

**Lesson Plan Title:** What are the Effects of Global Warming?

**Topic:** Mathematical Modeling and Scientific Method

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**Teacher Grade:** 9-12

**Teacher School:** William Chrisman High School

**Teacher District:** Independence School District

**Standards (Performance, Knowledge and NETS-S)**

**Show-Me Standards**

Goal 1.1-develop questions and ideas to initiate and refine research

Goal 1.2- conduct research to answer questions and evaluate information and ideas

Goal 1.4- use technological tools and other resources to locate, select and organize information

Goal 1.5- comprehend and evaluate written, visual and oral presentations and works

Goal 1.6- discover and evaluate patterns and relationships in information, ideas and structures

Goal 1.8- discover and evaluate patterns and relationships in information, ideas and structures

Goal 2.1-plan and make written, oral and visual presentations for a variety of purposes and audiences

Goal 2.3- exchange information, questions and ideas while recognizing the perspectives of others

Goal 3.1- identify problems and define their scope and elements

Goal 3.5-reason inductively from a set of specific facts and deductively from general premises

Goal 4.1-explain reasoning and identify information used to support decisions

Goal 4.6- identify tasks that require a coordinated effort and work with others to complete those tasks

**Mathematics GLE**

Algebra Relationships

1.B.10 Generalize patterns using explicitly or recursively defined functions

1.C.10 compare and contrast various forms of representations of patterns

1.D.12 understand and compare the properties of exponential, polynomial, rational, logarithmic, and periodic functions

1.E.12 describe the effects of parameter changes on polynomial and periodic function

2.A.12 use symbolic algebra to represent and solve problems that involve periodic relationships, including recursive and parametric relationships

3.A.11 identify quantitative relationships and determine the type(s) of functions that might model the situation to solve the problem (including recursive forms)

Data and Probability

1.A.10 formulate questions, design studies and collect data about a characteristic

1.C.12 describe differences among various studies and which types of inferences can legitimately be drawn from each

2.C.12 create a scatter plot, describe its shape, determine and analyze regression equations using technological tools

**NETS-S Grades 9-12**

- 2. Make informed choices among technology systems, resources, and services.
- 7. Routinely and efficiently use online information resources to meet needs for collaboration, research, publication, communication, and productivity.
- 8. Select and apply technology tools for research, information analysis, problem solving, and decision making in content learning.
- 10. Collaborate with peers, experts, and others to contribute to a content-related knowledge base by using technology to compile, synthesize, produce, and disseminate information, models, and other creative works.

**What concepts do you want students to understand after completing this lesson?**

Developing a mathematical model to fit collected data. Use the mathematical model to analyze data about a real life situation. Develop and analyze a hypothesis about a real life situation. The use of scientific method for study design.

**Essential Question**

Is global warming a problem that needs to be addressed?

**Criteria for Success (How will you know students have gained an understanding of the concepts?)**

Student will design a study about one factor that could be affected by global warming. Students will design a study about the factor. The study will include writing a hypothesis, determining the data needed and collecting the data, determining the criteria for analyzing the hypothesis, finding a conclusion, summarizing the study, and identifying follow-up questions. The students will write a paper and will present a summary of the results in a multimedia product.

**Resources (What resources will you and your students use?)**

Internet, graphing calculators, Word, PowerPoint, Excel, Smart Ideas

Articles on Global warming:

Borenstein, Seth (2008, March 23). Global warming disturbs seasonal timing changes. *Kansas City Star*, p. B.

<http://www.globalwarming.org>

<http://www.climatehotmap.org>

<http://topics.nytimes.com/top/news/science/topics/globalwarming/index.html?inline=nyt-classifier#>

[http://www.sciencedaily.com/news/earth\\_climate/global\\_warming/](http://www.sciencedaily.com/news/earth_climate/global_warming/)

Global Warming information:

[US EPA - Global Warming Site](#)

[Global Warming: Early Warning Signs](#)

[ScienceDaily: Global Warming News](#)

[NRDC: Global Warming](#)

[Global Warming Simulation, Global Warming Interactive, Climate ...](#)

Weather Information:

[Welcome to The Weather Underground : Weather Underground](#)

[NOAA - National Oceanic and Atmospheric Administration - Past Weather](#)

[World Climate: Weather rainfall and temperature data](#)

Also available is the Almanac's. These are available at the library.

