Deforestation and Technology	**Grade 11 – Plants in the Natural Environment**

Lesson Plan

Assessment	AOL, Graphic Organizer
Cross-curricular	Mathematics

Big Ideas

- Plants are critical to the survival of ecosystems.
- Humans affect the sustainability of ecosystems when they alter the balance of plants within those ecosystems.

Learning Goals

- I know the steps of the carbon cycle.
- I understand how deforestation affects the carbon cycle.
- I know that open source tracking of tree cover can help governments and organizations better manage forests and monitor industry.

Specific Expectations:

F1. analyse the roles of plants in ecosystems, and assess the impact of human activities on the balance of plants within those ecosystems

F1.2 assess the positive and negative impact of human activities on the natural balance of plants (e.g., crop rotation, the use of fertilizers and herbicides, the introduction of new species)

F3. demonstrate an understanding of the structure and physiology of plants and their role in the natural environment

F3.4 explain the various roles of plants in the sustainability of the natural environment (e.g., in nutrient cycles, in the water cycle, in erosion control, in wildlife habitats)

Description:

In this lesson students will calculate the amount of carbon in local trees by doing measures on actual trees. Students will also learn how deforestation affects the carbon cycle. **This lesson is intended for the college level.**

Materials

Reforestation: Impact on Climate video

Deforestation Visuals

Carbon Cycle Graphic Organizer (Student and Teacher)

Carbon Calculator

Exit Card (included in Lesson Plan)

Safety Notes

Take note of student allergies if going outside to measure circumference of trees.

Introduction

First students will watch the video: Reforestation: Impact on Climate:
http://ed.ted.com/featured/I1QcUVAy TedED

"From logging, agricultural production and other economic activities, deforestation adds more atmospheric CO2 than the sum total of cars and trucks on the world's roads" – Scientific American, November 13, 2012

As you saw in the video, forests play an important role in minimizing climate change and improving air quality by absorbing CO_2 (a greenhouse gas) and water and using energy provided by the sun to produce O_2 as well as carbohydrates to use for energy. This is an important part of the Carbon Cycle:
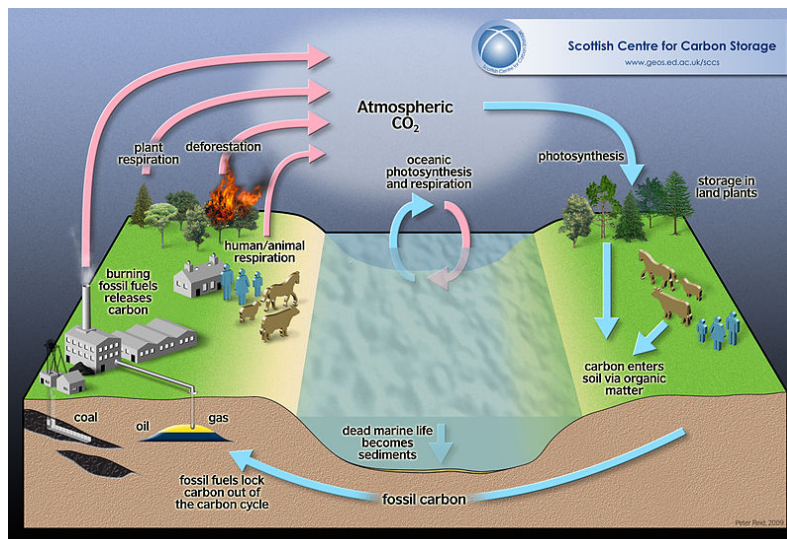
The teacher can use the presentation Reforestation Visuals (See Link) to teach the steps of the Carbon Cycle and the causes and consequences of Deforestation. The teacher can help students to fill in the graphic organizer Carbon Cycle (student) (See Link) using a copy of Carbon_Cycle.pdf provided.

