middle School curriculum and a health lesson.

Brief Description: Students explore the meaning of essential nutrients, using periodic tables to compare the elements that are essential to people and plants. Students make predictions as to where in the environment plants obtain each of their essential elements.

Subjects Taught: Science, Language Arts

Objectives: The students will:

1. Define an essential element;
2. Compare and contrast the essential nutrient requirements of plants and humans;
3. Explain why plants cannot use elemental nitrogen found in the atmosphere; and
4. Identify the sources for each essential nutrient needed by plants.

Materials Needed:
Provide nutrition labels from boxes of cereal (or photocopies), like Quaker Oats® Breakfast Bars, which feature phosphorus and potassium on the label or Cheerios®. Also, have a nutrition label from a snack food, such as a candy bar.
Prepare the images from Masters 1.1to 1.6 in the media available to you.
Colored Pencils – one per student
Projectable images from *Nourishing the Planet in the 21st Century*:

- Master 1.1, ***Essential Nutrients;***
- Master 1.2, ***The Periodic Table***;
- Master 1.4, ***Essential Plant Nutrients***;
- Master 1.5, ***Essential Human Nutrients;***
- Master 1.6, ***Sources of Essential Nutrients***

One photocopy per student:

- Master 1.2, ***The Periodic Table;***
- Master 1.3, ***Chemical Symbols of the Elements;***
- Master 1.6, ***Sources of Essential Nutrients***

Background Information: There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances we encounter. Out of that list of 100 elements, plants require 17 essential nutrients to complete their life cycles; germinate, grow, build tissue, flower, pollinate, produce seed or vegetative structures to reproduce (runners, tubers, bulbs, rhizomes, etc.) and/or survive cold or dry periods. A nutrient is considered essential if it is required by the plant to complete its life cycle, cannot be replaced by another nutrient, is directly involved in the plant's metabolism, and is required by many different plants. These nutrients are identified on Master 1-4. Plants that grow on land obtain these nutrients from air, water and soil.

Cells carry on the many functions needed to sustain life. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or organism needs. Plants and humans require similar sets of essential nutrients. The essential nutrients needed by humans are identified on Master 1-05.

In the context of plant requirements, carbon, oxygen, and hydrogen are called the non-mineral nutrients. Some essential nutrients are obtained from more than one source. For the purpose of this activity, you want students to realize that plants obtain their nonmineral nutrients (carbon, hydrogen, and oxygen) from the air and water, while the rest come from the soil.

Activity One: Essential Nutrients

1. Begin the lesson by explaining that scientists who are interested in studying human health must understand the specific needs of the body. Ask:

   "What do humans need to live?"*(Answers will vary.)* Accept all answers.

2. Write student responses on the board, on an overhead transparency, or using an electronic board.
3. Direct the discussion to elicit air (oxygen), water, and food. Some students may realize that sleep is also required for survival. Other students may suggest environmental conditions such as temperature and pressure or material things such as clothing and shelter.
4. Remind students that life requires energy for its existence. Ask students:

   "What do people take into their bodies from their environment to help them survive?"

(Students should recognize from their previous answers that air, water, and food are obtained from the environment.)

"What do we need from the air?" *(It is the oxygen in the air that we require.)*

"Why do we need water? (*Students should be able to explain that our cells are mostly made of water. Water is the medium in which life has evolved. It is required for the chemistry of life.)*

"Why do we need food to survive?" (*Students should recognize that we derive chemical energy from food and that food supplies the chemical building blocks needed by our cells.)*

5. Remind students that humans (and animals) eat plants and other animals to obtain chemical energy and provide them with the building blocks needed by their cells. Ask:

   "Do plants need food?" *(No, not in the sense that humans or other animals eat food. Plants do not eat. Plants make food from minerals, water, and gasses. Plants do need nutrients. What may be commonly be called "plant food" is actually fertilizer.)* Make sure students realize that PLANTS DO NOT EAT! Plants absorb nutrients from soil as they take in water. Plants absorb carbon dioxide through their leaves from the atmosphere during photosynthesis.
6. Explain that they will now investigate the chemical elements that are essential for plant growth.
   a. Display an image of Master 1.1, ***Essential Nutrients***.
   b. Ask different students to read aloud the criteria that describe an essential element.
7. Pass out a copy of Master 1.2, ***The Periodic Table*** and a copy of Master 1.3, ***Chemical Symbols of the Elements*** to each student.
8. Instruct the class to think about the definition of "essential element" and use a colored pencil to shade those elements on the periodic table that they think are essential for healthy plant growth based on the information they have learned in the past.
   a. If possible, students should think of an example of how a given element is used by the plant (such as nitrogen being used to make protein).
   b. Give students about 5 minutes to complete this task. This step gives you an opportunity to assess how well students can relate their knowledge of chemistry to biology. For example, students may respond that carbon is used to make sugar. Students likely will not be able to suggest a function for elements needed in trace amounts. Usually, such elements are needed as cofactors for enzymes. It is not important to discuss the uses of each

element, but it is important that students understand that these elements are needed to build cell structures and to carry out the cell's chemistry through enzymatic reactions.

9. Display an image of Master 1.2, ***The Periodic Table***.
   a. Ask a student volunteer to read aloud the elements shaded on his or her periodic table. b. Have the volunteer explain why he or she selected those particular elements.
   c. Have additional students add to the list with their predictions.
   d. As the elements are read off, circle them on the image.
   e. Students are not expected to identify the complete list of essential elements. Their responses, however, will reflect their relative knowledge about the biology of plants.
10. Explain that you are now going to reveal which elements have been shown to be essential for plant growth and compare them with students' predictions. Display an image of Master 1.4, ***Essential Plant Nutrients***.
    a. Students likely will be surprised that so many elements are essential for plant growth.
    b. The comparison between the elements predicted by the students and the accepted ones should show some overlap, especially among the most abundant elements: carbon (C), hydrogen (H), nitrogen (N), oxygen (O), phosphorus (P), and sulfur (S).
    c. If not already mentioned, ask students to name an important molecule in the cell that requires the element phosphorus. If not mentioned, you can explain that the most important energy molecule in the cell is adenosine triphosphate (ATP) and it includes the element phosphorus.
11. Ask:
    "Do you think that humans require the same essential elements as plants?"
    (Responses will vary. Some students may think that since humans and plants are very different from each other, they will need different sets of elements. Others may reason that since plants and humans are each made of cells, the essential elements needed by both will be similar. Still others may think that since all of the food humans consume ultimately begins with plants that the nutrients may be similar or exactly the same.)
12. Display an image of Master 1.5, ***Essential Human Nutrients.***
    a. Ask students to comment on how similar or dissimilar the pattern of elements is compared with that shown previously for plants.
    b. Students should notice that the two patterns are more alike than different. If using transparencies, you can align and overlap the transparencies of Masters 1.4, ***Essential Plant Nutrients*** and 1.5, ***Essential Human Nutrients*** to make this point clearer. If using other technology circle the similarities.

13. Referring to the box of cereal and candy bar nutrition labels, ask students what types of nutrients they think humans need and how different foods can provide those nutrients. Have the students look at the labels on the two boxes to see how they compare. Ask:

    "Which nutrients from both labels are the same?"

    a. Have students share with another student in their proximity the ingredients listed on the labels.
    b. Have students refer back to the periodic table of elements. Which of the nutrients from the nutrition label can students find on the periodic table?
    c. Which of the nutrients on the labels are also nutrients that plants need?
    d. Ask students to compare some of the common nutrients that plants and humans both need, such as calcium, copper, iron, magnesium, phosphorus, potassium and zinc.
    e. Based on cereal nutrition label, have five students share which of their foods seem to provide the most nutrients for humans and create a visual list.
14. Summarize the concept that nutrients plants require to grow are the same nutrients humans need to grow; humans receive these nutrients from plants.

