

## Reforestation: Impact on Climate

### Science Topic: Carbon Cycle, Deforestation and Reforestation

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Grades: 6<sup>th</sup> – 8<sup>th</sup>

Essential Questions:

- How do deforestation and reforestation affect the carbon cycle?
- What can people all over the world do to preserve and restore forests?

Lesson Overview:

Students will learn about the importance of large-scale forest landscapes and the impacts of deforestation and reforestation with a focus on global climate change. Focus will be given to the carbon cycle and the ways in which forests decrease carbon dioxide and greenhouse gases in the atmosphere, thereby minimizing climate change, and improving air quality. Consideration will also be given to the ways in which deforestation and forest restoration affect wildlife.

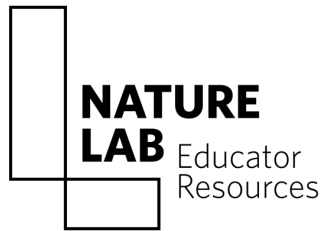
A companion interactive whiteboard presentation that incorporates video and glossary terms used throughout this lesson is provided to use in classroom instruction (see Teacher's Guide for directions).

Themes:

- Clean air: Forests provide numerous benefits, including cleaning our air by filtering out dust and pollution and absorbing carbon dioxide and other greenhouse gases. Trees provide natural filtration and storage systems.

Time Frame:

This lesson is designed to be completed in three 45-minute sessions.



### Vocabulary:

- Carbon cycle: The movement of carbon between the living and nonliving environment through natural processes.
- Deforestation: Cutting or removal of all or most of the trees in a forested area.
- Reforestation: Planting new trees in areas where they have been removed by cutting or destroyed by fire or disease.
- Greenhouse Gases: Gases in the atmosphere, such as carbon dioxide, which absorb energy from the sun.

### Videos and images used in associated Power Point lesson plan:

- Reforestation: Impact on Climate Introductory video
- Scientist interview questions

### Background for the Teacher:

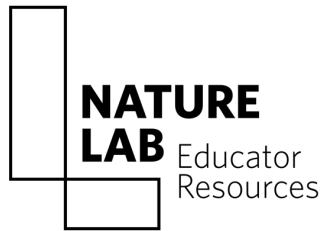
In this lesson, students learn the value of forests and their role in the carbon cycle. Students will investigate deforestation and its impact on climate and explore local and global reforestation efforts.

Deforestation is clearing Earth's forests on a massive scale, often resulting in damage to the quality of the land. Agriculture is the largest global driver of deforestation. Farmers cut forests to provide more room for planting crops or grazing livestock. Many small farmers will each clear a few acres by cutting down trees and burning them in a process known as "slash and burn" agriculture. To provide wood and paper products loggers cut down a large number of trees each year. Wildfires and overgrazing also prevent the growth of young trees.

The quickest solution to deforestation would be to simply stop cutting down trees or to manage forest resources. Reforestation efforts are a vital way to undo some of the damage that has already been done.

Reforestation has many positive effects on the environment. One of the most dramatic impacts is an increase of habitat for millions of species. Adding trees allows the forest to expand its canopy, which blocks the sun's rays during the day and holds in heat at night. Forest soils are moist, and protection from sun-blocking tree cover keep them from drying out. Without this coverage plants and animals would experience extreme temperature swings that can be harmful.





Reforestation also impacts climate change. Trees play an important role in absorbing the greenhouse gases that fuel global warming. Trees also anchor soil with their roots. When they are removed, the soil is transported and deposited in other areas releasing carbon into the air. Adding to forests mean smaller amounts of greenhouse gases entering the atmosphere.

