NUTRIENTS FOR LIFE
FOUNDATION

Growing Minds In Science

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Melissa Bigge

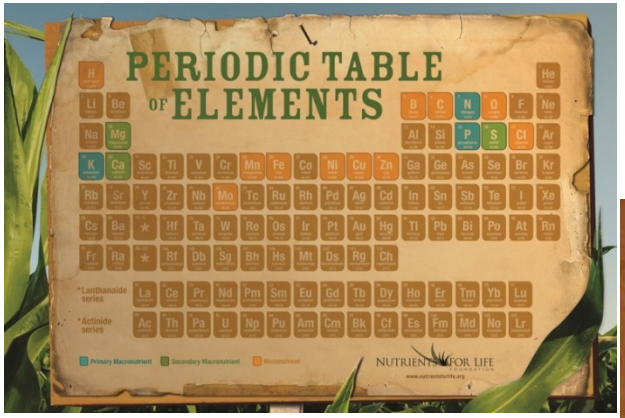
Magnet Scramble

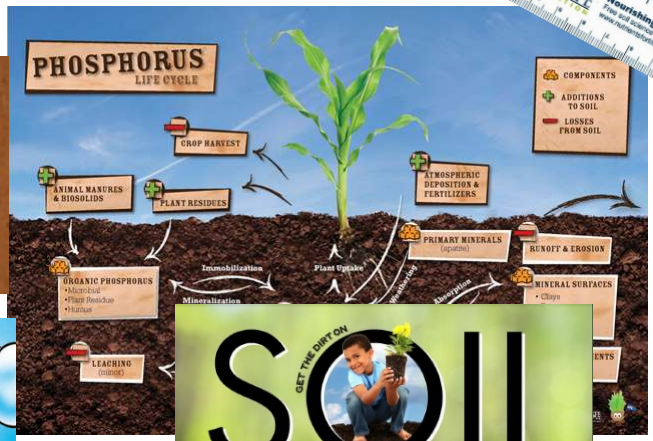
- 3 minutes!
- Create two sentences using the words on the magnet to create sentences about soil science or food production.
- Then get in pairs and share!

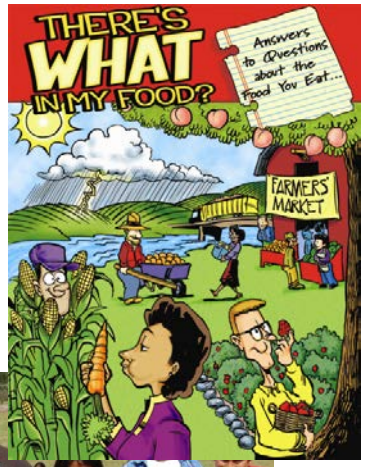
NUTRIENTS FOR LIFE FOUNDATION

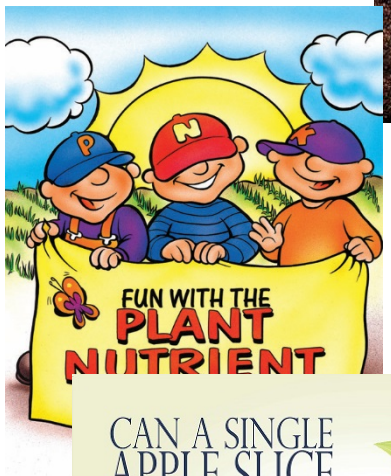
- Who are we?
  - A Foundation with a goal to provide science-based information to help educate people about the benefits of fertilizer.
- With whom do we partner?
  - International Plant Nutrition Institute
  - Smithsonian Institution
  - The Fertilizer Institute
  - Discovery Education

