

Target Grade and Subject: 10-12, Chemistry

References

1. Acid Rain Fact Sheet , www.msc-smc.ec.gc.ca/cd/canada/factsheets/acidrain/index_e.cfm
2. The Green Lane- Climate Change Overview, www.ec.gc.ca/climate/overview
3. The Ozone Layer Fact Sheet and Quiz, www.msc-smc.ec.gc.ca/cd/factsheets/ozone
4. Issues in Ecology, Number 1. Spring 1997, Human Alteration of the Global Nitrogen Cycle; Causes and Consequences, published by Ecological Society of America
5. What's The Answer to Global Warming?, September 2005, Discover magazine, Darcy Frey
6. Michigan Content Standards www.michigan.gov/mde/0,1607,7-140-28753---,00.html
7. Carbon Calculator www.carboncalculator.com
8. Clean Air Status and Trends Network www.epa.gov/castnet
9. NADP nadp.sws.uiuc.edu

Michigan Content Standards

MI.SS.7-9.02.05.01 * Describe how social and scientific changes in regions may have global consequences ---will be addressed in notes, discussions, and research paper/ presentations

MI.SS.10-12.02.05.02 * Explain the causes and importance of global issues involving cultural stability and change, economic development and international trade, resource use, environmental impact, conflict and cooperation, and explain how they may affect the future---will be addressed in notes, discussions, and research paper/presentations

MI.S.10-12.05.02.03 * Describe how human activities affect the quality of water in the hydrosphere. (Key concepts: Quantity of water rate of use, urbanization. Oceans-oil spills, garbage, ocean life, global warming, marine life. Fresh water-industrial waste disposal, agricultural run-off, herbicides, pesticides, pollution, sewage, acid rain, nutrient levels, ground water-landfills, leaching, and disposal of toxic wastes, purification technology-filtering, chlorination. Also see Atmosphere and Weather benchmarks. Real-world contexts: Examples of local and regional human activities that have measurable effects on water, including farming, industry, sewage disposal, and toxic waste disposal.)---will be addressed in notes, water testing, acid rain reactions, pH calculations, discussions, and research/presentations

MI.S.10-12.05.03.04 * Explain the impact of human activities on the atmosphere and demonstrate means for limiting pollution from households and personal transportation. (Key concepts: Air pollution-car exhaust, industrial emissions, and smog. Related effects-breathing problems, acid rain, greenhouse effect and impact of deforestation, ozone depletion. See Reflecting on Scientific Knowledge benchmarks and Geosphere benchmarks. Real-world contexts: Examples of human activities that affect the atmosphere, including use of aerosol spray cans, discharge from smoke stacks, car exhaust, burning leaves and wood in stoves and fireplaces; actions, including turning off lights, turning down heat, tuning-up cars, filling tires, driving at a consistent speed, mandating higher fuel efficiencies.)---will be addressed in notes, discussions, greenhouse gas CO₂ activity, carbon calculator activity, burning candle demo and reactions/ calculations, research/presentations

MI.S.10-12.02.01.05 * Evaluate alternative long-range plans for resource use and by-product disposal in terms of environmental and economic impact. (Key concepts: Understanding of limitations of knowledge and technology, side effects of resource use. Real-world contexts: large scale systems for mining, energy use, manufacturing, transportation, and housing.)--- will be addressed in notes, discussions, research, and final presentations

MI.S.K-12.05.01 STANDARD: All students will describe the earth's surface; describe and explain how the earth's features change over time; and analyze effects of technology on the earth's surface and resources. (Geosphere)---will be addressed in notes, discussions, etc

MI.S.7-9.05.01.05 * Explain how technology changes the surface of the earth. (Key concepts: Types of human activities-surface mining, construction and urban development, farming, dams, landfills, restoring marsh ands, reclaiming spoiled and. Real-world contexts: Local example of surface changes due to human activities listed in the Key concepts above; local

examples of negative consequences of these changes, such as groundwater pollution, destruction of habitat and scenic and, reduction of arable and.) – will be addressed in notes, discussions, etc

Science

I. Reflecting on Scientific Knowledge (R) II.1

All students will show how science and technology affect our society

II. Ecosystems (LEC) III.5

All students will describe how materials cycle through an ecosystem and get reused in the environment- soil and carbon cycle, etc.