### Classroom Activities:

#### Materials

For each group of students/individual student:

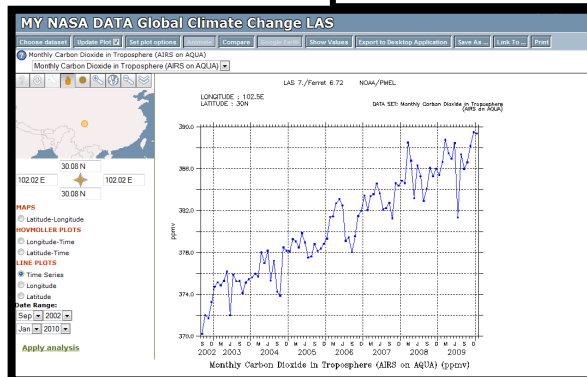
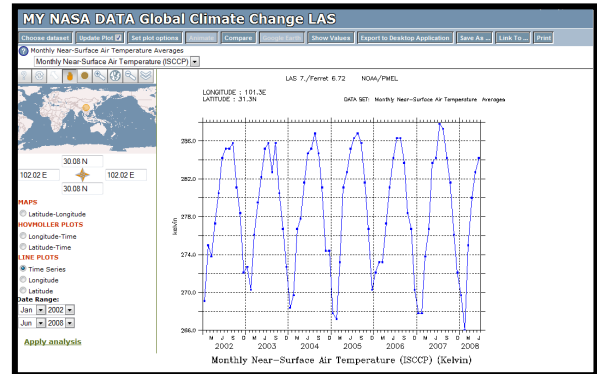
- Notebook paper/journal

#### Engage

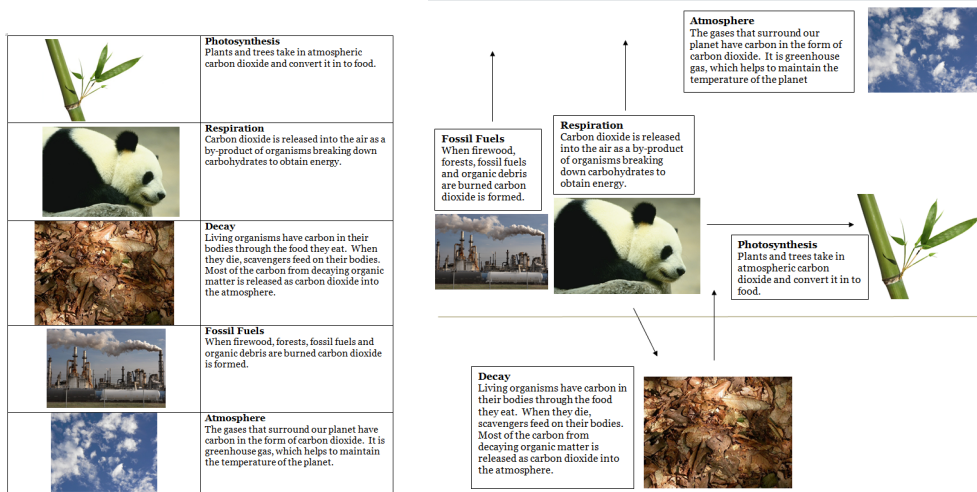
How do trees benefit humans and the environment?

### Presentation Slides 1-18

1. Share the slides from NASA displaying a series of before and after images of once forested areas (<http://www.mnn.com/earth-matters/wilderness-resources/photos/7-striking-examples-of-deforestation-from-nasa/deforestat-2>). Ask students to consider what is happening in each pair of images before explaining to students that the images show the same area before and after trees have been removed.
2. Share with students the Reforestation: Impact on Climate overview video and review the guiding questions.
3. Provide students with the definition of Deforestation.
4. Display images of the Sichuan Province in China. This region has a rolling landscape of bare land and tree stumps because of deforestation. Provide students with the graph illustrating CO<sub>2</sub> in the atmosphere and the graph illustrating the monthly surface temperature at the coordinates of the Sichuan Province. Ask students what patterns they observe. For the monthly surface temperature graph, guide students to look at the peaks in temperature. As an optional extension to this portion, it is suggested you consider allowing students to investigate their local coordinates for trends or to generate graphs for other regions.