Evaluation Options:

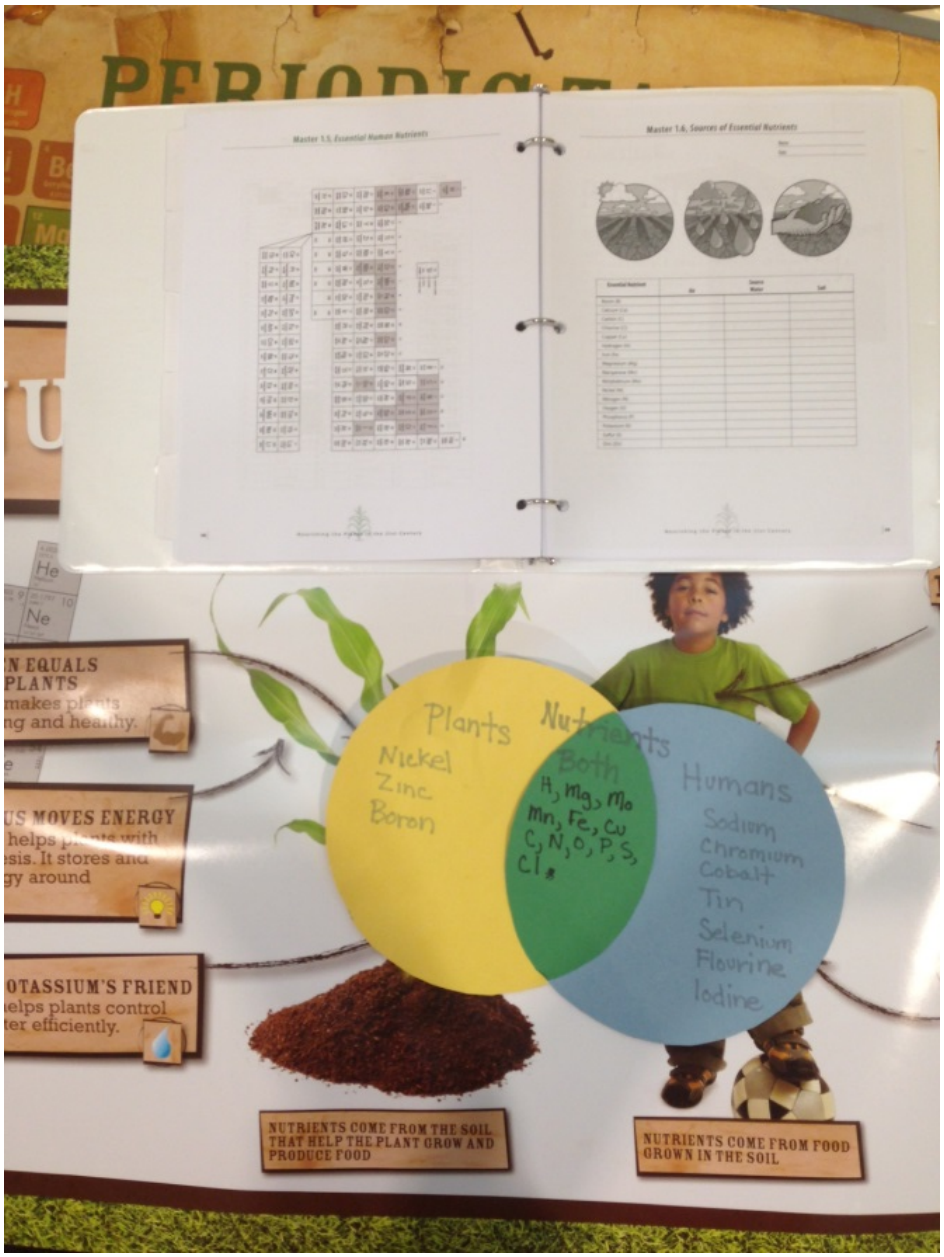
1. Assess student completion and accuracy of ***Sources of Essential Nutrients***.
2. Evaluate student participation in discussion and activities.
3. Have students select one of the nutrients discussed that is essential to both humans and plants, research the nutrient and write how the nutrient is used in plants and in humans, what deficiencies are and sources for both plants and humans.
4. Have students research nutrients that cycle and create a diagram of that cycle (nitrogen, carbon, water).

