Carbon Footprint Project
Curriculum Guidelines
2008
Hello, and welcome to EnviroEd’s Carbon Footprint Curriculum. This program was first written and utilized by volunteers in Harvard’s EnviroEd program, partnering with Citizen Schools and Boston Public Schools, in the fall of 2007. It was the second semester in which we were a partner with those organizations and our second success introducing environmental concepts to the 5-8 graders in the 6 schools that we taught in. The program was designed as a once a week after-school program that culminated in a final presentation in December. During that presentation the students presented their videos to a small panel of school members and community members and had an excellent evening. Over the course of the ten weeks that we taught we feel the students learned a great deal and enjoyed the program. The return of several of the students to the program in the spring is a testament to this fact. It is our hope that this curriculum proves as useful and successful for you, in whatever form you decide to use it, as it did for us. Good luck!

July 8, 2008

A. Patrick Behrer & Aubrie Pagano, EnviroEd co-directors
Introduction:

In 1975 UNESCO published the Belgrade charter which “called for the development of environmental education as one of the most critical elements of an all-out attack on the world’s environmental crisis.” This document also established the goal of environmental education to be the development of a world population that is: “...aware of, and concerned about, the environment and its associated problems, and which as the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones.”

In the 30 years since that declaration there has been an incredible expansion of environmental education programs, both internationally and in the United States. Continuing the expansion of these programs and increasing their efficiency and scope is one of the best ways we have of taking steps to slow and stop the multitude of environmental problems currently facing the world. From Global Warming to continual deforestation none of these issues can be effectively combated if the general public does not have a basic level of environmental literacy.

As educators, activists, community members and volunteers this processes of increasing environmental literacy falls to each of us. Programs like this “Carbon Footprint Project” promote increased environmental literacy as well as a sense of personal involvement and a feeling that individual actions can make a difference.

Finally, as numerous handbooks and reports on the subject have attested, environmental education is good education. It involves the students and forces them to actively participate in the learning process. Often times it is concerned with issues of local importance that students can relate directly to their own lives and it typically avoids rote memorization activities in favor of comprehensive projects and involve and encourage critical thinking and problem solving.

In short, environmental education is education that is necessary not only for the benefits that increased environmental literacy will have for the planet and human living standards but because it is also beneficial for the students educational experience. It can and should be integrated across curriculums and this project presents one of many ways in which that can be done.
How to use this curriculum:

The “Carbon Footprint Project” curriculum was designed for, and first implemented in, an after school program in inner city middle schools in the Boston Public School District. The lessons are each meant to be approximately an hour and half and the project was meant to last for ten weeks with one lesson taught each week. The final week was a meant to be a presentation of the project.

Because it was designed as an after school program it takes advantage of the flexibility that this allows to conduct some teaching outside as well as in locations “off campus.” It also is very heavy on hands on activities as a way of keeping the students engaged after a normal school day.

Some of the activities therefore my not be appropriate for a more formal class setting. Educators are encouraged to use this curriculum as a guideline in developing their own activities and to add or take away where they feel it is necessary. Each classroom is different and what works in one may not work in another. Whether this curriculum is used in its entirety or in part the ultimate goal should be increasing students understand of global warming and how everyone contributes to that phenomenon.

Acknowledgements

We would like to thank both Citizen Schools and the Boston Public School district for their logistical support and for allowing us to first teach this curriculum in their programs. Boston Public Schools provided the classrooms and students while Citizen Schools gave classroom support and organized the final presentation of the WOW at Northeastern University. Citizen Schools also provided classroom funding where necessary.

The student teaching groups who first taught and provided feedback on this curriculum also deserved to be thanked. From Harvard University we would like to thank Christopher Behrer, Elizabeth Shope, Jane Yun Ng, Alyssa Hill, Sasha Klein, Quinn Dang, Tess Margaret Hellgren, Tess Woods, Peter Tilton, Danialle Marie Gram, and Haley Fink. From Boston College we would like to thank Laura Yount, James Birney, Natalie Raffol and Sarah King.
Lesson Plan I: Biodiversity and Global Warming Introduction

School: ____________________________    Date: ____________

| Lesson Objectives:                                                                 |
| By the end of the lesson, the students will have learned:                         |
|   1. Understand what the class rules are                                         |
|   2. What an Ecosystem is                                                        |
|   3. What Biodiversity is and how it relates to a healthy environment             |
|   4. What Global Warming is                                                       |

| Agenda:                                                                            |
| Post in the room for students to see. Even appoint a student, responsible for writing the agenda on the board. |
|   1. Opening Ritual – 10 Minutes                                                   |
|   2. Review Agenda and Set Context – 10 Minutes                                    |
|      a. Go over classroom rules – have kids write them on a poster                 |
|      b. Explain the WOW                                                            |
|      c. Go over today’s lesson                                                     |
|   3. Activity: **Environmental Pre-test**  Time: 10 Minutes                        |
|   4. Activity: **Lecture about Ecosystems, Biodiversity & Food Web**  Time: 15 Minutes |
|   5. Activity: **Play Tic Tac Toe outside with the new Vocab**  Time: 20 Minutes    |
|   6. Activity: **Explain the basics of Global Warming**  Time: 15 Minutes           |
|   7. Teach Back – 5 Minutes                                                       |