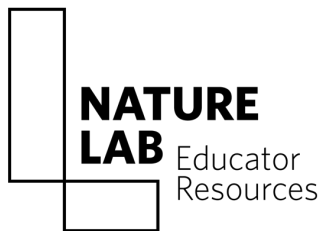


5. Explain to students that deforestation drives climate change. Forests are the largest storehouse of carbon after the oceans. When forests are destroyed by activities such as logging and land conversion for agriculture, they release large quantities of carbon dioxide and other greenhouse gases into the atmosphere, which can increase temperatures.
6. Share the scientist video answering the question, “How does deforestation contribute to global climate change?”
7. Provide students with the definition of Carbon Cycle. Explain to students that Carbon makes up all organic matter, which is part of all living things. Carbon can be found in gaseous form, carbon dioxide, and in water in a dissolved form. Explain that students will investigate the carbon cycle and its relationship with trees. Slide 12 includes examples of items made with carbon and a chart listing ways carbon is good and bad. In the Appendix there is a chart with missing key words that students can fill in as you review this slide.
8. Distribute charts of five different components of the carbon cycle. Ask students to cut and position the images to create a cycle drawing arrows guided by the descriptions.



9. Ask students to consider which components they identify as producing carbon dioxide gases and share with their 2:00 clock buddy. Information about clock buddies is included under additional resources.
10. Ask students to pair up with their 7:00 clock buddy and evaluate their cycle to determine which of the components of the carbon cycle can reduce carbon dioxide levels.
11. Summarize with students what deforestation is and the effects of deforestation on the carbon cycle by creating a T-chart. Allow students a couple minutes to brainstorm their responses. If desired, use the online random name generator to call on student to share. <http://www.superteachertools.com/instantclassroom/random-name-generator.php>

Deforestation	Effects of Deforestation



## Explore

What threats do forests face?

### Presentation Slides 19-26

1. Distribute roles for students to participate in a socratic seminar. A socratic seminar is a discussion among students in which they are given the opportunity to develop a deeper understanding of the focal point of the discussion through sharing of perspectives, questions, and interpretations. In this seminar students will be exploring different perspectives on the pros and cons of deforestation.
  - a. Conservationists: Forests are home to many species of plants and animals.
  - b. Logger: My job is to cut down trees and without this job I cannot provide for my family.
  - c. Pharmacist: Many medicines come from our forests and many are yet to be discovered.
  - d. Farmer: I clear away land by burning a few acres of trees to grow crops for my family to eat.
  - e. Environmentalist: Forests help moderate climate change by taking in carbon dioxide during the day. Too much carbon dioxide leads to an increase in greenhouse gases, which causes changes in our climate.
  - f. Restaurant owner: I need paper and meat products to meet my customers' demands.
2. Explain to students that to prepare for their seminar, students will research more information about their role in small groups. Students can research by using printed out resources or access online links using computers or smart phones. Students can organize their research using a Placemat Strategy. The Placemat Strategy provides an opportunity for each student to record individual responses and ideas regarding an issue, topic or question for consideration. The strategy can be used to brainstorm ideas, record researched information or analyze documents. On one placemat, students should write down supporting evidence for their position for or against deforestation. On the other they should write down ways in which the actions associated with their role impact the carbon cycle.

<p>1. What evidence do you have in support of your argument for or against deforestation?</p>	

<p>1. How does evidence for your role impact the carbon cycle?</p>	

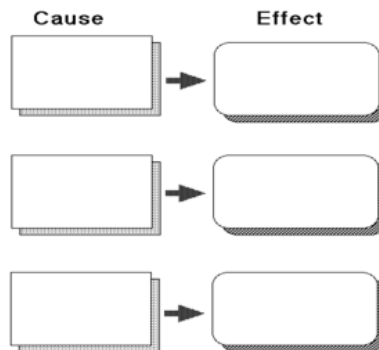
3. Facilitate the seminar by allowing time for each group to explain their perspective and offer evidence in support of their view as well as how their role impacts the carbon cycle. To ensure that all students are participating, give each student one or two talking chips. These chips can be pieces of paper with their name, Popsicle sticks or game chips. When a student shares, they will place a chip in a central location (a cup or tabletop). You could also use a talking stick to facilitate one student speaking at a time. Students will use their placemats to refer to throughout the seminar. Suggested guiding questions to keep conversations moving;
  - a. Who has a different perspective?
  - b. Who has not yet had a chance to speak?
  - c. Where do you find evidence for that in the text?
  - d. Can you clarify what you mean by that?
  - e. How does that relate to what (someone else) said?
  - f. Has anyone changed his or her mind?