All students will analyze how humans and the environment interact

III. Matter and Energy (PME) IV.1

All students will identify and describe forms of energy

All students will explore how changes in matter are related to changes in energy and how living things and human technology change matter and transform energy

IV. Geosphere (EG) V. 1

All students will describe and explain how the earth's features change over time.

All students will analyze the effects of technology on the earth's surface and resources.

V. Hydrosphere (EH) V.2

All students will analyze the interaction of human activities with the hydrosphere

VI. Atmosphere and Weather (EAW) V.3

All students will analyze the relationships between human activities and the atmosphere

Unit Overview

This unit will provide an overview on the issue of global change and how human activities affect the hydrosphere, atmosphere, and geosphere. I already have a unit on water testing at the Muskegon River that I will be able to use. In this unit, we cover several parameters, calculate the Water Quality Index (WQI) and discuss the reasons for parameters to be outside normal levels, which directly relate to global change and pollution. We can review topics such as acid rain, pH calculations, and chemical reactions involved in N deposition when we look at the hydrosphere. I will be supplementing my existing notes with Andy Burtons notes on Acid Rain and Nitrogen deposition. I will be adding the information on the atmosphere from Bill Holmes and Janet Vails notes, including discussions on greenhouse gases, CO₂, ozone, and Air Quality Index (AQI) . I will also be using the Greenhouse Gas CO₂ Investigation I prepared for class and the burning candle demo, and going over the chemical reactions for combustion. I will briefly cover the geosphere using Andy Burtons notes on soil testing and land use changes, and also tie this to an existing unit on groundwater cleanup and soil. The final project will be a research paper on how human activities affect the hydrosphere, atmosphere, and geosphere, and ways of limiting pollution from these activities or alternatives that may reduce the environmental impact.

Teaching Objectives

1. to complete the water testing unit and tie it to global change unit.
2. to complete the global change unit and have chemistry students understand global change concepts and the chemical reactions involved in global change.
3. to perform investigations that demonstrate key concepts of global change.
4. to tie the global change unit to the Advanced Earth unit on groundwater and soil/geosphere.
5. to have students complete a 3-5 page research paper on human activities and technology that have global consequences of affecting our water, air and earth.

Learning Objectives for Students

Upon completion of this unit, students will be able to

1. define and demonstrate an understanding of global change,
2. recognize major factors affecting global change, including expressing an understanding of Nitrogen deposition, ozone depletion, greenhouse gases, carbon dioxide, climate/ temperature changes, land use changes.
3. participate in field studies of global change- will consist of existing water testing and testing of rainwater also. I will not be adding air and soil testing at this time.

4. demonstrate capability of using instrumentation needed for taking field measurements of factors indicating global change such as
 - a. water testing of parameters including DO, BOD, FC, pH, NO₃, SO₄, PO₄, TDS, iron, conductivity, hardness, (currently included in my unit)
 - b. ozone- discussion only- will look at the chemical reactions for formation of ozone- use ozone quiz.
 - c. CO₂- simulated with the Greenhouse Gas CO₂ Investigation. We will look at combustion reactions that form CO₂.
 - d. N deposition- addressed by internet research on websites, NADP, and CASTNET
 - e. Soil testing- will look into future sample collection at the Muskegon River and various sites, including agricultural, for next year if I can get money for some soil testing kits and equipment
5. research climate change using the internet/technology to identify damage to parts of our ecosystem from global change, such as soil, plant foliage, wildlife, water, atmosphere(currently in my unit)
6. tabulate and map results of field measurements(currently in my unit)
7. present project results using Power Point(currently in my unit)
8. write a reflection paper on what global change means to them personally and to their community(currently in my unit)
9. write a research paper on global change

Five Days of Classroom Activities- Global Change Unit

Assume water testing unit is completed- I will be happy to provide a copy of this to any teachers that would like it- it is about 30 pages long

Day 1. Intro unit by having students read article from September 2005 Discover magazine, "What's the Answer to Global Warming?" and discussing issues such as short and long term fixes. Or use "Hazy Days in our Parks", Smithsonian, June 2005, by Charles Petit, (Kate Bradley)

Notes on overview of global change (use Kate Bradleys notes)

Notes on hydrosphere, acid rain, N deposition, N saturation, review pH calculations, chemical reaction of acid rain and NO_x (use Andy Burtons notes)