The teacher can use the presentation "Deforestation Visuals" (See Link) to teach the steps of the Carbon Cycle and the causes and consequences of Deforestation.
Using the third slide "The Carbon Cycle" (and with your teacher's help), complete the Carbon Cycle graphic organizer "Carbon_Cycle.pdf" (See Link) for your notes.

Action

In past science classes, you may have calculated your climate footprint in metric tones of CO_2. In this activity, you will not only estimate your carbon emissions, but you will also calculate how many tones of carbon a typical local tree contains and how many trees you would have to plant in order to offset your carbon emissions.

Use this link to calculate your carbon emissions:
http://www.nature.org/greenliving/carboncalculator/

Your teacher will create a data table listing each student's carbon emissions.

Next, in pairs, calculate the amount of carbon in a typical tree from your local area.
1. You will need to go outside with a measuring tape.
2. Select a tree that is at least 5 feet tall and identify the species. Take a picture of your tree.
3. Measure the circumference of the tree at chest height in cm. Chest height is the circumference of the tree at 4.5 feet from the base.
4. Using the equation: $C/\pi = D$, determine the diameter of the tree.
5. Calculate the biomass of the tree using the equation:
$$M = aD^b$$
Where M is the biomass of the tree (in kg), D is the diameter of the tree (in cm) and a and b are coefficients related to the type of tree. Here are some examples for trees in Northern Ontario:

Type of Tree	"a"	"b"
Red Cedar	0.1019	2.300
Red Maple	0.0910	2.5080
Sugar Maple	0.2064	2.5300
Black Oak	0.0904	2.5143
Red Oak	0.1130	2.4572
White Pine	0.1617	2.1420
Birch	0.0629	2.6606
Beech	0.0842	2.5715

Values taken from: The Yale University site-
http://www.yale.edu/fes519b/saltonstall/biomass2.html - estimate

- After calculating the biomass, determine the amount of carbon stored in the tree.
  - Hardwood trees: Multiply biomass (M) by 0.521
  - Softwood trees: Multiply biomass (M) by 0.498
- Covert kg to tons to make it easier to compare your measurement and the carbon counter's measurement of greenhouse gases in the air (one metric ton = 1000 kg).
- Now divide your carbon emissions by the mass of carbon in one tree.

With your partner, answer the following questions.
- How many trees/acres would you need to plant to offset your carbon emissions for one year?
- How many trees would you need to plant to offset the whole class' carbon emissions for one year?
- Is this number of trees/amount of land needed to plant the trees practical? Why or why not?

This activity is adapted from Reforestation: Impact on Climate from The Nature Conservancy.

Consolidation/Extension
Now that you've calculated how difficult it would be to replant enough trees to offset your own carbon emissions, let's look at how the World Resource Institute, along with over 40 organizations, including Google, the University of Maryland, and the United Nations Environment Program is using new technology to protect the world's remaining forests.

Global Forest Watch (gwww.globalforestwatch.org) is an open-source tool that combines satellite pictures, computer algorithms, and crowd-sourced data to provide a real-time overview of the health of forests. To track forest cover, computer algorithms scan satellite pictures to look for sudden drops or spikes in green vegetation.

Global Forest Watch: Monitoring Forests in Near Real Time
https://www.youtube.com/watch?v=lTG-0brb98I

Summative Assessment (Assessment of Learning)
Students should complete the following exit card. Answers have been included.

Exit Card

How does deforestation impact upon the Carbon Cycle? *Deforestation removes carbon "sinks" meaning that less carbon is contained and more is left in the atmosphere as CO_2. Also, less plants and trees mean that less CO_2 reacts in photosynthesis and less oxygen is produced.*

Name two causes for deforestation. *Subsistence farming, industry, wood burned for fuel, large-scale agriculture, grazing land, urbanization…*

Name two negative impacts of deforestation. *Water is more polluted, nutrients are stripped from the soil, carbon cycle is disrupted, less oxygen produced, less carbon captured from the atmosphere…*

Give one example of what you can do personally to prevent deforestation. *Use public transportation, walk or bike, become vegetarian, reduce, reuse, recycle, use less energy from fossil fuels.*