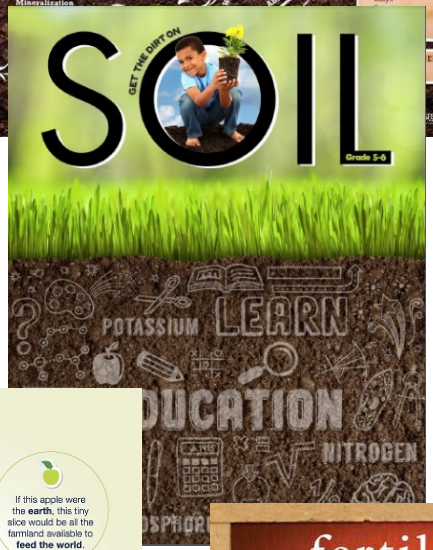
Educational Resources & Materials

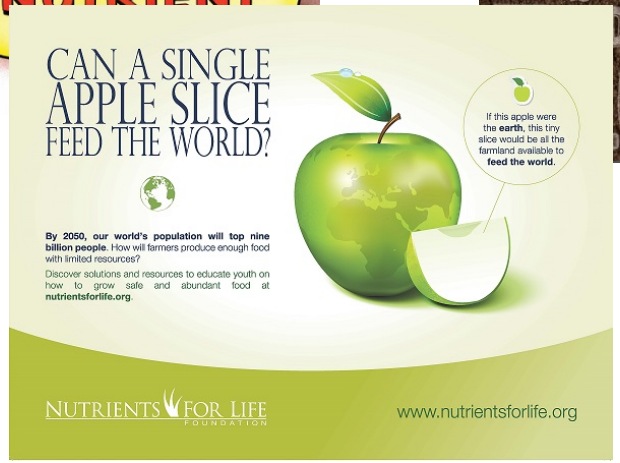








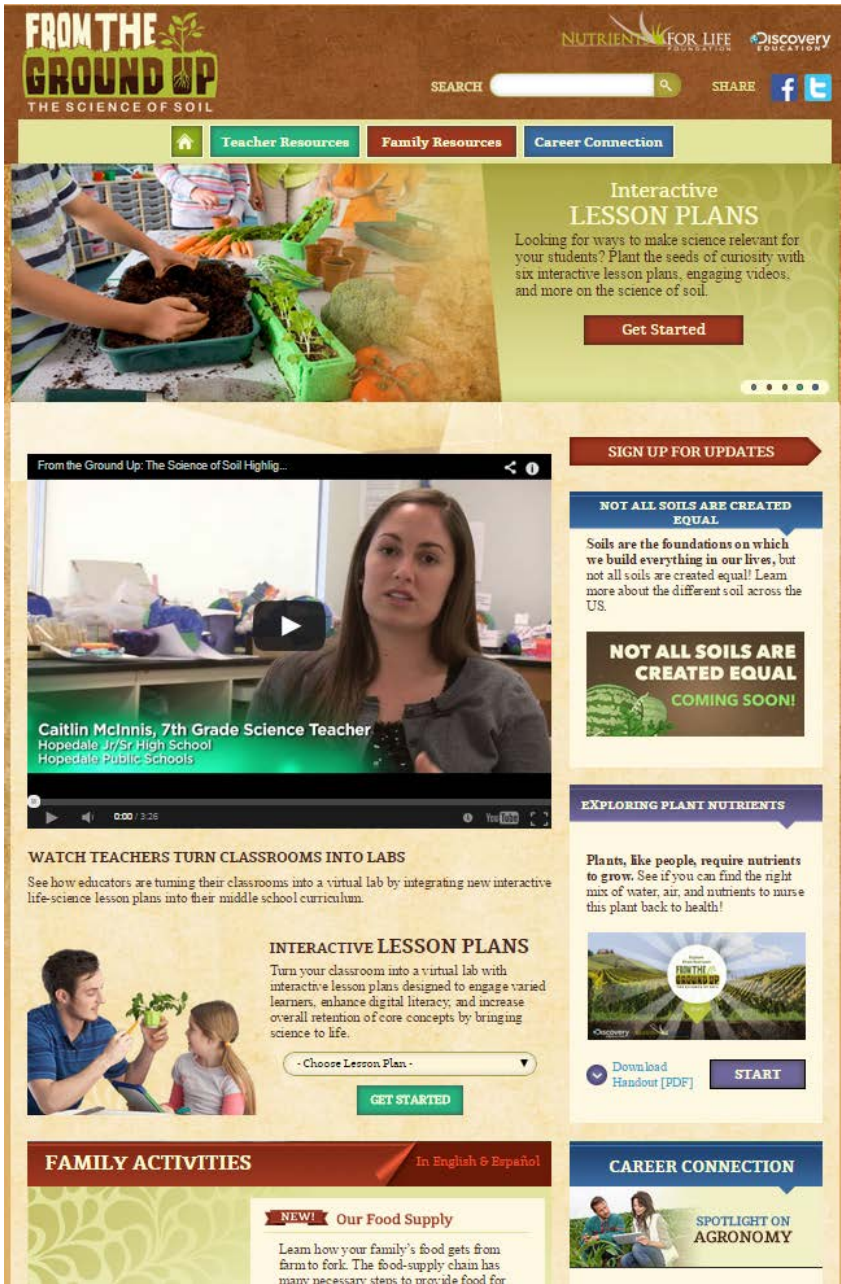




From the Ground Up: The Science of Soil

- Six interactive lesson plans
- Six educational videos highlighting soil science
- Teacher Toolkit
- Five family activities (both English and Spanish)
- Four career connection profiles
- Exploring Plant Nutrients Interactive Tool
- Not All Soils Are Created Equal Interactive Tool