Videos: An Inconvenient Truth(2006), director Davis Guggenheim

National Geographic: Six Degrees Could Change the World(2007)

### **Management (How will students share technology resources? How will you break up the lesson into segments—the number of hours or days?)**

After the first day students work in groups of four. Depending on class size students will work in pairs or individually on computers. Each student will have access to a graphing calculator. Printed materials will be available, such as the almanac, in the event issues with the internet are encountered.

**Day 1-** Engage students in the study through the article presentation, outcome classification, graphic organizer development and graphic organizer presentation.

**Day 2-** Students will develop questions and plan their study.

**Day 3-** The teacher will survey the class and if groups are struggling to complete their work, the teacher will refocus the group. Study plans will be completed and submitted to the teacher.

Students will use any necessary technology tools for the analysis. The tools include Excel, graphing calculator or other tools. Students will share their work with other group members through the generic student drive that is available to all students.

**Day 4 –** Students will organize and collect data. The group's draft proposal will be returned to students to be finalized and for inclusion in the study report. Major issues in the draft proposal must be corrected before a group can begin analyzing the information gathered.

**Day 5-** Students will analyze the data and begin writing the study report.

**Day 6 –** Students will develop a presentation that explains the study supported with a multimedia product.

**Day 7-** Groups will present their study to the class and invited teachers.

All documents will be sent to the teacher either through e-mail or Moodle. The teacher will

assist students with technology as necessary. The students may need help when using the graphing calculator. Students may copy screen pictures of the graphing calculator to put into word or a presentation. Students may insert the graphs from Excel or other spreadsheet software. The presentation may be done using PowerPoint or the students may make a movie.

**Learner Diversity (What diverse learner needs do you need to consider when selecting resources, grouping students or planning the culminating project? Are there any special considerations such as assistive technologies or second-language learning to take into account?)**

ELL students will be put in groups where students are willing to assist them in their work. Extra time will be given if a group is struggling due to language or technology issues. Students will organize their groups for effectiveness. If the teacher notices a group being ineffective the teacher will address the group and assist the group on setting goals for the group. If necessary the group will be disbanded to work in pairs or as individuals.

**Engage**

Capture the students' attention, stimulate their thinking and help them access prior knowledge.

**Article Presentation**

The teacher will begin with "What do you know about Global warming? What are some of the outcomes of global warming?" Students will discuss for 5 minutes these questions.

**Outcome Classification**

Students will use an article furnished by the teacher such as "Global warming disturbs seasonal timing changes," March 23, 2008, Kansas City Star (See article at the end of lesson). Students will read the article and identify, from the article, outcomes that may be caused by global warming. Students will work on separating the outcomes into categories such as, evidence exists to support global warming causes the outcome or evidence is lacking to support global warming as the cause of the event. Once the students have analyzed the article individually, they will get with a partner to compare their analysis. If the pairs do not agree they must reach a consensus on where to put an event.

**Graphic Organizer Development**

Students will develop a graphic organizer of the outcomes in the article and any other outcomes students are aware of or find in research that are linked to global warming. The organizer should classify the outcomes from the article as well as the other outcomes the students identify.

**Graphic Organizer Presentation**

The graphic organizers will be shared with the class. After sharing the organizers the class will begin the scientific method process. The class will discuss and identify outcomes that may be caused by global warming and need to be researched.

**Questions**

Students will brainstorm and write questions related to the selected outcomes. After brainstorming questions students will determine which question they would like to research. The students will then organize themselves into groups of 3 to 4 students to

begin the research process of the study.

**Explore**

Give students time to think, plan, investigate and organize collected information.

**Planning**

Once the groups have been established students are ready to begin research of their question. Students will develop a hypothesis for their study question. The hypothesis must be measurable. Students will determine data they need to collect, how to organize the data and how to analyze the data using mathematical models. The students will write a draft of the study. The description will include the hypothesis and an outlined description of the experiment. The draft proposal should be turned in to the teacher by the end of day 3.