| Lesson – By Activity                                                               |
| Activity #1: Pre-test on Environmental knowledge                                    |
|   * Use attached test and explain to the students that this is simply              |
|      to assess how much they know now and they will take it again at               |
|      the end to see how much they’ve learned.                                      |
| Activity #2: Lecture on Ecosystems, Biodiversity & Food Web                        |
|   * Put each of the vocabulary words below at the top of a sheet of                |
|      paper and place them at a desk around the room. Have the                      |
|      students go around the room and write what they think each                    |
|      word means on the paper.                                                      |
|   * Collect the sheets and go over the words the kids don’t know                   |
|       o Suggestion: Write the words and the proper definition on                    |
|       large poster paper in the front of the room as you talk the                  |
|       kids through the definition                                                  |
|   * Make sure the students understand not just each word but how
each one is connected with the others

Activity #3: Tic Tac Toe to practice Vocabulary
* Take the class outside to a field if possible and the parking lot if not and make a tic tac toe board with duct tape. Split the class into teams
* Use the attached questions and have each team answer a question. If they get it right they can place a team member on the board but once on the board the team member can no longer help answer questions. They also must make an X or an O with their arms and if they stop they have to come off the board. If a team gets a question right then the other team gets a chance to answer. In order to keep the game moving give each team a certain amount of time in which to answer the question.

Activity #4: Basics of Global Warming
* Global Warming Vocab. You can do the same with this as with the previous Vocab, although the kids will probably know more of this because of the amount of media treatment.
* While explaining all of this, make sure that the kids understand the scientific process in addition to the vocabulary. Don’t explain too much of the effects on sea levels or storms, etc as that is a big part of next week’s lesson.

Materials and Equipment:
1. Lesson I Teacher Information (attached)
2. Chalk or tape to make tic tac toe squares

Teach Back:
Ask the students to teach back what they learned in this lesson, as a form of review.
Teacher Information:
Vocabulary Lists

- **Biodiversity**: A totality of genes, species, and ecosystems of a region and variation of life at all levels of biological organization.

- **Photosynthesis**: The conversion of carbon dioxide, water and sunlight into chemical energy by plants. It is also an important source of oxygen.

- **Ecosystem**: A natural unit consisting of all plants, animals and microorganisms in an area functioning together with all the non-living physical factors of the environment.

- **Biosphere**: The global ecological system integrating all living beings and their relationships.

- **Habitat**: The natural environment in which an organism lives, especially the physical environment that surrounds, influences and is utilized by a species’ population.

- **Food Web**: The feeding relationships between species in an ecological community. A graphical representation of the transfer of energy from one species to another within an ecosystem. (Emphasis the importance of small organisms to the survival of a predator, eg. Acorns > chipmunks > hawks. Also discuss the effect of small amounts of pollution low in the food chain on the lives of top predators)

- **Greenhouse Gases**: Components of the atmosphere that contribute to the greenhouse effect. Some greenhouse gases occur naturally in the atmosphere, while others result from human activities such as burning of fossil fuels such as coal. Greenhouse gases include carbon dioxide, methane, nitrous oxide, and ozone.

- **Conservation**: The preservation and careful management of the environment and of natural resources.
Three R’s: Reduce, Reuse, Recycle. (Explain why these are important relative to protecting the environment and conservation.)

Gene Pool: In population genetics, a gene pool is the set of genes in a species or population. Explain the following but you don’t need to write it: A large gene pool indicates extensive genetic diversity, which is associated with robust populations that have better chances of survival. Meanwhile, low genetic diversity can cause reduced biological fitness and an increased chance of extinction.

Global Warming Vocab

Ozone Layer: The ozone layer is a part of the Earth's atmosphere which contains relatively high concentrations of ozone which it is vitally important to life because it absorbs biologically harmful ultraviolet (UV) radiation emitted from the Sun.

Atmosphere: The layer of gases that surround the Earth and make the planet habitable. It is mostly made up of nitrogen and oxygen with small amounts of carbon dioxide.

Smog: A type of air pollution that is caused by large amounts of coal burning in an area and is caused by a mixture of smoke and sulphur dioxide.

Greenhouse Effect: The process in which the emission of infrared radiation by the atmosphere warms a planet’s surface. Radiation from the sun is normally reflected off the earth but when certain gases build up in the atmosphere the radiation is trapped and it causes the earth to warm.

Methane: A greenhouse gas roughly 25 times more potent than CO₂. It’s produced mostly by natural gas and oil mining as well as the decomposition of organic matter in land fills and on farms.

