

TEACHER GUIDE: REMOTE SCIENCE

FALL 2007

Dear Teachers,

This is the first teacher guide I have created for *Greentimes*, thus the format is a little different from past ones. We would greatly appreciate your feedback on this guide and any past guides. Your input directly affects our decisions of what to include in future guides, so please feel free to send feedback and suggestions to gilbersg@bc.edu. Also, you can visit www.greenscreen.org for more information.

Educationally yours,
Sarah Gilbert
Greentimes Program Manager

Table of Contents

Background Information	page 1
Vocabulary	page 2
Inquiry Science	page 2
Inquiry Science cont.	page 3
English Language Arts Connections	page 3
Social Studies Connections	page 3
Web Resources and Answers to NS Q's	page 3
Worksheet Instructions & Answers	page 4
Worksheets	page 5,6

2007 Greentimes Essay Contest will occur this fall for grades 5 & 6 and 7 & 8
Check out our web site for full details: www.greenscreen.org

Background Information

What is Remote Sensing and how is it used?

- Measurement or acquisition of information of an object or phenomenon, by a recording device that is not in contact with the object; remote sensing allows us to study things from a distance. Our senses (sight, sound, smell) use remote sensing to get information on the things that are around us.
- Scientists often use satellites for remote **sensing** to view Earth's surface and the atmosphere, to monitor weather and natural disasters, for global positioning and topographic mapping, and to study the solar system and universe. Such instruments measure light (photons) as radiation emitted or reflected from objects. This radiation is a form of solar radiation from the sun, and includes visible light, as well as infrared and ultraviolet (UV) energy.

How does ozone form?

Ozone is formed via a **Photochemical Reaction** which is a chemical change triggered by the radiant energy of the sun or other light source. Ultraviolet light from the sun triggers the photochemical reaction that causes oxygen (O₂) to form ozone (O₃). A website describing in better detail the production of ozone from oxygen is: <http://ozone.gi.alaska.edu/formed.htm>. Ozone production in the Stratosphere is natural and helps protect us from harmful UV rays while ozone produced in the Troposphere (also known as ground level ozone) is problematic because it has negative affects on the health of humans and other organisms.

How does different particulate matter help produce ozone in the troposphere?

In complicated chemical reactions the ground level ozone (smog) is produced from the combination and reaction of different chemical compounds mostly released by auto exhaust. These compounds, such as nitric oxides and hydrocarbons, react with sunlight to form ozone and a gamete of other highly toxic compounds. The ozone then gets trapped in the Troposphere and harms various living organisms. The following website has tons of information about this topic with graphics that help: <http://esa21.kennesaw.edu/activities/smog-city/smog-city.pdf>.

Vocabulary

The following vocabulary appears in this issue: remote sensing, satellites, ozone, pollution, passive remote sensing, external remote sensing, lasers, lidar, nitrogen, oxygen, carbon dioxide, argon, troposphere, stratosphere, ozone layer, mesosphere, thermosphere, exosphere, fossil fuels, nitrogen dioxide, sulfur dioxide, carbon monoxide, lead, acid rain, contaminated, toxic, combustion, simulate, computer models, computer simulations, climate models, solar radiation, electromagnetic spectrum, infrared, visible light, wavelengths, ultraviolet light, chlorofluorocarbons, photochemical reaction, and atoms.

These vocabulary terms are not clearly defined in the newsletter:

- **Chlorofluorocarbon-** any of several simple gaseous compounds that contain carbon, chlorine, fluorine, and sometimes hydrogen, that are used as refrigerants, cleaning solvents, and aerosol propellants and in the manufacture of plastic foams, and that are believed to be a major cause of stratospheric ozone depletion -- abbreviation *CFC*
- **Atom-** the smallest particle of an element that can exist either alone or in combination
- **Element-** any of the fundamental substances that consist of atoms of only one kind and that singly or in combination constitute all matter
- **Simulate-** to give or assume the appearance or effect of often with the intent to deceive: imitate
- **Fossil Fuel-** a fuel (as coal, oil, or natural gas) formed in the earth from plant or animal remains
- **Solar radiation-** is a general term for the electromagnetic radiation (energy) emitted by the sun

Inquiry Science

- ◆ The following link has five excellent lessons for students to better understand remote sensing that are not in this packet: http://ice.ucdavis.edu/~robyn/sge_ee.html. These lessons contain detailed background information, how the activities link to national curriculum standards and clear learning objectives. **I highly recommend that you check them out!**

Activity One: Air Composition

- Materials– large poster board, small stickers (78 one color, 21 another color, and 1 a third color) or you could substitute paper for the stickers and have the students glue it to the poster board or even use post-it notes.