**Refine the Plan**

Once the draft has been submitted the teacher will review the proposal and work with the students to refine any parts of the research that seem to be vague. The teacher will ask questions that require the students to think about what they are researching. The teacher needs to make sure the hypothesis is clearly stated. The teacher also needs to make sure students have discussed organization of data and have a clear method for analyzing the data. (ex. Students may want to look at the high temperature in 5 year cycles. The students would collect the high temperatures for a city graph the data and then write a mathematical model. The students would need to look at the models to determine whether there is a significant change from the years studied. Students will determine how many years, how many cities, and what is a significant change. Students must be able to defend why this is a significant change with research.)

**Data Collection**

Students will begin collecting and organizing the data to be studied. Students may use a spreadsheet, such as Excel, or a graphing calculator to organize data into tables and make graphs.

**Explain**

Involve students in an analysis of their explorations. Use reflective activities to clarify and modify their understanding.

**Data Analysis**

Before students can analyze their data the teacher will need to return the draft proposal to be edited. All major problems need to be fixed before the group begins the analysis. The students will need to make graphs. This may be done with Excel, graphing calculator or other graphing tool. To complete the analysis student will use mathematical models in Excel or a graphing calculator.

**Results**

The students will analyze the graphs and models developed and begin writing their report. In the analysis section students will discuss whether data supports the hypothesis or contradicts the hypothesis in the conclusion. Students will state in their report any problems that were encountered during the analysis.

Finally, students reflect on how their research could be improved (if the group had to

change any part of the experiment what might that be?), further research that could be done and include this in the report. Appropriate citations must be included in the report. Completion and submission of reports to the teacher must take place no later than the beginning of Day 7.

**Elaborate**

Give students the opportunity to expand and solidify their understanding of the concept and/or apply it to a real-world situation.

**Multimedia Development**

After the students have finished the written report the students will develop a multimedia presentation (PowerPoint, movie, electronic posters/flyers, etc.) in which they will summarize and present their research. The presentation will include the student’s research question, hypothesis, overview of the data collected; graphs, mathematical models used for analysis, the study conclusion, any problems faced during the study, and further research.

**Presentation**

Students will give their multimedia presentations. The audience for the presentations will include the students in class and invited teachers.

**Evaluate**

Evaluate throughout the lesson. Present students with a scoring guide at the beginning. Scoring tools developed by teachers (sometimes with student involvement) target what students must know and do. Consistent use of scoring tools can improve learning.

This lesson will include both formative and summative assessments as listed below.

**Formative Assessments**

List of Issues Scoring Guide

Criteria and expectations for the advanced level on the scoring guide:

- Possible outcomes from global warming – the list includes many changes from the article with appropriate MLA citations
- Organization – the list of changes includes how the changes could be measured or if they cannot be measured an explanation of why not.

Draft Proposal Scoring Guide

Criteria and expectations for the advanced level on the scoring guide:

- Hypothesis – Clearly stated and measurable. It will assist in answering the proposed question.
- Experiment process – Clearly explained process that is easy to follow. It includes information on what data is needed, how it will be organized and how it will be analyzed.
- Written process – Written clearly and easy to follow with few grammar or spelling errors. The proposal has cited sources both in the document and in a citation page. A title page is included with the proposal.
- Citations – Citations follow standard MLA format.

Self-Evaluation Form (administered at the end of each class period)

Criteria and expectation:

- An item that rates how the individual participated in the group or in class.

- A written item that describes what the individual was responsible for completing during the class period.
- An item that rates how well the group functioned during class.
- An item to agree/disagree that all members of the group participated during class.
- An item that provides the student a way to communicate to the teacher the need to discuss concerns or problems with the teacher.

### **Summative Assessments**

#### Final Report Scoring Guide

Criteria and expectations for the advanced level on the scoring guide:

- Draft proposal – Corrections were made so the proposal would score at the advanced level on the draft proposal scoring guide.
- Data – Collected data is relevant to the stated hypothesis and is organized. Tables and graphs are included with titles and labels. Mathematical models are included with data and are correct.
- Conclusion – The written conclusion is clear and easy to follow. Data in the report supports the conclusion. A reflection on errors and issues encountered in the process are included in the reflection as well as further research that needs to be conducted.
- Writing process – The paper is organized and easy to follow with few grammar or spelling errors. Sources have been cited in both the document and on a citation page. The paper includes a title page.