Test rainwater from open air and thru-fall collection sites set up previously- document results as in water testing unit. If time allows, research N deposition websites, NADP and CASTNET (Andy Burton)and have students summarize data form past two years in graph or table form with a brief discussion

Day 2. Demo burning candle (Janet Vail) and discuss combustion reactions, formation of CO₂

Notes on greenhouse gases, ozone, CO₂ (use Bill Homes and Janet Vails notes)

Show pictures of ozone damage to foliage

Ozone Quiz -from internet

Have students do carbon calculator from internet site

- o www.carboncalculator.com

Day 3. Greenhouse Gas CO₂ Investigation –as designed in class- final lab report due next day

Day 4. Notes on global warming affects on geosphere, increased temperature, soil moisture, land use changes (Andy Burton and Erik Lilleskov)

Groundwater cleanup activity – design a lab to filter waste water to either drinking water (grade =AB range) or swimming water (CD range) WQI levels- give as a take home assignment

Days 5, 6, and 7 Assign research paper, give rubric, 3 days in class to research and the rest is on their own

Day 8 Perform Groundwater cleanup lab, research paper outlines due for peer evaluation

Day 9 Reflection Paper- what are the top 10 things you need to know about global change?

Rough draft of research paper due for peer evaluation

Final Day- some time the next week, hand in research paper and present Power Point- allow enough time to complete outside of class

Students must take notes on power point presentations

Reward Day- watch movie on Greenhouse gases, or Toxic Waste, or other related topic

Overall Unit Assessment

Assignments to be graded

- Rain water test results/conclusions
- N deposition research and documentation of results
- Carbon Calculator
- Ozone quiz
- Greenhouse Gas CO₂ Investigation and lab report
- Groundwater cleanup lab
- Reflection Paper
- Research paper note cards and references
- Research paper outline- peer evaluation
- Research paper rough draft- peer evaluation
- Research Paper
- Power Point Presentation- peer evaluation
- Notes on Power point presentations

Global Change Research Paper

Requirements

3-5 pages, typed, double-spaced, 12 font, standard margins, MLA format

5 references, 3 journal references

minimum 1 note card per reference

outline 1-2 pages

rough draft 2-3 pages

A list of human activities to be researched will be provided for you to choose from – 1 student per topic, first come first served.

The Paper should address a minimum of six of these questions

1. Describe the human activity. Explain or define it.
2. Describe any examples of local or regional examples of the activity and include data on local levels and measurable affects.
3. How does this activity affect the Great Lakes
4. Describe how the activity affects the hydrosphere, water quality.
5. Describe how the activity affects the atmosphere, weather.
6. Describe how the activity affects the geosphere, soil, groundwater.
7. Give examples of ways of limiting the activity and reducing pollution from the activity- laws, regulations, protocols, treaties.
8. What are the impacts on human health? Spread of disease?
9. What are the impacts on the environment? Wildlife, habitats?
10. What are the alternatives to the activity?
11. Are there any long range plans to reduce the environmental impact and/or economic impact of the activity?
12. What political implications are involved?

List of Human Activities

1. Coal burning power plants
2. Automobile transportation/exhaust
3. Ice Mountain water bottling plant in Stanwood MI
4. Hydroelectric power plants- Croton-Hardy Dams

5. Agriculture/farming
6. Commercial hog farm in Fremont MI
7. Commercial dairy farms
8. Commercial chicken/turkey farms
9. Commercial uses of mercury
10. Commercial uses of Aluminum
11. Deforestation/forestry industry
12. Combustion of fossil fuels other than power plants and transportation
13. Invasive species
14. Nickel and Copper smelting
15. Industrial Revolution
16. International Trade patterns
17. Fisheries
18. Sewage system spills
19. Production and uses of CFCs
20. Production and use of Halons
21. Paper products
22. Production and use of chemical refrigerants/AC/freon
23. Construction/building materials
24. Plastics/polymers
25. Synthetic building materials
26. Chlorine chemicals
27. Bromine chemicals
28. Lawn fertilizers
29. Polychlorinated biphenyls PCBs
30. Polybrominated biphenyls PBBs
31. Volatile organic compounds VOCs
32. Livestock waste
33. Persistent Organic pollutants POPs
34. DDT
35. Ammonia/ammonium products
36. Aerosols
37. Need more- look at the Michigan Content Standards included in this unit!