Sample Pre- and Post-Assessment

1. What is an essential element?

2. Do plants and animals have the same essential elements? If so name three.

3. How do plants obtain essential elements?



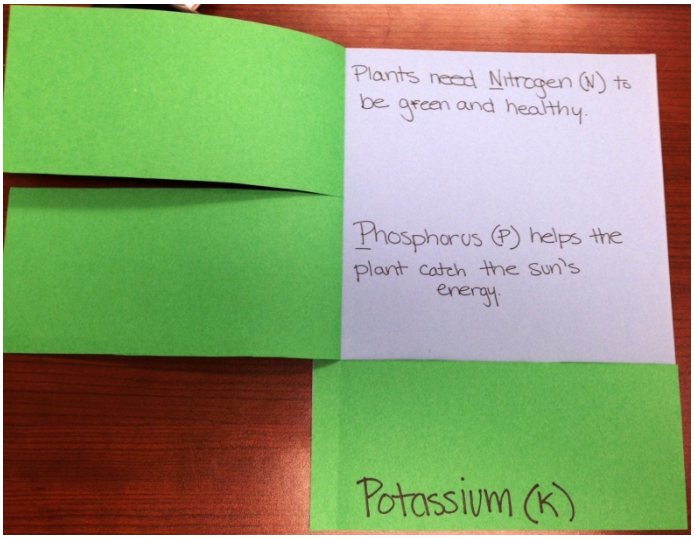
Plant Macronutrients Activity – Elementary School

What: Paper Manipulative

Level: Elementary School Level

Time: 15 minutes with educators

This activity is appropriate to use after introducing N, P, and K.



Materials:

1. Two sheets of construction paper per person
2. Glue Sticks
3. Writing Utensil
4. Scissors

Directions: Fold one sheet of construction paper in three times vertically. Unfold. Then fold a ½ inch edge on the left long side of the paper for a section to glue. Unfold. Cut on the three vertical folded lines all of the way until ½ inch from the edge of the paper. Glue the ½ inch folded section to the other sheet of construction paper.

Include the following text:

Nitrogen

Plants need nitrogen (N) to be green and healthy.

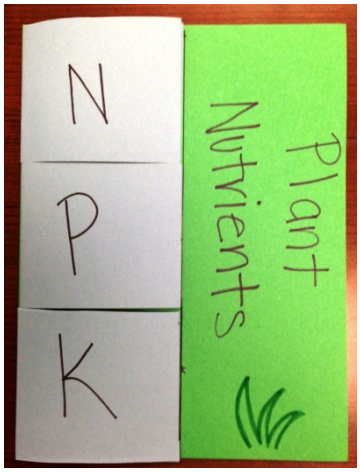
Phosphorus

Phosphorus (P) helps the plant catch the sun's energy.

Potassium

Potassium (K) protects plants against diseases and helps the plant when it is cold and dry.