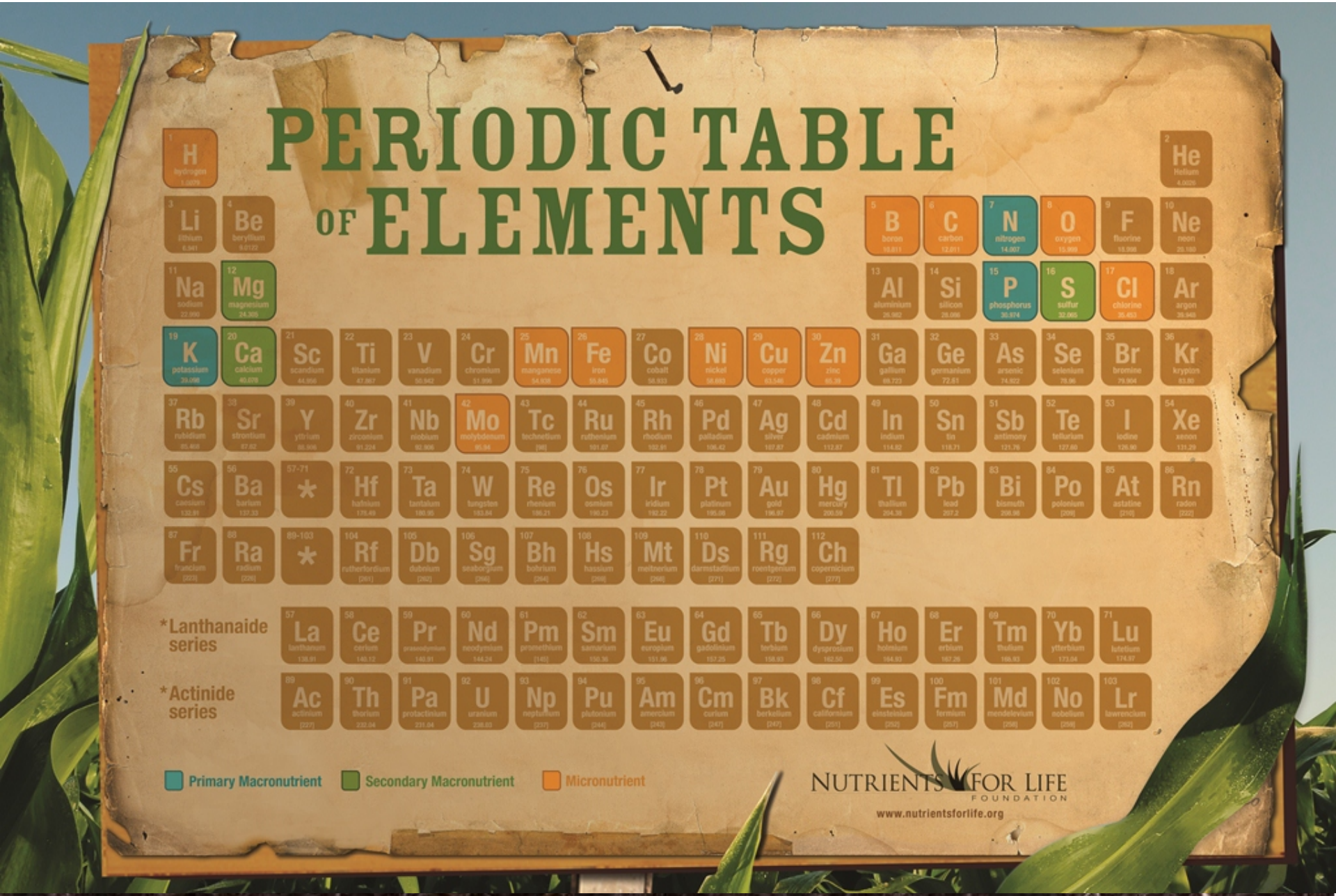
www.thescienceofsoil.com



Lesson 1

Engage

In Search of Essential Nutrients


PERIODIC TABLE OF ELEMENTS
H hydrogen
He helium
Li lithium
Be beryllium
B boron
C carbon
N nitrogen
O oxygen
F fluorine
Ne neon
Na sodium
Mg magnesium
Al aluminium
Si silicon
P phosphorus
S sulfur
Cl chlorine
Ar argon
K potassium
Ca calcium
Sc scandium
Ti titanium
V vanadium
Cr chromium
Mn manganese
Fe iron
Co cobalt
Ni nickel
Cu copper
Zn zinc
Ga gallium
Ge germanium
As arsenic
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Br bromine