#### Presentation Scoring Guide

Criteria and expectations for the advanced level on the scoring guide:

- Multimedia – The multimedia product includes a summarization of essential parts of the study – hypothesis, process, conclusion, issues encountered and further studies that need to be completed.
- Presentation by the group – Details about the study are provided during the presentation. All members of the group participate in the presentation and can explain clearly what the project is about and what was concluded.

Peer Evaluation Scoring Guide - The students will evaluate each group on its presentation. The students will develop a scoring guide for this process. It will include scoring the product, the presentation and the overall experiment from the information gathered on the project.

Posted on Sat, Mar. 22, 2008 10:15 PM

# Global warming disturbs seasonal timing changes

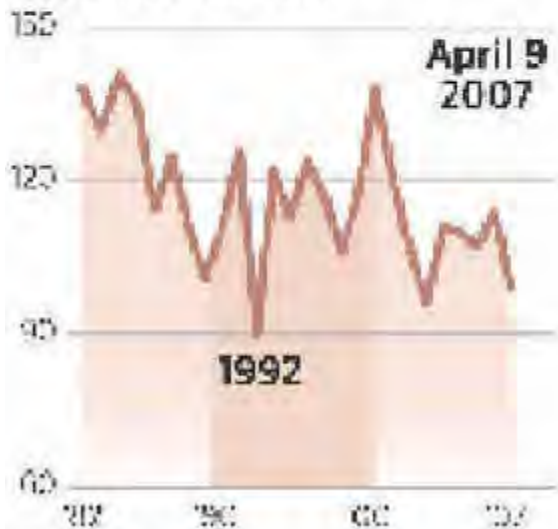
By SETH BORENSTEIN  
The Associated Press

## SPRINGING TO LIFE

Global warming is affecting plants and animals at springtime across the country.

### Marmot first sighting

Days into the year



Source: National Park Service

THE ASSOCIATED PRESS



WASHINGTON | The cherry trees are primed to burst out in a perfect pink peak about the end of this month. Thirty years ago, the trees usually waited till around April 5.

In central California, the first of the field skipper sagemoth, a drab little butterfly, was fluttering about on March 12. Just 25 years ago, that creature predictably emerged there anywhere from mid-April to mid-May.

And sneezes are coming earlier in Philadelphia. On March 9, when allergist Donald Dvorin set up his monitor, maple pollen was already heavy in the air. Less than two decades ago, that pollen couldn't be measured until late April.

Pollen is bursting. Critters are stirring. Buds are swelling. Biologists are worrying.

"The alarm clock that all the plants and animals are listening to is running too fast," Stanford University biologist Terry Root said.

Blame global warming.

The fingerprints of man-made climate change are evident in seasonal timing changes for thousands of species on Earth, according to dozens of studies and last year's report by Nobel Prize-winning international climate scientists. More than 30 scientists told The Associated Press how global warming is affecting plants and animals at springtime across the country, in nearly every state.

There are winners, losers and lots of unknowns when global warming messes with natural timing. People may appreciate the smaller heating bills from shorter winters, the longer growing season and maybe even better-tasting wines from some early grape harvests. But biologists also foresee big problems.

The changes could push some species to extinction. That's because certain plants and animals are dependent on each other for food and shelter. If the plants bloom or bear fruit before animals return or surface from hibernation, the critters could starve. Also, plants that bud too early can still be whacked by a late freeze.

The young of tree swallows — which in upstate New York are laying eggs nine days earlier than in the 1960s — often starve in those last-gasp cold snaps because insects stop flying in the cold, ornithologists said. University of Maryland biology professor David Inouye noticed an unusually early February robin in his neighborhood this year and noted, "Sometimes the early bird is the one that's killed by the winter storm."

The checkerspot butterfly disappeared from Stanford's Jasper Ridge preserve because shifts in rainfall patterns changed the timing of plants on which it develops. When the plant dries out too early, the caterpillars die, said University of Notre Dame biology professor Jessica Hellmann.

"It's an early warning sign in that it's an additional onslaught that a lot of our threatened species can't handle," Hellmann said.

It's not easy on some people, either. A controlled federal field study shows that warmer temperatures and increased carbon dioxide cause earlier, longer and stronger allergy seasons.

"For wind-pollinated plants, it's probably the strongest signal we have yet of climate change," said University of Massachusetts professor of aerobiology Christine Rogers. "It's a huge health impact. Seventeen percent of the American population is allergic to pollen."