Plant Macronutrients Activity – High school



Level: High School Level

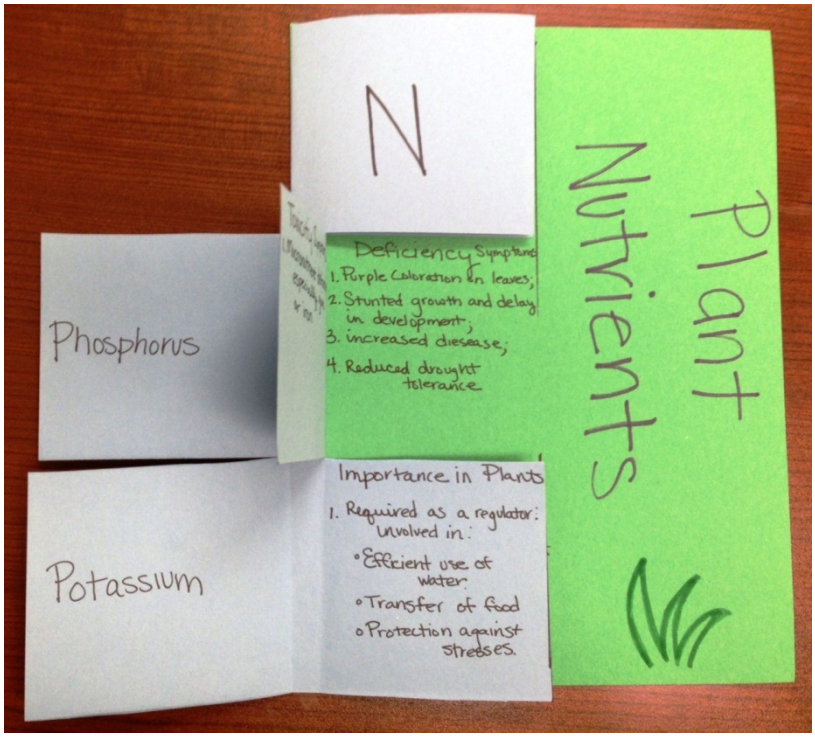
What: Paper Manipulative

Time: 15 minutes with educators

This activity is appropriate to use after introducing N, P, and K and discussing toxicity and deficiency symptoms.

Materials:

5. Two sheets of construction paper per person
6. Glue Sticks
7. Writing Utensil
8. Scissors



Directions:

1. Fold one sheet of construction paper in half horizontally.
2. Then fold the paper three times vertically and then unfold the paper.
3. Cut the paper on the three folded vertical lines.

4. Then fold a glue line so once attached to the other sheet of construction paper, the both 'pages' can flap (see visual).
5. Text:
    a. Top flap: Nitrogen
        i. Inside first flap, behind Nitrogen
            1. Component of proteins and nucleic acids.
            2. Required for chlorophyll production.
    b. Top Flap: Phosphorus
        i. Inside first flap, behind Phosphorus
            1. Component of nucleic acids and some proteins
            2. Required for energy transfer.
            3. Important for seed germination and water use.
    c. Top Flap: Potassium
        i. Inside first flap, behind Potassium
            1. Required as a regulator involved in:
                a. Efficient use of water
                b. Transfer of food
                c. Protection against stresses
    d. Next flaps:
        i. See visual: Deficiency and Toxicity on different flaps.

Plant Nutrient	Condition	Symptoms
Nitrogen	Deficiency	Light green to yellow leaves; stunted growth; low protein level; poor fruit development
	Toxicity	Dark green leaves; susceptible to drought, disease, and insects
Phosphorus	Deficiency	Purple coloration on leaves; stunted growth and delay in development; increased dis- ease; reduced drought tolerance
	Toxicity	Micronutrient deficiencies, especially zinc or iron
Potassium	Deficiency	Yellowing on edges on older leaves, dead leaves; irregular fruit development; reduced drought tolerance
	Toxicity	Nutrient deficiencies in magnesium and possibly calcium

Pocket Germination

Age: Pre-K to 5th grade

Time: 10-15 minutes (depends on age)

Group Size: up to 20

By the end of this activity, participants will be able to explain seed germination and what a plant needs beyond water to grow.

Materials Needed:

2”X 3” plastic jewelry baggies

Seeds – green bean seeds are great size to work with and see

Soil Moist – can be found at garden centers

Water

Plastic Spoons

Preparations:

1) Add 4 cups of water to 1 TBS of soil moist. The soil moist crystals will absorb the water. Allow an hour for the crystal to absorb fully the water (This will fill approximately 60 baggies).

2) If students are 2nd grade or lower, prepare bags ahead. Place 1 tsp. of prepared soil moist jell into baggies.