Deforestation: The clearing of forest land to make way for farming, urban or other uses. It contributes to global warming by removing a large number of trees which serve to remove CO₂ from the atmosphere.
Tic Tac Toe Questions

1. What is the connection between an acorn, a squirrel and a hawk called?
2. Are human beings part of an ecosystem?
3. When the gene pool in a species decreases what can happen to the species?
4. What is the difference between a diverse gene pool and biodiversity?
5. What is a habitat?
6. What are the three R’s?
7. What is the difference between reusing and recycling?
8. What is photosynthesis? Why is it important?
9. What are 3 of the 4 greenhouse gases?
10. What is one major source of CO₂?
11. Why is CO₂ bad?
12. Why is CO₂ good?
13. What is the Biosphere?
14. Are we part of the Biosphere?
15. What is the difference between an ecosystem and a habitat?
16. Do Greenhouse gases affect the biosphere?
17. What ecosystems do you see on a daily basis?
18. Are humans part of the food web?
19. Where does Carbon come from in the environment?
20. Are all greenhouse gases bad when they are in the atmosphere?
Lesson Plan II: Carbon Emissions Cause & Effect

School: ____________________________    Date: ____________

<table>
<thead>
<tr>
<th>Lesson Objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>By the end of the lesson, the students will have learned:</td>
</tr>
<tr>
<td>1. Global Warming, Causes &amp; Effects</td>
</tr>
<tr>
<td>2. Carbon Emissions, Causes &amp; Effects [as a set of greenhouse gases]</td>
</tr>
<tr>
<td>3. Anthropogenic Greenhouse Gas production</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Agenda:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post in the room for students to see. Even appoint a student, responsible for writing the agenda on the board.</td>
</tr>
<tr>
<td>1. Opening Ritual – 10 Minutes</td>
</tr>
<tr>
<td>2. Review Agenda and Set Context – 5 Minutes</td>
</tr>
<tr>
<td>4. Activity: <strong>“An Inconvenient Truth”</strong> Time: 30 Minutes</td>
</tr>
<tr>
<td>5. Activity: <strong>Vocabulary Jeopardy</strong> Time: 20 Minutes</td>
</tr>
<tr>
<td>6. Teach Back – Incorporated into Jeopardy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lesson – By Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity #1: Global Warming, Carbon Emission &amp; Anthropogenic production</td>
</tr>
<tr>
<td>* For this activity, you will need to first pass out the Lesson II Handout (found right after this lesson plan in your binder).</td>
</tr>
<tr>
<td>* Designate a teacher’s assistant to both pass out the handout and collect it before the Jeopardy game begins.</td>
</tr>
<tr>
<td>* Talk the students through the material. Engage them with questions along the way, in order to help to reinforce the lesson</td>
</tr>
</tbody>
</table>

| Activity #2: "An Inconvenient Truth" |

| Activity #3: Vocabulary Jeopardy |
| * Split the kids up into even groups of 3 or 4 (if possible) at random [when kids choose friends, someone inevitably gets left out] |
| * Ask one of the students to explain the rules of Jeopardy, if any of them know the rules [good way to engage them and make them listen to each other] |
| * Using the Lesson II: Climate Change Jeopardy handout, write the categories on the board just as they are laid out on the handout |
* Put a number on the board and cover it, then ask each group to ask the number. The closest group will start the game.
* When a group picks a category, say the statement with the least point value, and rotate around to each group clockwise, allowing one group at a time to try and answer within 15 seconds. If a group cannot answer, the next team has the opportunity.
* By the end, the team with the most points wins the game.

### Materials and Equipment:

1. [Lesson II Handout](#), to be given out during Activity #1 and #2 and then redistributed after class
2. DVD player and Television
3. [Lesson II: Climate Change Jeopardy](#) handout

### Teach Back:

Ask the students to teach back what they learned in this lesson, as a form of review.
* This lesson, it will be alright to simply ensure that the kids are teaching back through the Jeopardy questions
1. What is Global Warming in a sentence?

2. Name Three Greenhouse Gases. How do they contribute to Global Warming?

   1. 
   2. 
   3. 
Causes of Climate Change:

1. Greenhouse Gases:

2. Carbon Emissions:

3. Anthropogenic Carbon Emission:

What do you think might be some of the leading causes of recent global warming?

What are some ways that we all emit Greenhouse gases?
Effects of Climate Change:

The retreat of mountain glaciers during the past century is one example of evidence that the climate is changing.
Rising sea levels are another example of what could happen if the earth warms too much:

Photo courtesy of the National Oceanic and Atmospheric Administration

*The Majuro Atoll:* If sea level rises 20 inches then 80% of the Majuro Atol will be under water. Many other islands may also be submerged if sea level rises.

**Evidence of Climate Change:**

![Graph showing temperature and CO₂ concentration over time.](image)

(GDFL - Geophysical Fluid Dynamics Laboratory model; NCAR - National Center for Atmospheric Reserach model)
Global averaged temperature projections from two state-of-the-art climate models driven by the same scenario of the future CO$_2$ concentrations give similar results.

