WHAT'S THIS STUFF GOOD FOR?

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The concerned group of about 20 people gathered in a schoolroom on the campus at a local public school for their first meeting. It was 12:30 p.m. on an unusually warm Monday in January.

The meeting began with a discussion of the recent abnormally warm winters experienced in the region. Some members of the group pointed out that the six hottest years in the history of recorded time were the recent years of 1988, 1987, 1983, 1981, 1989, and 1980, in order of greatest to least temperature. Others noted it has been reported that ocean levels have risen by 1.25 mm per year for the past 100 years. Some areas in the United States have been experiencing unprecedented droughts, while others are having major flooding.

These issues were precisely the reason for this meeting. The group was concerned about the welfare of the region, and indeed, the whole planet. What were the causes of these phenomena, and what could be done, if anything, to return things to normal? Much discussion ensued, some regarding the vague issue of global warming that had been mentioned in a newspaper article, some about the conjectured causes, and in particular, a brief, but uninformed, conversation about the greenhouse effect. No one was quite sure what really causes it, but most knew that heat from the sun somehow gets trapped at the surface of the earth and keeps us warm, similar to the way the inside of a car heats up when left sitting in the sun with the windows up. The group agreed that perhaps this phenomenon was relevant to their concerns and decided to schedule another meeting and, in the meantime, try to read as much as possible about this greenhouse effect.

As they began drifting out into the halls, they heard a strange whirring in the air, coming from somewhere down one of the dark, empty hallways. Everyone was out in the hall watching and listening as the whirring became louder. Then, from around the corner, and seemingly from out of the ceiling, dropped a young woman wrapped in a rather large, billowy cape. Her cape was forest green, and she was clad in a skintight, earth-brown leotard and high buckskin moccasins. Around her neck was a medallion emblazoned with the letters "E.A." Her hair resembled tangled vines and hung below her shoulders.

She stood with arms outstretched blocking the hallway . She spoke to the small crowd standing with mouths agape.

"Your concerns are well-founded. I have come to you so that you may become informed about global warming. The greenhouse effect is caused by certain gases in the atmosphere. These gases, called the greenhouse gases, consist primarily of carbon dioxide, chlorofluorocarbons, methane, ozone, and nitrous oxide, the most prevalent of which is carbon dioxide. Imprudent human activity is causing the carbon dioxide level to increase significantly, resulting in higher temperatures on earth. It would be wise for you to take a long, hard look at the things you are doing which are causing this increase of atmospheric carbon dioxide."

With these words, the young woman disappeared as quickly as she had appeared, leaving the group somewhat perplexed. They stood looking at each other for a minute before one of them spoke.

"Maybe we should listen to this mysterious young woman. I've read a little about the evils of carbon dioxide emission and think there may be something to what she says."

They briefly reconvened and decided to schedule meetings for three days a week for the next 10 weeks, specifically to study carbon dioxide emission. One group member agreed to go to the library to gather information before the next meeting, which was scheduled for the following Wednesday. Then they adjourned.

At their second meeting, the group began by sifting through the information that had been obtained, and by the end of the allotted time, found that an enormous amount of carbon dioxide is emitted from automobiles in the United States alone; also the group discovered that another major factor is the destruction of the world's rain forests. A considerable amount of carbon dioxide is absorbed by these rain forests, and of course, their disappearance allows more and more to drift into the atmosphere. Much data on each of these factors were obtained from historical books and recorded by the group.

One member was concerned that all this information was past history; how could this tell anything about future emission? Again the whirring sound, and

the sudden appearance of the mysterious young woman in the large green cape. She spoke:

"Plot your data on a coordinate system, then draw a curve through those points; see what it looks like and where it goes. This should enable you to predict the future."

The young woman was gone in an instant.

"Good idea!" exclaimed one of the group. "Let's divide into two groups; one can analyze the automobile emission of carbon dioxide, and the other the atmospheric carbon dioxide due to rain forest destruction."

They immediately agreed, and after separating into groups, adjourned.