Instructions:

1) If not prepared ahead; give each student a spoon to place 1 tsp. of prepared soil moist jell into a baggie.

2) Each student will place one seed into the baggie, push out the air, and close the top.

The seeds will have the moisture they need to germinate.

3) Place the baggie into a pocket.

This provides warm conditions to help the seed germinate.

4) The seed will germinate in 3-4 days.

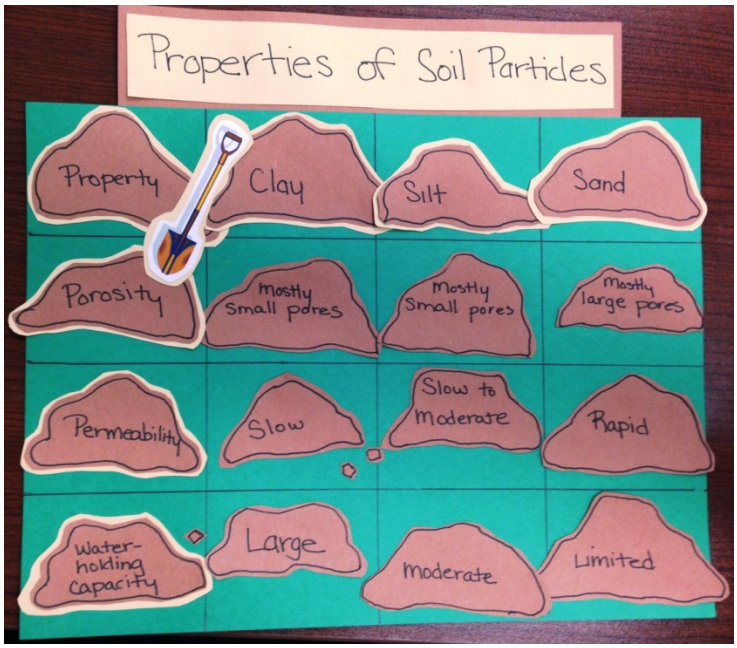
5) Students can then plant the seed in soil that will provide the nutrients the plant will need to grow.

*For pre-K and kindergarten you can tie the baggie to a string to make a necklace

Properties of Soil Particles Visual Activity

Level: High School Level

Time: 30 minutes with discussion



Materials:

Construction Paper

Ruler

Glue

Scissors

Pen

If possible, samples of clay, silt, and sand

Procedure:

1. Students should draw a 4 X 4 square table on one sheet of construction paper with a ruler.
2. Students label the top of the table with the following words: Property, Clay, Silt, and Sand. Then label the left row with Porosity, Permeability, and Water-Holding Capacity.
3. Students should then examine the clay, silt, and sand samples, if available, and discuss their observations for each property. Question: What is the clay sample's permeability? Answer: The clay sample seems to have a slow permeability; water moves slowly through the clay. Question: What did you observe with the sand sample's water-holding capacity? Answer: Sand has very limited water-holding capacity. It does not seem to retain very much moisture at all.
4. Students should complete the table descriptors of each category.

Property	Clay	Silt	Sand
Porosity	Mostly small pores	Mostly small pores	Mostly large pores
Permeability	Slow	Slow to moderate	Rapid
Water-holding capacity	Large	Moderate	Limited

Background information: Different types of soil, like silt, loam, and clay, have different properties that make it unique. Generally, we do not think much about the soil. Sometimes, soil even has a negative connotation when we call it dirt and wash it off our clothes and our bodies. In reality, soil is essential to our survival and that of nearly every organism on Earth. Our planet is mostly made of rock with an iron-nickel core. Plants and animals, including us, occupy a thin veneer on its surface. Our existence is possible because of the thin layer of soil that lies between the planet's rocky interior and the surface.

The weathering of rock slowly produces soils. Constant exposure to wind and rain cause the rocky crust to break down slowly into smaller particles. The process can take centuries to produce fertile topsoil. As rainwater seeps into cracks in the rock, temperature extremes cause the water to freeze and later melt. The rock expands, contracts, and fractures. These weathering actions are helped along by organisms that live on and in the soil. Soils are composed of both inorganic material derived from rock and organic material derived from living and dead organisms. Both are important to support plant growth. Some scientists believe that without life, soils are just dirt.