In this activity students will create a poster of the composition of air. As a class or in small groups have students place their stickers on the poster board. You can hand out the stickers randomly by having each student take a sticker out of a container and then come up and place them on the board or call them up one at a time. Once the poster is made explain to the students that they just created a poster representing the composition of air. Have them guess what each color represents. Then discuss with them what each one is (78%N, 21% O₂, 1% other gases.) Go into detail on how that one sticker represents all the pollution and ozone in our atmosphere. Have students think about the consequences of what it would be like if more than 1% of our atmosphere was these other gases.

Activity Two: Photochemical reactions

- Materials- 2 pieces of colored construction paper, tape, classroom windows

Some examples of photochemical reactions besides the production of ozone are the bleaching of paper by the sun and photography. An easy investigation to do with your students is to place a piece of colored construction paper in your classroom window and observe it over time to see how faded it becomes. Ideally you keep one piece of the same color paper in a dark place while the other piece of paper hangs in the window. Then compare the pieces of paper with your class. Another twist to this investigation is to tape a small cut-out of paper some place on the paper in the window facing the sun. The little piece of paper should block enough of the sun's rays to prevent the portion under it from fading too much. This will help with comparisons of what is happening to the paper over time too.

Reasoning: The pigment in the paper is reacting from sun light just like oxygen reacts from sun light. The pigment begins to change into another color pigment because a chemical change is occurring in the paper. The result is a different colored piece of paper. Similarly with oxygen reacting to ultraviolet sunlight, a new product is formed and this is ozone.

Inquiry cont.

Activity Three: Chemical Reaction The following web site has a similar activity but a little more supply intensive; it does produce more signs of a chemical reaction though: <http://www.teachers.net/lessons/posts/108.html>

- Materials: Gallon size zip lock bags (that seal very well), baking soda, vinegar, and small (mini-Dixie) cups.

This activity is designed to show students a simple chemical reaction and how something new is produced from the combination of simple ingredients. Always try this first to adjust the amount of materials used and to figure out any limitations you might have in your classroom.

In class, demonstrate to the students how to do this before they do it; the pouring of the materials in the bag can be tricky. Students can work independently or in groups of two or more with this activity. Students are to gather the materials: One zip lock bag with at least one mini-Dixie cups worth of baking soda poured into it and a mini-Dixie cup 3/4 filled with vinegar. Students are to place the Dixie cup with vinegar in the bag, but not to tip it over yet! They should do this on a flat surface placing the cup in the bag and then sealing the bag very well, trying to get out as much extra air as possible. Once the bag is sealed the students can dump the vinegar into the bottom of the bag to react with the baking soda making sure to never open the bag. The bag will fill foam and fizz as well as produce a gas that makes the bag inflate.

Have students observe what's happening in the bag and record their observations on the worksheet. Lead a discussion on this activity to help students better understand chemical reactions. Another variation can be done with Alka-Seltzer® or Airborne® in a bagged environment. The goal for both activities is to see that a gas is produced from the combination of different materials, thus a new product has been formed that was not there before. This is just like ozone forming from ultraviolet sunlight reacting with oxygen, this reaction yields something that was not previously there.

English Language Arts Connections

- Students can write an essay describing their opinion as to what the world would be like if instead of our atmosphere containing 1% of other gases (this includes all pollutants) it was to increase to more than 1%, what would the consequences be? Are there ways to prevent this? Do you think our world is headed this way with global warming?
- Using the vocabulary list (or any combination of this list) on p. 2 students can arrange these words into what they believe to be common groups and explain (justify) why they grouped the words like they did.
- Have students work in groups to write a play or skit about how we could use remote sensing to discover another planet that could support life? If time allows have the students perform their plays.

Social Studies Connections

- The Montreal Protocol was signed in 1987 and was an international response to end CFC production in developing countries. Find more info about this act at: http://ozone.unep.org/Ratification_status/evolution_of_mp.shtml. Students could work in groups to research the countries involved in this protocol and present them to the class and even countries that refused to be a part of it. Other options are to investigate how this protocol has changed over time.
- The Clean Air Act's website is: <http://www.epa.gov/air/caa/>. Another great topic for discussion and investigation.