At the next meeting, each group arranged its desks in a circle and began its work. The first group, who called itself the Green Group, had chosen to study rain forest destruction, and the second group, the Blue Group, had chosen automobile emission. Over the next several weeks, the groups spent many hours, both during scheduled meeting times and evenings at home, drawing graphs, writing equations, and interpreting results. Many group members had invested in a fancy calculator which did all the number crunching and even drew graphs! This made their task much easier.

At long last, on another warm Monday, they convened to discuss the results of their hard work. The Green Group reported that if the present trend of rain forest destruction is allowed to continue, there will be no rain forests left by the year 2050. On the other hand, the Blue Group had found that if carbon dioxide from automobiles continues to increase at its present rate, over a billion tons of carbon dioxide will be emitted in the same year. The leader of the Blue Group, after a moment's thought, said, "So what does this mean with regard to global temperature?"

This time, there was no whirring sound, but a quiet materialization of the young woman with the emblazoned medallion. She spoke.

"A doubling of carbon dioxide concentration results in a 3° C increase in average global temperature. You must also be aware that a temperature increase of 1° C causes a significant melting of polar ice caps, and as a result, a rise in ocean level of one foot."

She disappeared.

Another week went by—more calculations and computations and graphs and equations. With only two weeks left in their 10-week schedule, they met on a Friday afternoon, which notably was slightly cooler. Their combined work was reported and discussed. They had found that by the year 2050, if nothing is done to change the present trend, the average global temperature will have increased 3.6° C, and the oceans will have risen 1 foot, 2 inches.

"Good grief!" cried one member, "that would flood my house at Savannah Beach! What can we do to prevent this?"

Puzzled, they began looking around the room.

"Where is *she*?" one of them asked.

Their eyes searched the room expectantly but found nothing. They went out into the hall. Still nothing. They listened. They waited an hour. Finally, they gave up and went home, disappointed and afraid.

But, faithfully, they all reappeared at the scheduled meeting time on the following Monday. At exactly the time the meeting was to begin, a very loud and frantic whirring noise filled the room. A rather flustered green-caped woman entered the room. She spoke.

"I was detained due to a major oil spill off the coast of the Alaskan Wildlife Refuge, which required immediate attention. Now my words to you: Learn the causes for the destruction of the rain forest and the reasons for the high carbon dioxide emission from automobiles."

Over the next week, the Blue Group gathered statistics on the number of cars in the United States and the average gas mileage per car per year; the Green Group learned that the principal loss of rainforest was due to cattle grazing, logging, and agriculture. The Blue Group, after doing new calculations, new graphs, and new equations found that if the government required that average gas mileage for cars be increased by 1 percent per year, then carbon dioxide emission would be reduced by a very large factor. The Green Group discovered that if the amount of rain forest cut for cattle grazing was restricted over the same time period, carbon dioxide concentration could be significantly controlled. The net effect of these two imposed restrictions would at least maintain the present average global temperature and hence prevent the loss of land to the oceans.

"Great! My Savannah Beach house would be safe if only someone would require these conservation measures," exclaimed one member. The Green Group leader shouted, "Let's write Congress and tell them what we have found!"

Then a voice from above: "You have all done well."

And silence fell upon the room. "Who was that green-caped young woman?" someone asked.

The above is a moderately exaggerated account of a new mathematics course, *Earth Algebra*, which is being developed by the authors at Kennesaw State College, Marietta, Georgia, USA, Planet Earth. Appropriate for entry-level college humans, the course teaches and uses all the concepts of a traditional college algebra course.

Some units have already been piloted in selected sections of Math 105. Results have been phenomenal. Students exit the course with a real appreciation of mathematics' role in society. They also, curiously enough, learn mathematics by using it as a tool for decision making. Meetings are now being arranged with representatives from other disciplines to discuss integrating the course into the curriculum in the near future.

Students use algebraic techniques to model environmental issues and use equations and graphs to make predictions and recommendations for improvement. Much of the study is done by the students working in small groups in the classroom, with the guidance and motivation of the instructor. This technique removes the traditional lecture style from the course and makes mathematics a hands-on subject. Algebra is applied to a major social issue, making mathematics relevant.

The typical student evaluation of this course is: "This is the first mathematics course that I ever enjoyed; now I realize what mathematics is good for!"