



6-8TH GRADE: POLLUTION & EVOLUTION

GREEN GUIDE TRANSPORTATION UNITS

Transportation Location: three lessons, history/science (3-6)

Pollution and Evolution: one lesson, science (6-8)

3-D Bike Maps: one lesson, science (6-8)

Marketing Strategy and Transportation: two lessons, health/art (6-12)

The Cost of Transportation: one lesson, science (6-12)

What Do I Stand For?: one lesson (6-12)

Travel Journal: three lessons (6-12)

History of Transportation: two lessons (9-12)



SAFE ROUTES TO SCHOOLS
CURRICULUM

Find our curriculum online at : http://www.saferoutestoschools.org/green_curriculum.html

TEENS GO GREEN



Safe Routes to Schools is a program of the
Transportation Authority of Marin.

Part of the *Marin Safe Routes to Schools Curriculum*. Engaging lessons K thru 12 that include applicable state educational standards.

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LESSON PLAN

POLLUTION & EVOLUTION

6–8th Grades. Classroom setting.

A hands-on “natural selection” moth activity and scientific demonstration of atmospheric gases guides students to the realization that the humans are capable of altering our environment with pollution and that a changing environment leads to the successes and failures of species, possibly ours.



When the city of Manchester in the United Kingdom industrialized in the 1800’s heavy air pollution from coal covered the landscape with a dark sooty film. In less than 100 years, the local white and black “peppered” moth population evolved into 98% dark gray or black.

OBJECTIVES

Students will be able to:

- Recall two benefits of Active Transportation.
- Identify Charles Darwin as the author of the theory of natural selection.
- Differentiate between:
 - Evolution is when a species changes to adapt to the environment.
 - Extinction is when a species fails to adapt to environmental change.
- Explain how human pollution can lead to species extinction.

CA 7th Grade Science Standards

- 3a. Students know both genetic variation and environmental factors are causes of evolution and diversity of organisms.
- 3b. Students know the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution.
- 3e. Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

MATERIALS

Computer with **Pollution and Evolution PowerPoint** (3.6 MG download) and projector*.

**If the school can not provide a projector, we can bring one.*

Moth Natural Selection Simulation

- Black construction paper
- Newspaper
- Hole puncher
- Tweezers
- Tally Sheets

Atmospheric CO₂ Demonstration

- Baking soda
- Vinegar
- Soap bubbles
- Wide/clear Tupperware container at least 4 inches deep.

VOCABULARY

Species: A living plant or animal that is significantly different from the rest.

Charles Darwin: Claimed natural selection led to evolution.

Natural Selection: Theory that when the environment changes, the species best adapted to survive will remain.

Evolution: Theory that plant and animal species change to create diversity.

Environment: Your immediate surroundings and the natural world.

Extinction: When the environment changes and a species can not adapt.

Air Pollution: Unwanted, unhealthy material in the air.

Soot: Large air pollution particle from fire, almost as large as ashes.

Carbon Dioxide CO₂: clear gas and common pollution from burning fuel.

Greenhouse Gas: gas in the air that traps heat around the planet, like a greenhouse.

Global Warming or Global Climate Change: Theory that there is so much air pollution it is causing the planet to become warmer and weather less predictable.

PROCEDURE

Main Objective: Benefits of biking.

The “Pollution & Evolution” PowerPoint presentation guides the lesson.

After an introduction to evolution, students learn the history of peppered moths. During the Moth Natural Selection Activity each student takes a turn using tweezers as bird beaks to catch white and peppered moths in different environments.

To end the lesson a scientific CO₂ demonstration opens a conversation on global climate change and the future of our species on earth.

1. Introduce yourself as an instructor for the Teens Go Green program.

- Briefly highlight your relevant background and experience.
- Teens Go Green is the Middle/High School program for Safe Routes to Schools (SR2S). SR2S teaches classes in over 50 Marin schools K-12. SR2S is a program of Transportation Authority of Marin.
- Thank the class/teacher for having you as a guest.
- Briefly overview the rest of the lesson.

2. Begin the “Pollution & Evolution” PowerPoint presentation.

- Benefits of active transportation. Four images for bikes: clean air, exercise, no traffic, and fun. Four images for cars: air pollution, sedentary, traffic jams, and road rage.
- Explanation of Evolution.
 - i. Evolution is the changing of species to adapt to the environment.
 - ii. Charles Darwin theorized that natural selection creates evolution.
 - iii. Species not adapted to environment changes become extinct.
- Moth Natural Selection Activity. (See p. 5)
- The Story of the Peppered Moths.
 - i. During industrialization in England there were high rates of air pollution from coal
 - ii. Before air pollution all moths were peppered, only one was documented as black.
 - iii. The dark soot from air pollution changed the environment. Regular moths became more visible to predators (birds). Rare black moth became 98% of population.



PROCEDURE CONT.