Kr krypton
Rb rubidium
Sr strontium
Y yttrium
Zr zirconium
Nb niobium
Mo molybdenum
Tc technetium
Ru ruthenium
Rh rhodium
Pd palladium
Ag silver
Cd cadmium
In indium
Sn tin
Sb antimony
Te tellurium
I iodine
Xe xenon
Cs caesium
Ba barium
57-71 *
Hf hafnium
Ta tantalum
W tungsten
Re rhenium
Os osmium
Ir iridium
Pt platinum
Au gold
Hg mercury
Tl thallium
Pb lead
Bi bismuth
Po polonium
At astatine
Rn radon
Fr francium
Ra radium
89-103 *
Rf rutherfordium
Db dubnium
Sg seaborgium
Bh bohrium
Hs hassium
Mt meitnerium
Ds darmstadtium
Rg roentgenium
Ch copernicium
*Lanthanaide series
La lanthanum
Ce cerium
Pr praseodymium
Nd neodymium
Pm promethium
Sm samarium
Eu europium
Gd gadolinium
Tb terbium
Dy dysprosium
Ho holmium
Er erbium
Tm thulium
Yb ytterbium
Lu lutetium
*Actinide series
Ac actinium
Th thorium
Pa protactinium
U uranium
Np neptunium
Pu plutonium
Am americium
Cm curium
Bk berkelium
Cf californium
Es einsteinium
Fm fermium
Md mendelevium
No nobelium
Lr lawrencium
Primary Macronutrient
Secondary Macronutrient
Micronutrient
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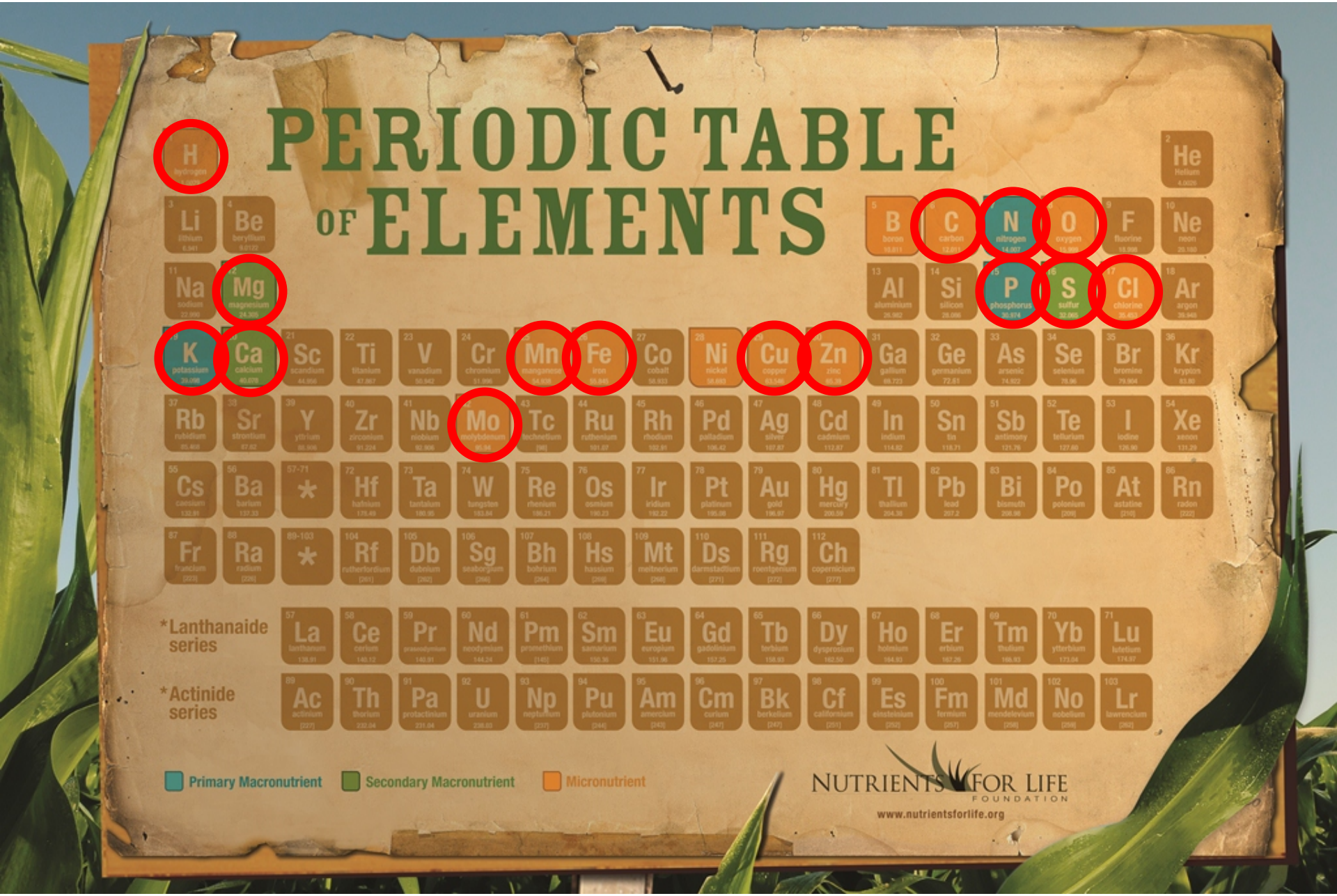