4. Provide students with an opportunity to self reflect on their participation in the socratic seminar and explain how the seminar influenced their thinking about the topic of deforestation and its impact on the carbon cycle.
  - a. Why is it important to hear both sides of an argument?
  - b. Do you think you have to completely agree with one side? Why or why not?

Self-Assessment

Taking a position on a question	5	4	3	2	1
Using evidence to support a position or presenting factual information	5	4	3	2	1
Drawing another person into the discussion	5	4	3	2	1
Asking a clarifying question or moving the discussion along	5	4	3	2	1

5. Guide students to understand the relationship between the effects of deforestation in one area, with the larger issues of global implications by viewing examples on slides 24-26. Students can develop a cause and effect chart to organize their learning.



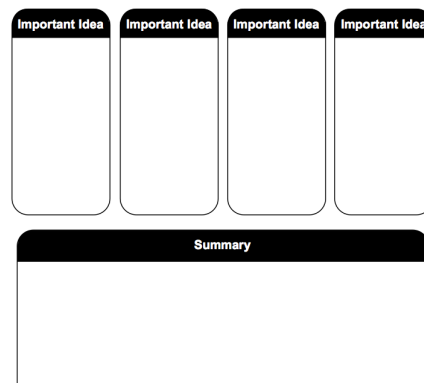


Explain

What can people do to protect and promote trees in their community?

Presentation Slides 27-60

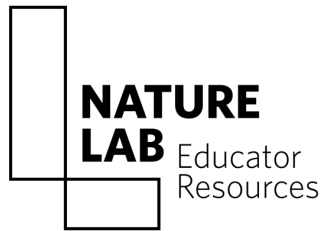
1. Share the scientist video answering the question, “How is wildlife conservation closely related to forest conservation?”
2. Explain that new conservation techniques are being introduced all over the world in an attempt to achieve a sustainable balance between nature and people. The teacher may choose to share slides 29-43 for students to summarize the relationships between wildlife conservation and forest conservation by drawing an image of each technique. These slides can also be printed out and divided to groups of four students. As students review their slide, they should note the important ideas and then summarize the information. Challenge students to illustrate how their conservation technique is helping balance the needs of nature and people on the back of the student summary graphic organizer. How does each of these techniques impact the carbon cycle?



The graphic organizer consists of four vertical rectangular boxes arranged in a row. Each box has a black header with the text "Important Idea" in white. Below the headers are four empty white boxes for notes. Below these four boxes is a single, wider rectangular box with a black header labeled "Summary" in white, and a large empty white space for a summary.

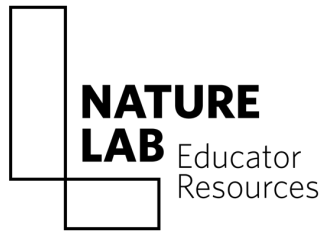
3. Reforestation was one of the techniques students explored when investigating the relationship between wildlife conservation and forest conservation. Ask students to reflect on how that technique was used and the benefits.
4. Share the scientist video answering the question, “How are preservation and restoration efforts of forests established?” Ask students to pair up with their 3:00 clock buddy and discuss how China is working to preserve and restore its forests by putting the events in the correct order.
5. Share with students a slideshow detailing a reforestation project in the Sichuan Province in China:

<http://www.nature.org/ourinitiatives/regions/asiaandthepacific/china/explore/china->



[tengchong-reforestation-slideshow.xml](#). Each slide has text that can be read aloud to students. Facilitate students pairing up with their 10:00 clock buddies to summarize the benefits of this reforestation project. Share the scientist video, “What are the major benefits of this large-scale restoration project?” Ask students to compare their summaries with the information in the video.