The relative amounts of clay, silt, and sand present determines the ability of a soil to accept and retain water. Porosity refers to spaces in the soil that can hold either air or water. Scientists define permeability as the rate at which water can travel through soil. Table 8 lists properties of particle size that relate to soils' interactions with water. Scientist call soils with desirable properties for farming 'loams.' Loamy soils typically contain about 50 percent air space, which allows root systems to "breathe" (i.e. obtain O2 for respiration). The solid half of soils is about 90 percent minerals and 10 percent organic material. Usually, loamy soils have names that more accurately reflect their composition, such as clay loam or silt loam.

Soil Contains Water Experiment

Age: K-3rd

Time: 15-20

Group Size: 20-30

By the end of this activity, participants will understand the role water plays with soil to grow plants.

Although this might not be a workshop "ready" activity, it is a nice activity to share with early elementary teachers for them to use in their classrooms.

Materials needed:

* 3 Coffee cans

* Regular moist dirt from a garden

* Dry sand from a sandbox (collected at the same time as the dirt, under similar conditions)

* Black construction paper

* Tape

* Sunny Window or top of a warm radiator

Instructions

Does Soil Contain Water?

*prepare a couple hours before the workshop

Water is water and soil is soil. Then there is the important scientific principle that plants must be watered, and the water must stay somewhere! Here is an experiment that uses coffee cans, dirt, and sand to explore the question of whether soil and sand "contain" water. This activity helps kids observe and hypothesize. As a bonus, it ties into the water cycle.

* Make a hypothesis. Ask the student is they think that dirt and sand contain water. Then ask how they can tell, and which one might hold more water.

* Then, line up your coffee cans and leave the first one dry and empty.

* Place black construction paper across the top of it, and tape it down at the edges.

* Now fill the next can half full with your garden dirt, and tape construction paper across the top as you did with the first can.

* Finally, fill the third can half full with sand and cover with the construction paper.

* Put all three cans in front of a sunny window and leave them there for a couple of hours.

* When you come back to observe, the paper on the top of the empty can should look dry and untouched. The paper on top of the dirt should be quite drenched. The paper on top of the sand will be slightly moist.

* Talk like a scientist with your child: why is it important to know if soil holds water? What if we just planted in sand? Or dry air? Ask what this tells us about the importance of water and soil to grow plants to feed the world.

Soil Separation Experiment

What: Soil Separation

Level: 3 to 12

Time: 8-10 minutes

Learning about soil does not have to be boring! This quick and easy soil separation experiment will keep your students engaged in your science lessons. The Soil Separation Activity is a part of the Nourishing the Planet in the 21st Century curriculum, Lesson 2: Properties of Soil.

As part of the second lesson, Properties of Soil, students learn that different soils have different characteristics by examining soil types that have been mixed with water to settle. Observing how some soils separate in the water, and how some do not, allows students to identify the differences between different soil types.

Materials needed for the experiment:

* 3 clear, 12-oz. plastic bottles

* 10 oz. each of potting soil, local soil, and sand

* Water

* Funnel (optional)

Fill about two-thirds of each 12-oz plastic bottle full of soil. Place potting soil, local soil and sand in separate bottles. (A funnel or a paper cone may make it easier to get the soil in the bottles.) Add water to near the top of each bottle. Place caps in the bottles, shake the contents well, and place the bottles in a location where they will not be disturbed. Prepare at least one day before making observations.

During the class time activity, keep the identity of each of the soils in the bottles a secret. Allow students to record their own observations and make hypotheses. This is what they should observe:

* The potting soil will show a thick layer of dark material on the bottom, a thick layer of cloudy water, and a thinner layer of material on the top.

* Local soils may differ, but a typical soil will show layering similar to potting soil, though there may be less material floating on the surface.