What do you think the graph tells us?
Lesson II: Climate change Jeopardy

<table>
<thead>
<tr>
<th>Category</th>
<th>1 point</th>
<th>2 points</th>
<th>3 points</th>
<th>4 points</th>
<th>5 points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Global Warming:

1. What is Global Warming, in a sentence?

Diagram Explanation:
1. Sunlight brings energy into the climate system; most of it is absorbed by the oceans and land.
2. *The Greenhouse Effect*: Energy, in the form of heat, radiates out from the warmed surface of the earth
   a. Some of this energy is absorbed by greenhouse gases in the atmosphere, which re-emit the energy in all directions
   b. Some of the infrared energy further warms the Earth
   c. Some of the infrared energy is emitted into space.
3. *Amplified Greenhouse Effect*: Higher concentrations of CO₂ and other greenhouse gases trap more infrared energy in the atmosphere than occurs naturally. The additional heat further warms the atmosphere and Earth’s surface.
2. **Name three greenhouse gases?**
   - The Diagram below gets all the human-produced gases down, but it leaves out water vapor, the final and most prevalent greenhouse gas.

![Diagram showing relative importance of greenhouse gases](image)

This diagram shows the relative importance of the major human-produced greenhouse gases to current warming. CO₂ is the most important followed in descending order by methane, CFCs, ozone and nitrous oxide.

3. **Which greenhouse gas is the most harmful?**
   - The world’s economy runs on carbon: the “fuel” in fossil fuels. Coal, oil, and natural gas contribute energy to nearly every human endeavor in industrialized nations, and carbon dioxide (CO₂) is a by-product of burning these fuels. Immediately eliminating CO₂ emissions would literally stop the industrial world. This graph illustrates how thoroughly fossil fuels and CO₂ emissions are integrated into American life.

   CO₂ contributes more to the recent increase in greenhouse warming than any other gas. CO₂ persists in the atmosphere longer and longer as concentrations continue to rise.
Causes of Climate Change:

1. *Greenhouse Gases*: Gases, in excess, which trap heat in the Earth’s atmosphere. This occurs when an ecosystem produces more gas than it can naturally get rid of.
2. *Carbon Emissions*: Carbon Dioxoide (CO₂) is the greenhouse gas most responsible for climate change.
3. Anthropogenic Carbon Emission: Carbon Dioxide emissions caused by humans and the industries and machines they have created.

What do you think might be some of the leading causes of recent global warming?

Greenhouse gas emissions from industry, transportation (1/3 of total US global warming pollution) and agriculture are very likely the main cause of recently observed global warming.

Some of the main sources of greenhouse gases due to human activity include:

* burning of fossil fuels and deforestation leading to higher carbon dioxide concentrations
* livestock and paddy rice farming, land use and wetland changes, pipeline losses, and covered vented landfill emissions leading to higher methane atmospheric concentrations.
* According to the Food and Agriculture Organization of the United Nations, the livestock industry is responsible for 18% of greenhouse gas emissions, a higher share than transportation.
* refrigeration systems, and use of CFCs and halons in fire suppression systems and manufacturing processes

What are some ways that we all emit greenhouse gases?

Major sources of an individual's GHG include home heating and cooling, electricity consumption, and transportation.
**Effects of Climate Change:**

The retreat of mountain glaciers during the past century is one example of evidence that the climate is changing.

<table>
<thead>
<tr>
<th>1928</th>
<th>1979</th>
<th>2003</th>
</tr>
</thead>
</table>

South Cascade Glacier, Washington

Rising sea levels are another example of what could happen if the earth warms too much:

*Photo courtesy of the National Oceanic and Atmospheric Administration*

1. **The Majuro Atoll:** If sea level rises 20 inches then 80% of the Majuro Atol will be under water. Many other islands may also be submerged if sea level rises. Sea level Rising – the ocean rises 1/10 of an inch each year; could submerge coral reefs and even islands!
2. Water Shortages – 3rd world resource management problems [e.g., Africa]
3. More Diseases – disease spreads easier in warmer weather
4. Ecosystem Changes – Earlier springs [between 1936-1998, 36 plant species flowered 7.3 days earlier!]

How can we see the effects of global warming upon the environment?
* Keeling Chart: In 1958, American scientist Charles David Keeling began measuring the concentration of the gas carbon dioxide (CO2) in the atmosphere. This graph presents data gathered on Mauna Loa, a volcano in Hawaii.

![Keeling Chart](image)

**Note:** the fluctuation in the measurement stems from the wavering CO2 concentrations in the Northern hemisphere, where CO2 concentration peaks in early spring just before plant growth begins and falls off in October when the growing season ends.
Evidence of Climate Change:

Global averaged temperature projections from two state-of-the-art climate models driven by the same scenario of the future CO₂ concentrations give similar results.

What do you think the graph tells us?

Both graphed lines show that warming is projected to increase in the next century as greenhouse gas levels rise; Both show that warming will likely be greatest in the northern regions close to the pole; Both show that warming will likely tend to be greater over land than over the ocean.
Lesson Plan III: Field Trip Day

School: ____________________________    Date: ____________

Lesson Objectives:
By the end of the lesson, the students will have learned:
1. Be introduced to a green building and the thoughts behind it. Get some ideas for their reduction plans.