6. Share the scientist video, “How does this project benefit the local community?” Provide students with data around the 277 Tengchong households that receive funding to protect forested areas on slide x. Ask students to consider the following questions:
  - How many hectares of newly planted forests are being protected and how does that compare to the entire region?
  - What impact will this reforestation effort have on the carbon cycle?
7. Explain to students that effectively displaying information and data is a critical part of communicating science. Graphical representation of ideas has become part of our world and is a powerful way to convey information. Infographics have been produced to help explain everything from the economy to ecology.
8. Ask students to create an infographic that helps the viewer understand the relationship between carbon dioxide, deforestation/reforestation, and global climate change. Information from the scientist videos and articles can be summarized to support their infographic. Included below are examples of completed infographics. These types of graphics can be created by many different software packages, such as PowerPoint or the free OpenOffice equivalent. Vector graphics programs exist that can make this process easier too, such as Inkscape (free) and Xara. For the especially computer savvy, flash animations could be created.
9. Students should be encouraged to share their projects with others at various stages of project development: during planning, development and after completion of the final product.
  - a. **Planning:** Ask students to sketch out their infographic and include statements about data and information they will include. Students will place their sketches on their desk with blank sticky notes. Direct students to rotate around the room to at least three other projects and write down a compliment and make a specific suggestion for improving the design on the provided sticky notes.
  - b. **Development:** Ask students to pair up with a partner and share their designs in the development stage. As their partner is providing feedback the students will record their recommendations. Specifically ask students to evaluate how effectively the infographic is communicating the relationship between carbon dioxide, deforestation/reforestation, and global climate change.
  - c. **Completion:** After students have developed their final infographic ask students to display them on their desk next to a carousel feedback form. In teams of two



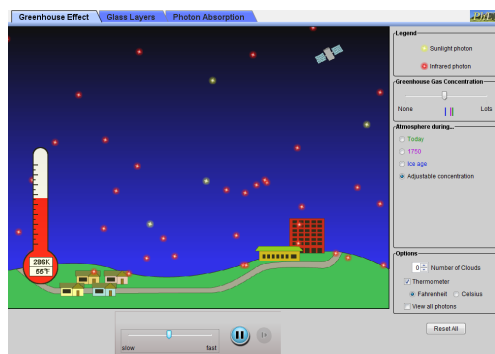
ask students to carousel around the room and write down their feedback for eight of the projects. Feedback should include commenting on the effectiveness of communicating their information, the accuracy of information included, visual design and any additional comments or considerations.

- d. Reflection: Guide students into reflecting on their project by responding to the following questions:
1. What is the most important thing you learned from this project?
  2. How did your project communicate the relationship between carbon dioxide, deforestation and global climate change? Use evidence from your peer feedback.
  3. What would you do differently if you did this project again? Include any projects you reviewed that may have inspired your changes.



Extend Option 1

1. Students can explore an interactive Greenhouse simulation from the PhET™ project at the University of Colorado. Through this simulation students will observe patterns to explain why greenhouse gases affect the temperature.  
<http://phet.colorado.edu/en/simulation/greenhouse>



### Extend Option 2

1. Students can calculate their carbon footprint using the Kids Carbon Calculator. <http://www.cooltheworld.com/kidscarboncalculator.php> They will later compare this data to global figures.
2. Lead students outside to select a tree that is at least 5 feet tall and identify the species by using a dichotomous key or tree ID application. If there are several trees on your school grounds you may want to encourage students to select different species to compare.
3. Measure the circumference at breast height in cm. Breast height is the circumference of the tree at 4.5 feet from the base. Guide students to record their measurements.
4. Lead students back to the classroom and use the equation below to measure the biomass of their tree. Information about the species coefficient can be found at: <http://www.yale.edu/fes519b/saltonstall/biomass2.html#estimate>

Calculate the biomass of your tree in kg \_\_\_\_\_

Formula:  $M=aD^b$

M= biomass

a= species coefficient a

D= diameter at breast height

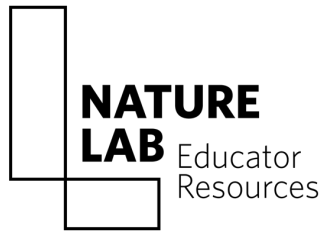
b= species coefficient b

5. After calculating the biomass, students can determine the amount of carbon stored in their tree.

Is the species hardwood or softwood? \_\_\_\_\_

Calculate the amount of carbon in your tree in kg: \_\_\_\_\_

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: \_\_\_\_\_  
(1 metric ton = 1000 kg)

6. Using their final amount of carbon stored in their tree students can compare their figure to how much carbon is emitted each day globally by viewing the carbon counter:  
[http://www.dbcca.com/dbcca/EN/what-you-can-do/downloadable\\_widget.jsp](http://www.dbcca.com/dbcca/EN/what-you-can-do/downloadable_widget.jsp)
7. Ask students to consider the following questions;
  - a. How many trees/acres would they need to plant to offset their carbon emissions? How about the whole class' carbon emissions?
  - b. Is this number of trees/amount of land needed to plant the trees practical? Why or why not?