www.nutrientsforlife.org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Os osmium
Ir iridium
Pt platinum
Au gold
Hg mercury
Tl thallium
Pb lead
Bi bismuth
Po polonium
At astatine
Rn radon
Fr francium
Ra radium
*
Rf rutherfordium
Db dubnium
Sg seaborgium
Bh bohrium
Hs hassium
Mt meitnerium
Ds darmstadium
Rg roentgenium
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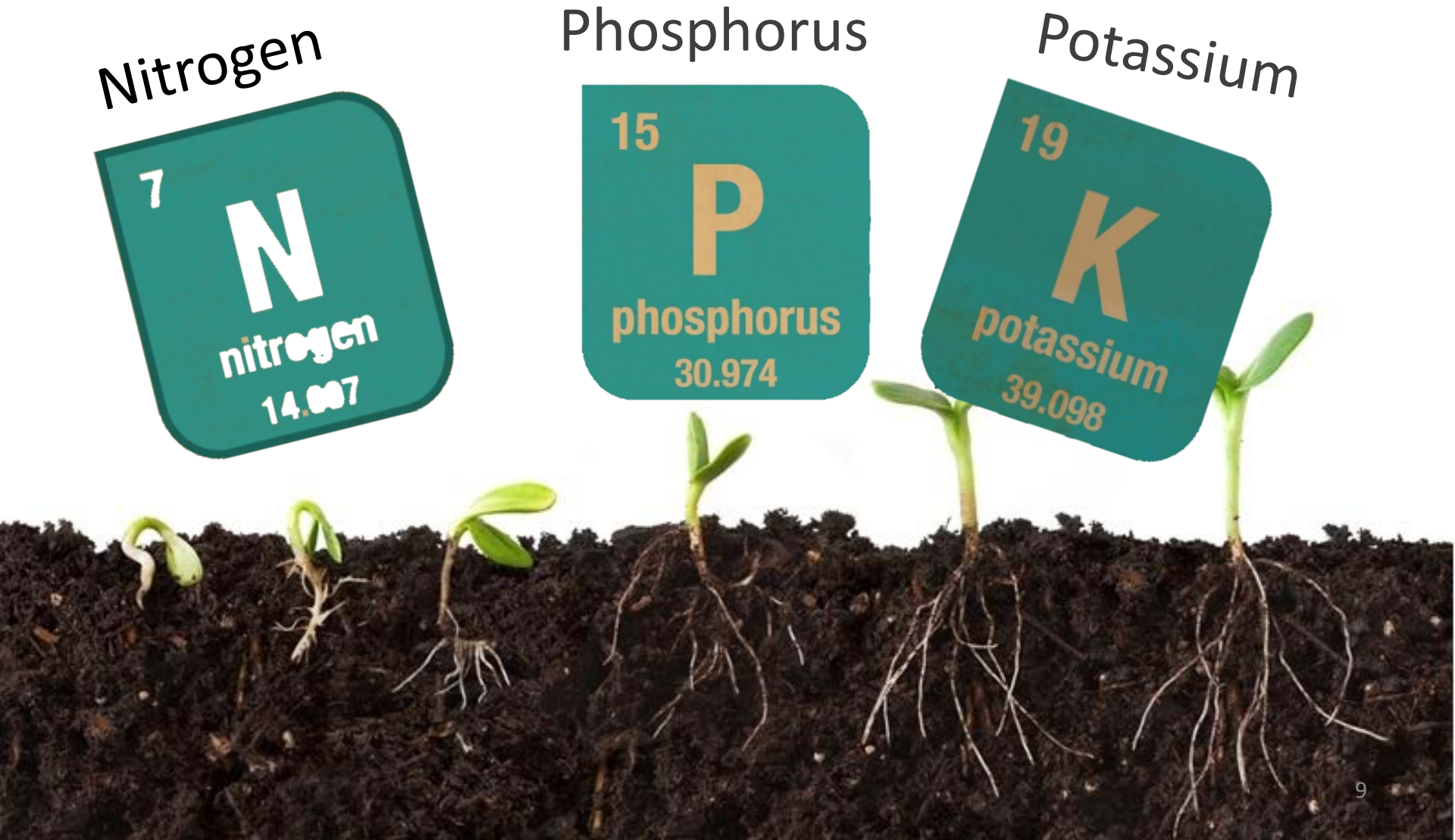
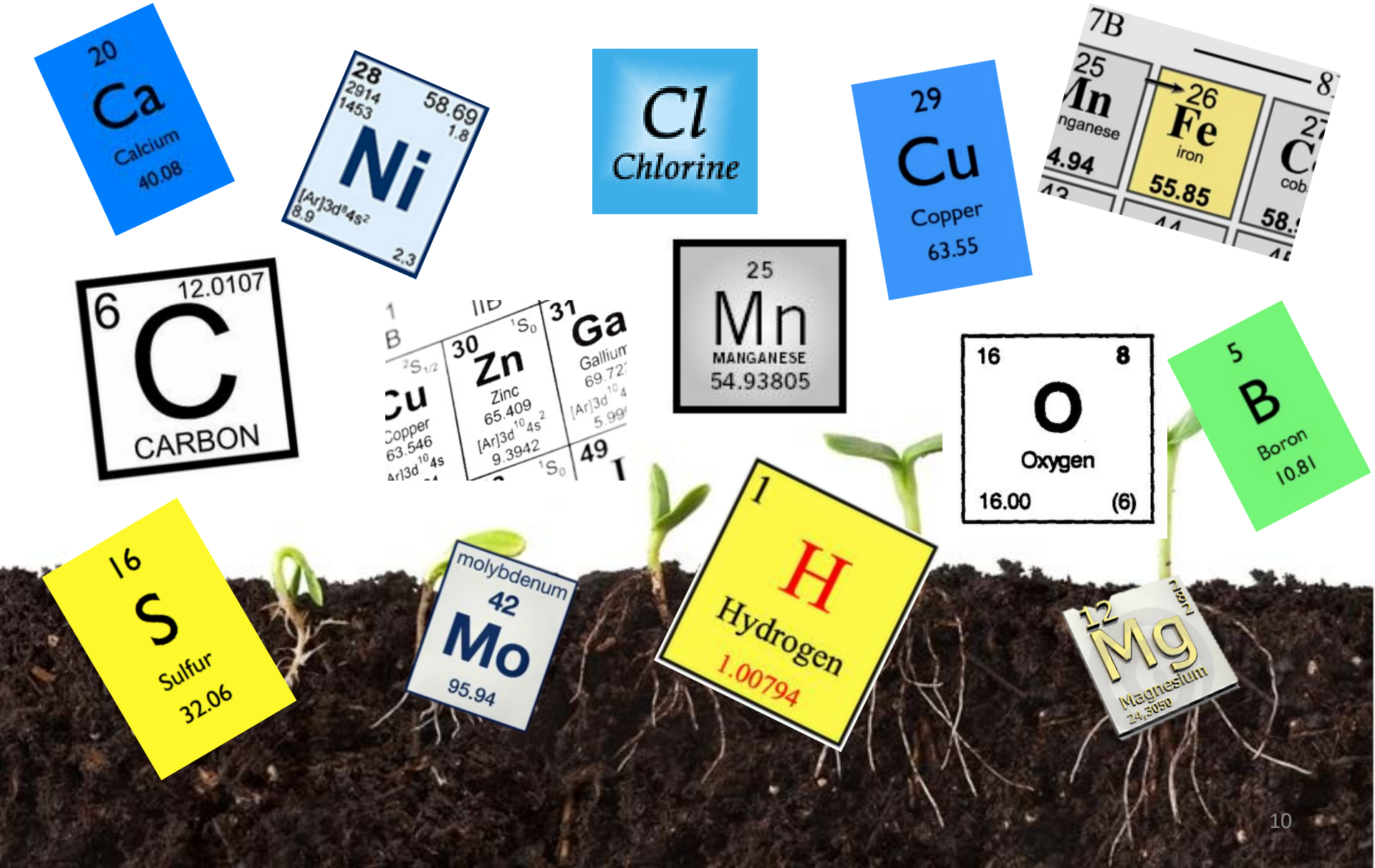
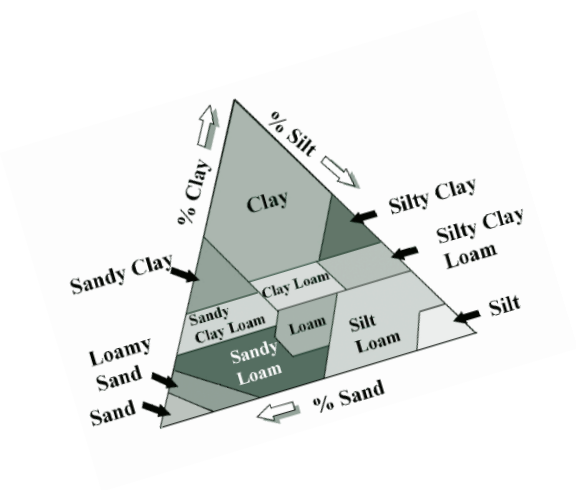
What are the basic nutrients?