Agenda:
Post in the room for students to see. Even appoint a student, responsible for writing the agenda on the board.
1. Opening Ritual – 10 Minutes
2. Review Agenda and Set Context – 5 Minutes
3. Activity: Curriculum Appropriate Field Trip (see below) Time: 3 hours
4. Activity: Introduce the Carbon Footprint Time: In transit
5. Teach Back – In transit
6. Clean Up

Lesson – By Activity
Activity #1: Field Trip
* Suggestions: Local LEED certified buildings, centers of sustainability research, companies whose products have a ‘green’ focus.
* The goal is to get the kids thinking about the Carbon Footprints which they will be working on in the next few lessons.

Materials and Equipment:
* Buses or other transport
* Survey (attached)

Teach Back
Ask the students to teach back what they learned in this lesson, as a form of review.
Lesson Plan IV: Start of WOW!: Intro to Carbon Footprints & Initial Calculations

Lesson Objectives:
By the end of the lesson, the students will have learned:
  1. What the necessary components of a Carbon Footprint are
  2. How to take some of the measurements

Agenda:
Post in the room for students to see. Even appoint a student, responsible for writing the agenda on the board.
  1. Opening Ritual – 10 Minutes
  2. Review Agenda and Set Context – 5 Minutes
  3. Activity: Explain the point of a Carbon Footprint Time: 20 min
  4. Activity: Break into groups to take measurements Time: 30 min
  5. Activity: Return to Class and have each group report their findings Time: 15 min
  6. Teach Back

Lesson – By Activity
Activity #1: Explain the Point of a Carbon Footprint and what it is.
  * Have the kids come up with things that they think they should measure to calculate their Emissions (see below for list).
Activity #2: Break into groups to take measurements
  * Split the kids into two groups under each of the Citizen School teachers.
  * Have the students go around the school and take the measurements that they came up with in the first activity (try and have each group go outside).
Activity #3: Return to Class and have each group report their findings
  * Bring everyone back together and have the groups appoint a spokesperson and secretary and have each group explain to the other what they found.
  * The CTs should write this down as well in case the students forget it or loose it

Materials and Equipment:
List of Measurements (attached)
Tape Measure
Teach Back
Ask the students to teach back what they learned in this lesson, as a form of review.
What is a Carbon Footprint

A Carbon Footprint is a measure of the impact of human activities have on the environment in terms of the amount of greenhouse gases produced, measured in units of carbon dioxide.

1. Have the kids list ideas for how their school emits Carbon. Buses, electricity, etc. Once they come up with a list of the ways that their school emits carbon have them think of ways to measure those emissions.
   a. Try and tailor the discussion to the following measurements required for the Calculation program:
      - Size of class room
      - # of class rooms
      - Size of school
      - How many cars in parking lot
      - How far do people drive
      - How many days of school are there
      - % of cars vs. % of trucks/SUVs
      - # of school owned Vehicles
      - Distance traveled
      - Days per year which they travel
      - How many dumpsters
      - How many times per year the dumpster is emptied
      - Current student population
      - Population 30 years ago

2. Break the kids into groups to measure the highlighted statistics. The non-highlighted information will be recorded in the next lesson.
Lesson Plan V: Footprint Calculations & Carbon Emissions Research

School: ____________________________    Date: ____________

| Lesson Objectives:                                                                 |
| By the end of the lesson, the students will have learned:                         |
|   1. Use the internet                                                            |
|   2. Calculate out the Carbon Footprint                                          |
|   3. Complete initial research on solutions to the problem                        |

| Agenda:                                                                          |
| Post in the room for students to see. Even appoint a student, responsible for writing the agenda on the board. |
| 1. Opening Ritual – 10 Minutes                                                   |
| 2. Review Agenda and Set Context – 5 Minutes                                     |
| 3. Activity #1: **Compute the school’s Carbon Footprint** Time: 35 Minutes        |
| 4. Activity #2: **Take the internet activity quizzes** Time: 15 Minutes           |
| 5. Activity #3: **Game of your choice!** Time: 20 Minutes                        |
| 6. Teach Back – 5 Minutes                                                        |

| Lesson – By Activity                                                             |
| Activity #1: Compute the school’s Carbon Footprint                               |
| * **If Computer Lab:** Allow as many kids as possible to have their own computer. Use the internet to access “EPA's Climate Change Emission Calculator Kit (Climate CHECK)” (WinZip of Excel spreadsheet, 3.4 MB) |
| * You can also allow the kids to navigate Google.com, first entering Environmental Protection Agency; then looking on the site for Climate Change; then looking for High School Teacher Tools and Emission Calculators |
| * Here is the link, if the kids absolutely cannot find the site: http://epa.gov/climatechange/wycd/school.html |
| * **If no Lab:** Split the kids up into 2 groups around the laptops, one with each teacher. Use the CD(s) of the Footprint calculator (WinZip file), to make the process move along faster. |

Double check that the class has all the measurements that are required for the footprint
* If yes, then move forward with the calculations, until the Carbon Emissions figure is calculated at the bottom. Allow the kids to analyze the graphs at the bottom for a moment, asking them to reflect on what the graphs and the numbers indicate, not only about global warming (1) causes, but about (2) possible effects
and (3) solutions. Write their answers to these questions on the board, and also in your Binder.