- Atmospheric CO₂ Demonstration. (See p. 7)
- Humans, the environment, and extinction.
 - i. Human pollution can change the environment.
Humans changing the environment may result in extinction.
Notable endangered wildlife.
 - ii. What environment do humans need to survive?
Concerns for Global Climate Change

3. Conclusion: Review the objective of Evolution and Pollution.

- Darwin is suggested natural selection as the process of evolution.
- Our environment drives our need to adapt, and the peppered moth proves that humans have the ability to change our environment resulting in the extinction of species unable to adapt.
- Will humans be adapted in the future environment that we create?
 - i. What lessons can we learn from Beijing's air?
 - ii. Can Active Transportation help create a healthy environment?

Conclusion: *Our activities, as humans, effect the planet and the species that we share it with. It has happened before - the moths are a great visible example - and it is happening again, even if the pollutant is invisible. We need to change our energy use habits, and most importantly, our fossil fuel combustion, if we want to curtail these effects. Riding a bike is a great place to start.*

ACTIVITY: MOTH NATURAL SELECTION

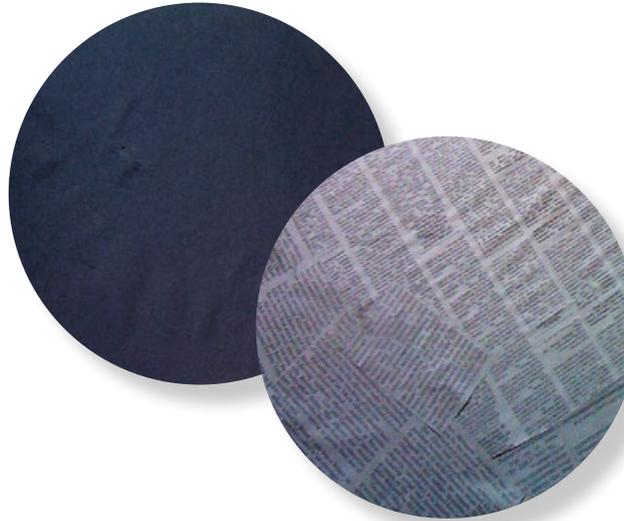
Introduction:

Students role play birds hunting for both moths in a regular and polluted environment. Counting each number of prey, survival rates are compared between the peppered and black in the regular and polluted environments.

PROCEDURE

Main Objective: Benefits of biking.

1. Show students the two "environments" that the moths were found in, normal tree bark (newspaper) and soot-covered bark (black construction paper).



2. Show them both types of "moths," represented by paper circles made by a hole puncher.



3. Sprinkle both types of "moths" on both environments.



ACTIVITY: MOTH NATURAL SELECTION

PROCEDURE CONT.

4. Explain that the tweezers are their “beaks” and that they should catch as many moths as they can in 60 seconds.



5. Conclusion: On the natural background the dark moths were easy prey, but when pollution turned the environment black the peppered moth nearly went extinct while the black moths thrived.

- Spend 60 seconds hunting moths on the natural tree bark.
 - i. Tally the number of each moth caught on the natural bark.
 - ii. Calculate the survival rate.
- Spend 60 seconds hunting moths on the polluted bark.
 - i. Tally the number of each moth caught on the natural bark.
 - ii. Calculate the survival rate.

DEMONSTRATION: ATMOSPHERIC CO₂

INTRODUCTION:

CO₂, one of our most common pollutants, is easy to ignore because it is invisible. CO₂ is infamous as a greenhouse gas, but in high quantities it can displace the oxygen that is available to breathe, causing shortness of breath or even suffocation!

Note: this demonstration may require a little practice to perfect the method.

PROCEDURE

Fire adds Carbon to the air, creating Carbon-dioxide (CO₂). CO₂ is the most common greenhouse gas, and can even limit the amount of air available to breathe.

1. In this experiment we will show you an invisible layer of CO₂ gas.

- CO₂ is a dangerous greenhouse gas that warms the planet.
- CO₂ is heavier than O₂, so CO₂ “sinks” in the air near the surface.

2. In Beijing CO₂ is displacing the oxygen needed for humans to breathe.

- See articles from Cycling News Tour of Beijing below in “Resources”
“During the competition, the day on which there was the least pollution we had 210 mg/m³ (of carbon dioxide) in the air. The maximum limit in Europe is 40 mg/m³. You really felt the lacking oxygen,” one rider said.

3. We will now create a layer of CO₂ using baking soda and vinegar.

- Pour a mixture of baking soda and vinegar into the Tupperware. (Fig. 1 and 2)



Fig. 1



Fig. 2

DEMONSTRATION: ATMOSPHERIC CO₂

PROCEDURE CONT.

- Immediately blow a bubble over the Tupperware allowing it to descend into it.
- The bubble (oxygenated air) should hover above the bottom of the Tupperware, sitting on a layer of dense CO₂. This shows CO₂ blocking oxygenated air. (Fig. 3.)



Fig. 3.

- 4. CONCLUSION: Humans create air pollution that can change our environment and lead to the extinction of certain species. We can prevent air pollution by choosing active transportation.**

RESOURCES

http://en.wikipedia.org/wiki/Peppered_moth_evolution

<http://www.cyclingnews.com/news/riders-fight-against-pollution-at-the-tour-of-beijing>

<http://www.cyclingnews.com/news/mixed-feelings-over-tour-of-beijing>

<http://www.nytimes.com/2011/12/07/world/asia/beijing-journal-anger-grows-over-air-pollution-in-china.html>