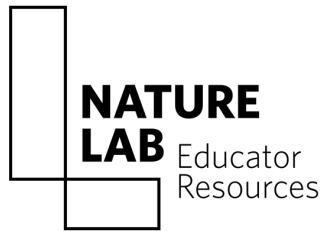
### Evaluate

Have students self-evaluate for:

- Their understanding of the carbon cycle demonstrated by accurately organizing provided components of the carbon cycle within a cycle.
- How well their socratic seminar role was developed on their placemat graphic organizer, their participation during the seminar, and their reflection of the socratic seminar.
- Their infographic and its effectiveness in communicating the intended message.

Specific questions:

1. Describe the role of trees in the carbon cycle.
2. Explain the relationship between carbon dioxide, deforestation/reforestation, and global climate change.
3. List two effects that human activity has on the carbon cycle.



Additional resources and further reading:

Clock Buddies

[http://www.newton.k12.ia.us/administration/ed\\_services/2nd\\_Year/Session%201/Clock\\_Buddies.pdf](http://www.newton.k12.ia.us/administration/ed_services/2nd_Year/Session%201/Clock_Buddies.pdf)

This is a learning partner strategy. Students are given the graphic of a clock and at each slot two students will record each other's names. Whenever the teacher announces a time for students to process learning a partnership is identified and students meet with their partners.

Carousel Feedback Form

[http://www.kaganonline.com/online\\_magazine/Carousel\\_Feedback\\_Form.pdf](http://www.kaganonline.com/online_magazine/Carousel_Feedback_Form.pdf)

This is a cooperative learning strategy. This form is included with a student project for their peers to capture their feedback on.

Random Name Generator

<http://www.superteachertools.com/instantclassroom/random-name-generator.php>

This tool can be used to randomly select students to share their learning.





Poll Everywhere

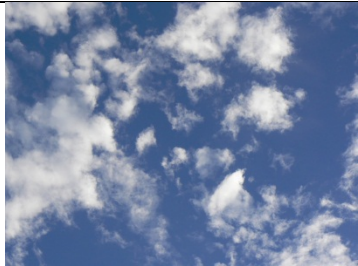
<http://www.polleverywhere.com/>

This tool is an audience response system that uses mobile phones, twitter, and the web.

Why is Carbon Good?	Why is Carbon Bad?
Carbon is an important _____ in living things.	Too much carbon dioxide in the atmosphere changes the _____.
Plants need carbon dioxide to _____.	Too much carbon dioxide dissolving in the ocean makes it more _____, which can harm animals and plants that are adapted to less acidic environments.
_____ in the atmosphere keeps the planet warm and livable.	Carbon dioxide and other gases react with water to form _____.
Some of the things we use every day contain _____.	



	<p><b>Photosynthesis</b> Plants and trees take in atmospheric carbon dioxide and convert it in to food.</p>
	<p><b>Respiration</b> Carbon dioxide is released into the air as a by-product of organisms breaking down carbohydrates to obtain energy.</p>
	<p><b>Decay</b> Living organisms have carbon in their bodies through the food they eat. When they die, scavengers feed on their bodies. Most of the carbon from decaying organic matter is released as carbon dioxide into the atmosphere.</p>
	<p><b>Fossil Fuels</b> When firewood, forests, fossil fuels and organic debris are burned carbon dioxide is formed.</p>