Essential Nutrients





Lesson 2

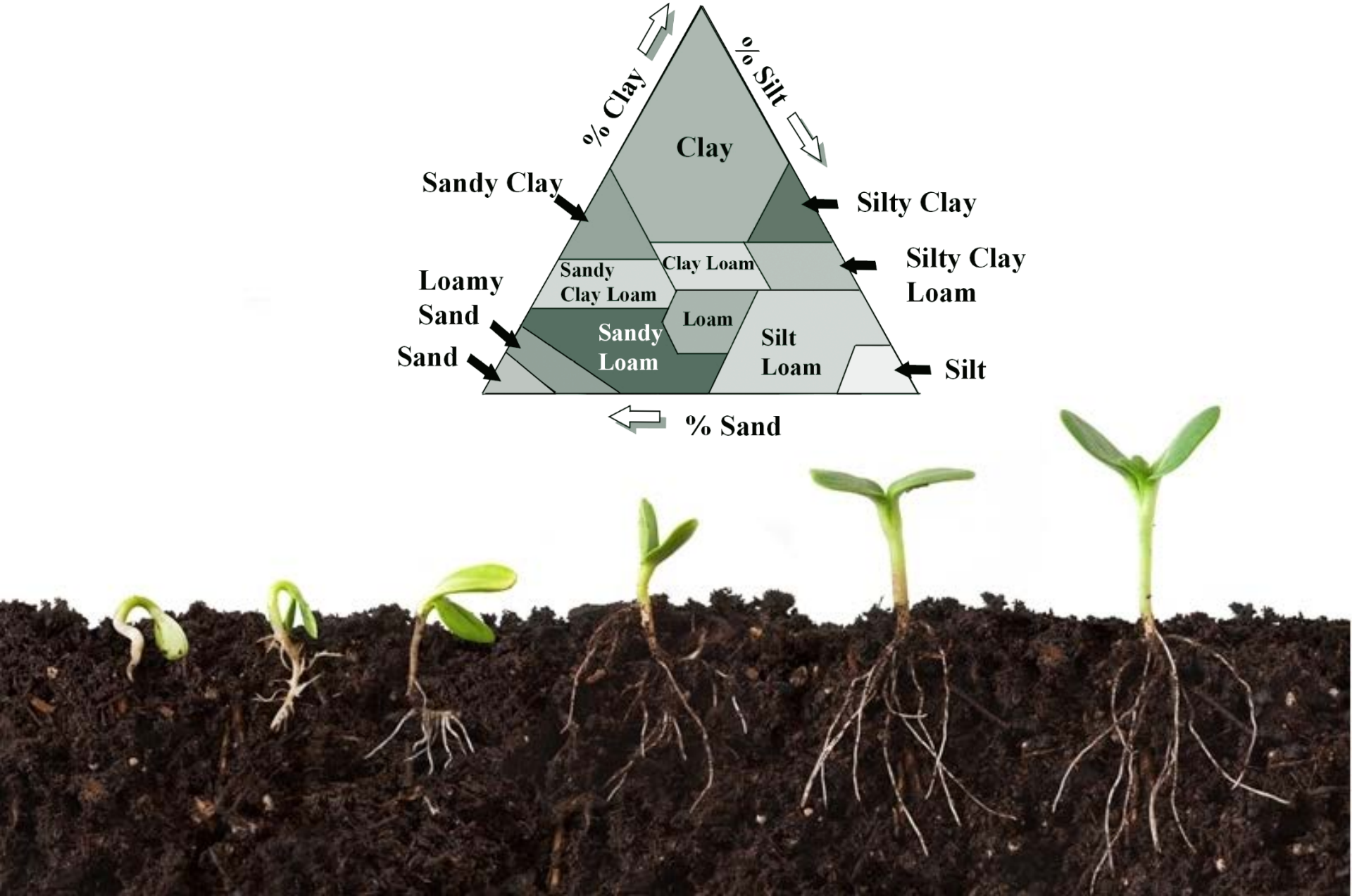
Explore

Properties of Soil

-Observe the soil in the bottles

-What do you notice?

-What is different?


% Clay
% Silt
Clay
Sandy Clay
Silty Clay
Clay Loam
Silty Clay Loam
Sandy Clay Loam
Loamy Sand
Loam
Sandy Loam
Silt Loam
Sand
Silt
% Sand

Lesson 3

Explain

Plant – Soil Interactions

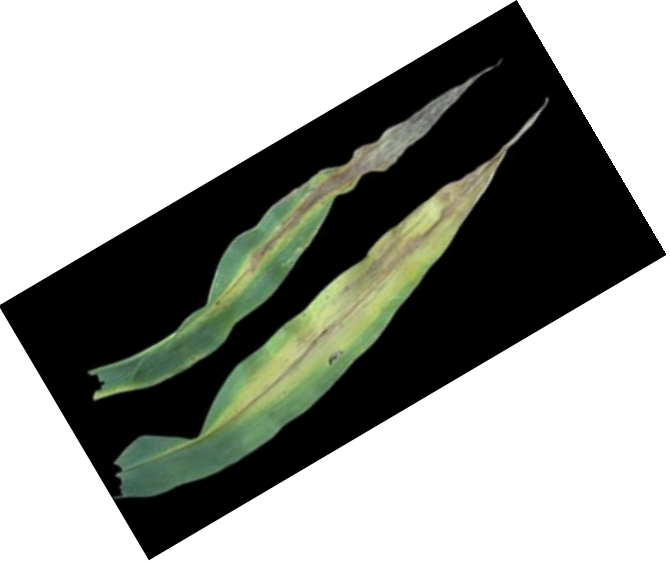
Students investigate the mechanism by which roots obtain nutrients from the soil.

Students describe what they can see and then explore how the plants use each part of the roots.