* Most of the sand will form a very thick layer on the bottom of the container. There will be a thick layer of clear water and a very thin layer of material on the surface.

Soil to Plate Paper Chain Activity

What: Paper Chain Activity

Level: High School Level (see last paragraph for elementary modifications)

Time: 30 minutes with educators

This activity is appropriate to use after introducing N, P, and K and creates a visual to explain the concept of "from soil to table."

Materials:

1. Three paper plates per participant (optional: substitute one brown paper plate per participant for the soil component)
2. One sheet of construction paper
3. Stapler
4. Scissors
5. Markers
6. Hole Punch
7. String or Ribbon

Directions:

1. First fold a paper plate in half and staple along the edges; it will resemble a pita pocket. Then cut along the folded edge; this is where they can place the nutrients, then plant into the soil.
2. Participants will color this section and label "soil."
3. Next, cut three squares (around 3 x 3") and label each with N, P, and K. **
4. Punch one hole in the soil component, and then two on each N, P, and K component. See visual.
5. Next, on a new paper plate, participants should draw a vegetable plant, like corn, in the middle of the plate. Then, cut off the ridges of the plate so that it will fit inside the "pita pocket" later.
6. On the final paper plate, draw a delicious plate of food that includes the vegetable from the previous vegetable plant. Punch one hole in the plate of food and two holes in the vegetable plant.

7. Tie each component to each other in this order:
    a. Soil – N – P – K – Vegetable (Corn) Plant – Plate of Food
8. To explain the connection between our food and soil, educators can teach starting from the soil and go 'up' the chain to the plate of food. Other educators may like starting with the plate of food and working back to the soil.

** There are many opportunities for modifications so that the chain can fit the appropriate age level. For instance, early childhood and Kindergarten teachers can completely eliminate the N, P, K components and concentrate on the concept that "soil helps plants grow so that we can have fruits and vegetables on the table."

Another modification can be to make the squares look like parts of the periodic table of elements, with weights. A periodic table poster should be supplied; for example, Nitrogen would be labeled: "N: 14.007; 7."

Another modification includes making "N" in the shape of a cloud (87 percent of the air we breathe is made up of nitrogen), "P" in the shape of a fish (Phosphate was formed from ancient sea life), and "K" in the shape of table salt (Potassium is salt left over from evaporated oceans). This is a great opportunity to tie in the Nutrients for Life postcards.

Worms in Soil Demonstration

Level: Elementary School Level

Time: 10 minutes with discussion

Occasionally, teachers may request a Regional Representative to come and teach in the classroom about soil, and this demonstration is guaranteed to captivate interest!

Worms and soil go together when students look at the essentialness of healthy soil in growing plants.

Materials:

Two glass jars or clear plastic containers (locking lids work best)

Worms (Canadian Crawlers can be found in bait shops and are often larger than local worms)

Tin foil to cover the jars pre-event

Carrot

Moist soil

Optional: two or three different colors/shades of soil

Procedure:

1. Three days before the event, add soil to the jars.

a. If available, add layers of different colors/types of soil.

2. Add worms to one of the jars; the other jar will not have worms in it.

3. Worm Care: Make sure that the soil is moist, or the worms will dry out. Cover the sides of the containers with tin foil so that the worms will be in the dark.

4. Add small bits and scrapes of carrots to the top of the soil in both containers. Over the next few days, the worms will bring the bits of carrots down into the soil. Because of the orange color, it will be easy for students to observe how some carrots were ‘pulled’ into the soil.

5. Take the foil covering off for the presentation so students can see the wormholes and worms. Remind students to carefully hold the containers with both hands as they pass them around.

6. Questions for discussion:

a. What do you see different between both containers?

b. What have the worms been doing these last few days?

c. What do plants need to grow?

d. How do worms help plants grow? They make room for air in the soil, and they help move nutrients into the root zone of plants. Worm casting (worm poop) also provides wonderful humus for plants.

e. What nutrients in soil help plants grow?