Activity #2: Take the internet activity quizzes

* [http://www.koshlandscience.org/exhibitgcc/responses01.jsp](http://www.koshlandscience.org/exhibitgcc/responses01.jsp): do the two activities: “CO2 Emissions Calculator” and “Consider the Alternatives”

* After the class has figured out the Footprint, the next step is to get the kids thinking about reduction and offsetting costs. To do this, the class should look on the Koshland Science Museum Site and complete the two activities outlined in the Climate Change section.

* After the kids have completed these, again ask them to reflect on (1) the choices that they made, (2) why they made the choices that they did, and (3) which solutions they think could apply to their school (and which would not be appropriate for their school). Write their answers down in your binders, because these answers will be useful in structuring the Action Plan.

Activity #3: Game of your choice

* You can look up playground and indoor games on google.com, and then put an environmental twist on them—get creative! This is a great opportunity for you to have free range over the curricula.

* If you feel really uncomfortable with this look on our website or email enviroed1@gmail.com for suggestions.

**Materials and Equipment:**

1. Computers with internet access (preferably a computer lab, but if not, at least 2 laptops to give kids the most hands-on experience entering data and looking at the graphs it generates)
2. CD with the Climate Change Emission Calculator on it
3. Websites to visit:
   - [http://www.koshlandscience.org/exhibitgcc/responses01.jsp](http://www.koshlandscience.org/exhibitgcc/responses01.jsp)
   - EPA's Climate Change Emission Calculator Kit (Climate CHECK) (WinZip of Excel spreadsheet, 3.4 MB. This can also be found on our website or via email at enviroed1@gmail.com)

**Teach Back**

Ask the students to teach back what they learned in this lesson, as a form of review.
* Have the kids mini-present their findings of the Carbon Emissions and their online Climate Change Surveys [30 second – 1 minute presentations in front of the class]
Lesson Plan VI: WOW! Action Plan, Video and PowerPoint Presentation

Lesson Objectives:
By the end of the lesson, the students will have learned:
1. Create a viable Action Plan to both reduce and offset carbon emissions
2. Plant seeds and take a proactive role in the environment
3. Plan ahead for the WOW!

Agenda:
Post in the room for students to see. Even appoint a student, responsible for writing the agenda on the board.
1. Opening Ritual – 10 Minutes
2. Review Agenda and Set Context – 5 Minutes
4. Activity: Planting Activity Time: 15 Minutes
5. Clean Up – 5 Minutes [because the planters will be messy]
6. Activity: Video and PowerPoint planning Time: 25 Minutes
7. Teach Back – 5 Minutes

Lesson – By Activity
Activity #1: Action Plan writing exercise
* Explain what reducing carbon emissions and offsetting carbon emissions entail, without giving specific examples.
* Remember: reducing emissions means to lower the amount of carbon being released into the air and offsetting means to fund someone else’s effort to reduce carbon emissions.
* Explain how an Action Plan lays out and describes exactly how a school or person can reduce and offset their carbon emissions.
* On notebook paper passed out by the teacher helper, have the kids write down for 3-5 minutes some ideas of their own, re: reducing and/or offsetting carbon emissions
* Tell the kids that personal choices can be an effective method of fighting climate change.
* After the kids have written their ideas, elect a volunteer to be the scribe to write on the board, and help brainstorm some ideas for the Action Plan.
Here are some potential components to the Action Plan:

1. Shopping: making strategic consumer choices. Purchasing energy-efficient products helps reduce the release of greenhouse gases into the atmosphere. For example, aluminum packaging has a much more energy intensive production process than plastic packaging, and therefore higher greenhouse emission
2. Recycling: Buying products that are reusable or recyclable, or contain reduced packaging, can save a significant part of the energy and resources required for manufacturing new goods. By recycling paper, cardboard, glass or metal, an average family could reduce their carbon dioxide emissions by up to one ton annually.

3. Cutting down on products used around the home, especially power-intensive electric products such as desktops, can have a large effect on overall emissions.

4. Public transport: More frequent use of public transportation helps the environment by reducing the use of cars. Boats and ferries are the most efficient method of fossil fuel transport, followed by trains, then buses. Airplanes can be more than ten times less energy-efficient than cars.

5. Walking is the least harmful mode of transportation, followed by the bicycle, whose usage produces no carbon emissions. However, the manufacturing of bicycles does emit carbon dioxide and other pollutants.

6. Trees: Protecting forests and planting new trees contributes to the absorption of carbon dioxide from the air. There are many opportunities to plant trees in the yard, along roads, in parks, and in public gardens.

7. Labels: The Energy Star label can be seen on many household appliances, home electronics, office equipment, heating and cooling equipment, windows, residential light fixtures, and other products. Energy Star products use less energy.