- **LESSON 3: PLANT SOIL INTERACTIONS**

  Actual plant roots are examined and analyzed in lesson three. The diffusion process used by roots to absorb nutrients, and the transport of water through the xylem are demonstrated in visual lab activities.

  Students also learn about soil horizons and the formation of soil. Then, students investigate the Great Dust Bowl.



Lesson 4

Elaborate

Plant Nutrient

Deficiencies

Corn Case Study 2

Primary Information

The farmer reports that the plants are stunted. Her corn grows in sandy soil. Some weeds are present in the fields. She provided the following photograph, which shows some yellowing of leaves.

Corn Case Study 2

Secondary Information

The farmer sent this additional photograph of a leaf from an affected plant. She also reports that some of her plants have stems that aren't strong enough to support the ears of corn.

Nutrient Deficiencies of Corn

Potassium Deficiency

Plants that lack potassium show stunted growth and mature later than normal plants. Potassium deficiency results in yellowing and drying of the leaf edges, especially on older leaves. The death of cells in the leaves may be visible as a dark discoloration. The stems of potassium-deficient plants are weak and often break below the ears.

Potassium deficiencies happen most often in soils that are sandy, wet, or compacted (dense) or when potassium has been removed through repeated cropping and natural levels are low. Restoring potassium to the soil will help the plants better absorb water and prevent wilting and dry leaves.

a   b

The older leaves of potassium-deficient corn plants yellow and die around the edges (a), while areas of cell death on leaves may appear as dark spots (b).

- **LESSON 4: PLANT NUTRIENT DEFICIENCIES**

  Students discuss the need to restore nutrient balance in the soil to maintain healthy plants in lesson four. In the main activity, students assume the roles of plant doctors and diagnose nutrient deficiencies in crop plants. Teachers have the option of conducting this activity through an interactive Internet program, or through reference manuals in the classroom.

  High School Edition: Students also use EDTA to observe the physical manifestation of a plant calcium deficiency.

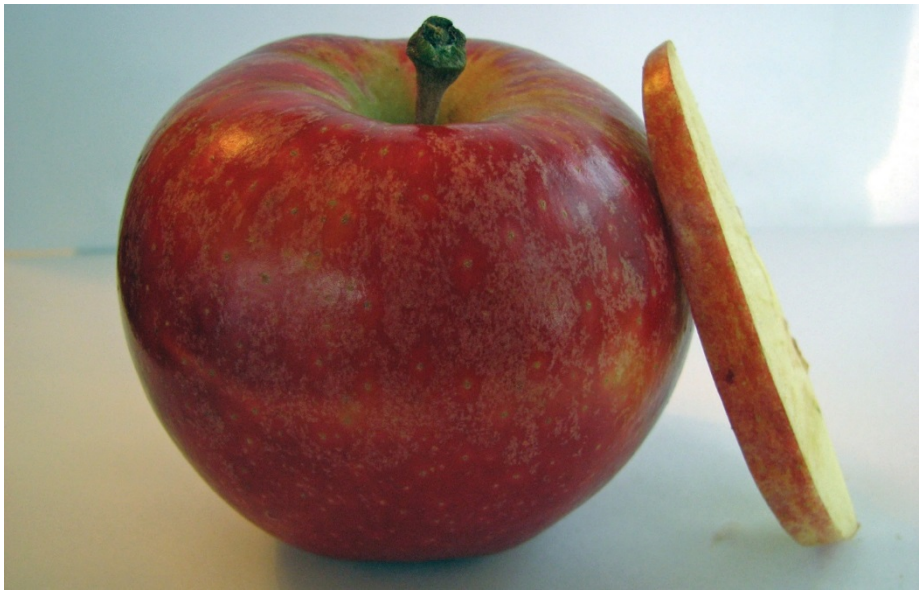
Lesson 5

Explain-Elaborate

Fertilizers And The Environment

Discussion: If a billion acres of extra farmland are needed to feed the world's population, from where should it come? What are you willing to sacrifice?

The Apple Activity



- **LESSON 5: FERTILIZERS AND THE ENVIRONMENT**

  Lesson five bridges science to social issues. Students use estimates of population growth and land use to calculate how much additional farmland will be needed in the future to feed the growing world population. Students investigate the advantages and disadvantages of using organic and inorganic fertilizers, as well as the role of nutrient pollution and how to limit its negative affects.

Lesson 6

Evaluate

Nourishing the Planet

In the 21st Century

-As an Expert make 3 recommendations

- **LESSON 6: NOURISHING THE PLANET IN THE 21ST CENTURY**

  In this concluding lesson, students discuss what challenges must be met in order to feed the world's population in 2050. Students then analyze a list of 10 recommendations about farming and select the three that they feel are most important based on what they have learned about soil, plant growth and plant nutrients through a class discussion and debate.

BSCS

Pre-test and Post-test Assessment

- For high school and middle school lessons, pre- and post-test are available for download at http://www.nutrientsforlife.org/teachers/curriculum/lessons/1

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