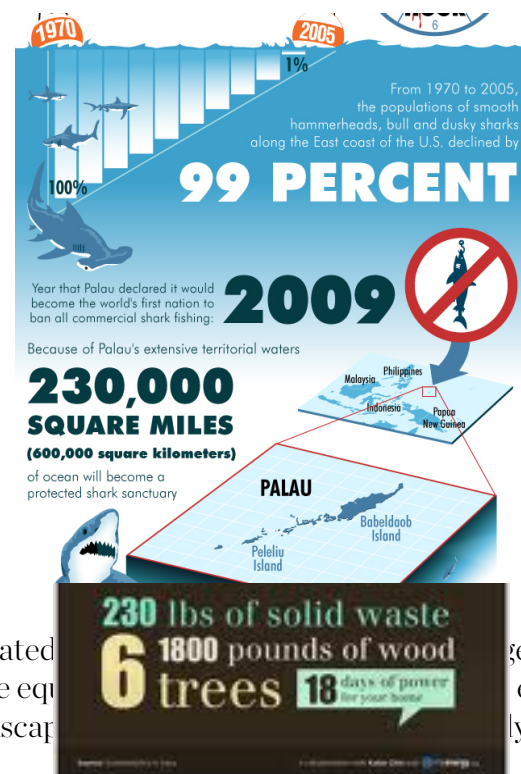
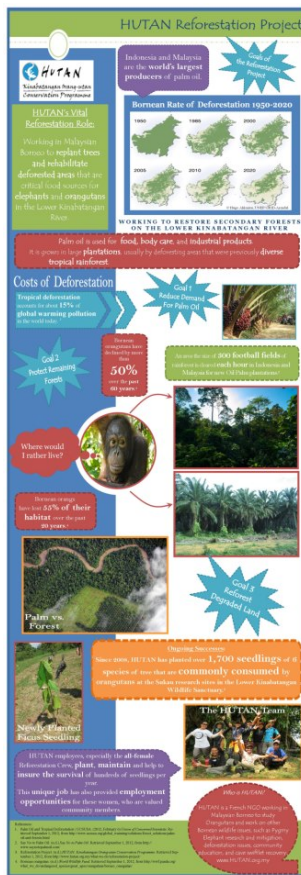
			<p>Atmosphere The gases that surround our planet have carbon in the form of carbon dioxide. It is greenhouse gas, which helps to maintain the temperature of the planet.</p>
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## Communicating Reforestation Using Infographics

Effectively displaying information and data is a critical part of communicating science. Graphical representation of ideas has become part of our world and is a powerful way to convey information. Infographics have been produced to help explain everything from the economy to ecology.

You will be creating an infographic that helps the viewer understand the relationship between carbon dioxide, deforestation/reforestation, and global climate change.

Information from the scientist videos and articles can be summarized to support your infographic. Included below are examples of completed infographics.



These types of graphics can be created in PowerPoint or the free OpenOffice equivalent. This process is made even easier with software like Inkscape, and flash animations could be created.

tools, such as those that exist that can make you more computer savvy,

## Communicating Reforestation Using Infographics

You will be sharing your projects with others at various stages of project development: during planning, development and after completion of the final product.



**Planning:** Sketch out your infographic and include statements about data and information you will include. You will place your sketch on a desk with blank sticky notes. Then, you will rotate around the room to at least three other projects and write down a compliment and make a specific suggestion for improving the design on the provided sticky notes.

Due Date: \_\_\_\_\_



**Development:** Pair up with a partner and share your designs in the development stage. As your partner is providing feedback you will record their recommendations. Specifically evaluate how effectively the infographic is communicating the relationship between carbon dioxide, deforestation/reforestation, and global climate change.

Due Date: \_\_\_\_\_



**Completion:** After you have developed your final infographic you will display them on your desk next to a carousel feedback form. In teams of two, carousel around the room and write down your feedback for eight of the projects. Feedback should include commenting on the effectiveness of communicating their information, the accuracy of information included, visual design and any additional comments or considerations.

Due Date: \_\_\_\_\_



**Reflection:** Reflect on your project by responding to the following questions:

What is the most important thing you learned from this project?

How did your project communicate the relationship between carbon dioxide, deforestation and global climate change? Use evidence from your peer feedback.

What would you do differently if you did this project again? Include any projects you reviewed that may have inspired your changes.

Due Date: \_\_\_\_\_