Web Resources and Answer to Newsletter Activities:

Answer Key to Newsletter Activities:

- **True or False:** 1) T 2)F 3) F 4) T 5) T 6) F
- **Fill in the Blank:** 1) Passive and External Remote Sensing 2) light and radar 3) simulations, models 4) Troposphere (bad) Stratosphere (good) 5) Ultraviolet light 6) Nitrogen, Oxygen
- **Compound Nouns:** Photochemical Smog, Ultraviolet Radiation, Visible Light, Ozone Layer, Carbon Dioxide

Links:

- Weather underground uses computer models to predict hurricanes: <http://www.weatherunderground.com/tropical/>
- National Weather Service information about computer models: <http://www.nhc.noaa.gov/aboutmodels.shtml>

Worksheet Instructions, Framework Connections and Answer Key

Worksheet 1

This worksheet is designed to accompany **Activity Two** in the Inquiry section. Questions 1 and 2 will have a variety of responses. Question 3 can have numerous examples but some common ones are: baking a cake, burning a log, Rust on a bicycle, etc. (these are all examples of chemical reactions) some none chemical reactions are making kool aide (this is a mixture). Question 4 a chemical reaction is: a process in which one or more substances are changed into new substances. Question 5 a gas was formed. Question 6 they should argue that a chemical reaction did occur because a gas was formed, which is a new substance.

Worksheet 2

This worksheet is about the electromagnetic spectrum. Students can label the diagram of the wavelengths and then make lists of examples from the picture of each type of radiation. Here is a brief description of each form of radiation:

Radio waves have the longest wavelength in the electromagnetic spectrum. These waves carry the news, ball games, and music you listen to on the radio. They also carry signals to television sets and cellular phones.

Microwaves have shorter wavelengths than radio waves, which heat the food we eat. They are also used for radar images, like the Doppler radar used in weather forecasts.

There are **infrared waves** with long wavelengths and short wavelengths. Infrared waves with long wavelengths are different from infrared waves with short wavelengths. Infrared waves with long wavelengths can be detected as heat. Your radiator or heater gives off these long infrared waves. We call these thermal infrared or far infrared waves. The sun gives off infrared waves with shorter wavelengths. Plants reflect these waves, also known as near infrared waves.

Visible light waves are the only electromagnetic waves we can see. We see these waves as the colors of the rainbow. Each color has a different wavelength. Red has the longest wavelength and violet has the shortest wavelength. These waves combine to make white light.

Ultraviolet waves have wavelengths shorter than visible light waves. These waves are invisible to the human eye, but some insects can see them. Of the sun's light, the ultraviolet waves are responsible for causing our sunburns.

X-Rays: As wavelengths get smaller, the waves have more energy. X-Rays have smaller wavelengths and therefore more energy than the ultraviolet waves. X-Rays are so powerful that they pass easily through the skin allowing doctors to look at our bones.

Gamma Rays have the smallest wavelength and the most energy of the waves in the electromagnetic spectrum. These waves are generated by radioactive atoms and in nuclear explosions. Gamma rays can kill living cells, but doctors can use gamma rays to kill diseased cells.

Answers:

1) Radio Waves: Ray's TV - TV reception uses radio waves; Satellite Dish at Ray's TV - receives movies via radio waves from a satellite; Taxi - Car radio receives radio wave signals; Taxi - Driver receives instructions on a CB radio which uses radio waves; Radio Tower - broadcast's radio signals; Large Satellite dish in field - receives radio waves from distant stars

2) Microwaves: Microwave in Waves Grill - uses microwaves to cook food ; Disk-like antennas on tower - send microwave communications

3) Infrared: Heat lamps above food in Waves Grill - use infrared waves to keep food hot; Ray's TV - Remote controls use infrared waves to communicate with the TV; Trees, bushes, grass, and farm - vegetation reflects short infrared waves; Observatory - astronomers study thermal infrared (long infrared waves) from stars

4) Visible Light: Rainbow - water droplets cause white light to break apart into the colors of the rainbow; Photographer's studio - portrait photographers use film sensitive to visible light; Observatory - astronomers look at visible light from planets and stars

5) Ultraviolet: Tanning Salon -use ultraviolet waves to tan our skin; Sunglasses store - sunglasses protect our eyes from the ultraviolet waves; Suntan lotion - protects our skin from ultraviolet waves; Observatory - astronomers see some ultraviolet radiation from planets and stars

6) X-rays: Dr. Bob's Health Clinic - uses x-rays to study our bones; High energy x-rays are also used to treat cancer

7) Gamma Rays: Dr. Bob's Health Clinic -gamma radiation is used to kill sick cells through nuclear medicine; Gamma radiation is given off by nuclear explosions that occur within stars, like our sun.

Name: _____

Date: _____

GREENTIMES SR: REMOTE SCIENCE
Worksheet 1 (Accompanies Activity 3)

1. Please record your observations on what is happening in the bag.
2. Explain why you think the ingredients did what they did in the bag when they were combined?
3. Provide some other examples of when different materials are combined and they produce something new?
4. Look up the definition of chemical reaction and write it here.
5. Did any signs of a chemical reaction occur, if so which one(s)? (heat produced or adsorbed, color change, gas formed or disappeared, composition of the substance changed)
6. Do you think this was a chemical reaction, why or why not? Provide evidence and details to support your claim. Write in complete sentences please.