8. Cars: Purchasing a vehicle which gets high gas mileage helps to reduce emissions of carbon dioxide.

9. Renewable energy: The use of alternative energy sources, such as solar, wind, geothermal, and hydro energy, is gaining increased support worldwide. These methods of energy production emit few greenhouse gases once they are up and running.

10. Carbon offsets: The principle of carbon offset is thus: one decides that they don't want to be responsible for accelerating climate change, and they've already made efforts to reduce their carbon dioxide emissions, so they decide to pay someone else to further reduce their net emissions by planting trees or by taking up low-carbon technologies. Every unit of carbon that is absorbed by trees -- or not emitted due to your funding of renewable energy deployment -- offsets the emissions from their fossil fuel use. In many cases, funding of renewable energy, energy efficiency, or tree planting -- particularly in developing nations -- can be a relatively cheap way of making an individual "carbon neutral"-- some as inexpensive as US$0.11 per metric ton (US$0.10 per US ton) of carbon dioxide.
11. Using less animal products: The United Nations' Food and Agriculture Organization reports that rearing livestock contributes more greenhouse gases than all fossil fuel burning combined. A 2006 study from the Department of Geophysical Sciences at the University of Chicago found the difference between a vegan diet and red meat diet is equivalent to driving a sedan compared to a sport utility vehicle.

12. Some examples of what can be done can be seen here:

* After thinking up different ways in which the school can improve, the next step is to isolate 5-10 ideas, and break them down as specific as possible. A good example of this is to ask student to walk and bike more, as a recommendation, and then map out both walking and bike routes to the school in the PowerPoint presentation.

* When these ideas have a good shape and are written down, you can move onto Activity #2, and then come back to these ideas when planning the PowerPoint presentation.

**Activity #2: Planting Activity**

* Designate roles: someone pass out cans so that the kids can fashion planters out of them (cutting out small holes in the bottom with scissors); someone pass out the seeds; someone can pass out the plates; someone “man” the soil bag.

* This activity is pretty self-explanatory. Put down the plate, place cut can atop the plate; insert soil and plant the seeds about 1/3 down into the can after the top has been cut off and holes have been made in the base.

* These can either stay in the school or be taken home, as a show of individual effort to reduce carbon emissions.

**Activity #3: Video and PowerPoint planning**

* Again, for the first 5 minutes, ask the kids in small groups to write down the ways that they would a) act out in a video an Action Plan and b) include in a PowerPoint presentation.

* Ask the kids to write a rough script for the video or think of some fun scenes and scenarios.

* Ask the kids to think of a topic to go on each slide, in logical order (e.g., slide 1 = “how we did our calculations”; slide 2 = “what we found to be X’s carbon footprint”)

* Ask another child to write the ideas on the blackboard (or you do it, if you are running out of time) and have the class vote on the ideas to go in the video.

* After the ideas are settled upon, designate roles for the following two classes. Some kids will be working on the video first (using the camera,
helping with the acting or the narration) and others will be working with the PowerPoint.

* Keep a record of the action plan, video and PowerPoint layouts (with role designations) in your binder.

<table>
<thead>
<tr>
<th>Materials and Equipment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Notebook paper (for note-taking on the Action Plan and the Layout ideas)</td>
</tr>
<tr>
<td>2. Plant seeds (any kind)</td>
</tr>
<tr>
<td>3. Planting soil</td>
</tr>
<tr>
<td>4. Plastic or Aluminum cans (to be recycled and used as planters)</td>
</tr>
<tr>
<td>5. Scissors</td>
</tr>
<tr>
<td>6. Recycled plastic plates</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Teach Back</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask the students to teach back what they learned in this lesson, as a form of review.</td>
</tr>
<tr>
<td>* Suggest that they teach back the Action Plan!</td>
</tr>
</tbody>
</table>

Lesson Plan VII: WOW! Video and PowerPoint Presentation Creation
Lesson Objectives:
By the end of the lesson, the students will have learned:
1. Begin to Film Video advertising reduction plan
2. Begin to create Powerpoint for the presentation of the reduction plan

Agenda:
Post in the room for students to see. Even appoint a student, responsible for writing the agenda on the board.
1. Opening Ritual – 10 Minutes
2. Review Agenda and Set Context – 5 Minutes
3. Activity: Film Video Time: 1.25 hrs
4. Activity: Create Powerpoint for Carbon Footprint Time: 1.25hrs
5. Teach Back – 5 Minutes
6. Clean Up – 5 Minutes

Lesson – By Activity
Activity #1: Film Video
* Split the kids into to groups based on what they want to do (or have one group do the Video in week 7 and then Powerpoint in week 8 and vice versa).
* The first group will then take the ideas from the reduction plan and make a video demonstrating how the plan will work and what people can to reduce their Carbon Emssion.

Activity #2: Create Powerpoint for Carbon Footprint
* Have the second group of kids begin to come up with a Powerpoint presentation to give about how they measured the Carbon Footprint and what they discovered about the CO₂ emissions of their school

Materials and Equipment:
Video Camera and props for the Video (props needed should determined in Week 6 when Video is determined)

Teach Back
Ask the students to teach back what they learned in this lesson, as a form of review.

Lesson Plan VIII: Finishing WOW! Video and PowerPoint
Lesson Objectives:
By the end of the lesson, the students will have learned:
1. Teamwork
2. How to complete the WOW! under time constraints

Agenda:
Post in the room for students to see. Even appoint a student, responsible for writing the agenda on the board.
1. Opening Ritual – 10 Minutes
2. Review Agenda and Set Context – 5 Minutes
3. Activity #1: Video Final Shooting & Editing Time: 45
4. Activity #2: Musical Ecosystems and/or Was Time is it, Bessy? Time: 20
5. Teach Back – 5 Minutes

Lesson – By Activity
Activity #1: Video Final Shooting & Editing
* This process should be pretty much up to the teachers. Ensure that the PowerPoint gets done and that the video is completely shot by the end of the day.
* Whether this means splitting up into smaller groups, or pooling everyone together to accomplish a large task, the teacher should use their judgment with the class.
* Finally, ensure that the kids volunteer/are assigned to WOW! Roles. Each classroom will need: IT People (to work the PowerPoint); Action Plan presenters; and video presenters

Activity #2: Musical Ecosystems and/or What Time is it, Bessy?
* Musical Ecosystems
  o This game is played where each child chooses to be an animal in a given ecosystem (ask someone to name an ecosystem: coral reef, rainforest, prairie, whatever). Then you explain to the kids that the game is just like musical chairs, but because of global warming, each time a chair gets taken away, it signifies one animal’s habitat becoming destroyed. Turn on the music and wait to switch it off again. Each time someone gets “out” debrief the group on what just happened (Why did this particular animal get forced out of their habitat? Could this happen in real life? How does global warming and anthropogenic greenhouse gas contribute to or cause the problem?). Do this until there is only one chair left.
What Time is it, Bessy?

- This game basically works like Red Light, Green Light. If you remember from Lesson II, Bessy was the cow whose methane caused greenhouse gas emissions. So we will use her for this game. Someone will be Bessy the cow and stand far away from the line of other kids. The kids will ask Bessy, “What time is it, Bessy?” and the child who is playing the cow will answer any time of the day (e.g., 10 o’clock). When Bessy calls out the time, the other line of kids takes 10 steps (or the correlating number of steps to the time of day). This will happen 3-5 times, depending on how far away the kids line up. On the final turn (which you will let the kids know is “the final turn”), they will ask “What time is it, Bessy?” and the child will answer “DINNERTIME”, at which point the other kids will run away and try not to get tagged and eaten. The first child tagged become Bessy.

**Make sure to debrief the kids on Bessy, and what she symbolizes (livestock that naturally produces methane—a gas that accounts for 18% of greenhouse gases in the atmosphere—as a result of their gassy diet).**

---

Materials and Equipment:

1. At least two laptops, so that the kids can simultaneously work on the PowerPoint presentation and the video/editing (with each Citizen Teacher)
2. A music player: even just use your iTunes from your laptop, or ask Citizen Schools for a CD player

---

Teach Back

Ask the students to teach back what they learned in this lesson, as a form of review.

---

Lesson Plan IX: WOW! Rehearsal and Run-through
Lesson Objectives:
By the end of the lesson, the students will have learned:
1. Public Speaking Skills
2. Have completed and practiced their WOW

Agenda:
Post in the room for students to see. Even appoint a student, responsible for writing the agenda on the board.
1. Opening Ritual – 10 Minutes
2. Review Agenda and Set Context – 5 Minutes
3. Activity: **Explain basic rules of Public Speaking** Time: 15 min
4. Activity: **Have the kids come up with a short speech to introduce the Video and Powerpoint** Time: 20 min
5. Activity: **Do a complete Rehearsal of the WOW** Time: 10 min
6. Activity: **Go over what the kids did well** Time: 20 min
7. Teach Back – 5 Minutes

Lesson – By Activity

Activity #1: Go over the basic aspects of good Public Speaking
* Ex: proper dress, eye contact, loud & clear speaking, consistent gestures within “box.”

Activity #2: Have the kids come up with a short speech to introduce the Video and Powerpoint
* The kids should have already written what they will say during the Powerpoint. Use this time to have all of them together come up with a short introduction to their project. Have them explain that they did a Carbon footprint and why following the reduction plan is important.

Activity #3: Do a complete Rehearsal of the WOW
* Treat this as if it is the real thing. Have the CTs watch and take notes while the kids go through the whole presentation.

Activity #4: Go over what the kids did well
* The CTs should ask the kids what they thought they did well and could improve on.
* Have them make a list of things to work on for the real presentation and include any suggestions that the CTs have if the students do not think of it on their own.
* If there is time left have the kids do another rehearsal and try to
fix some of the things discussed.

<table>
<thead>
<tr>
<th>Materials and Equipment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials for the WOW</td>
</tr>
<tr>
<td>Teach Back</td>
</tr>
</tbody>
</table>

Ask the students to teach back what they learned in this lesson, as a form of review.

**Sources consulted:**

