

**Project Title:**  
Photosynthesis: The Reversal of Pollution  
**New Mexico**  
**Supercomputing Challenge**  
**Final Report**  
**April 21-22**  
**Team Number:**  
151  
**School Name:**  
Taos Middle School

**Team Members:**  
Delaney E. Galligan (captain)  
Lena S. Schulze

**Project Mentor:**  
Tracy L. Galligan

**Executive Summary:**

The problem we investigated this year was to see if we could model the reduction of pollution (based on experimentation) using real world variables in Starlogo TNG. The reason we decided to model this situation was because of Delaney's science fair project. (In her project she used select micronutrients to advance carbon dioxide-to-oxygen conversion in alfalfa to reverse the process of pollution.) We decided to model this because we wanted to know roughly how long it would take for the photosynthetically advanced alfalfa to 'reverse' or stop the process of pollution and roughly how much alfalfa was needed to do so. In the model it shows the alfalfa fields (which you can select the size of), and the carbon dioxide, sunlight and water falling down on the plants. When the variables (sunlight, carbon dioxide and water) collide with the

alfalfa, real life reactions occur. What we mean by that is that when the water and sunlight collide with the alfalfa the variables 'die' and the alfalfa grows, and when the carbon dioxide collides with the alfalfa the carbon dioxide 'dies', soon (a few ticks later) another carbon dioxide dies because that alfalfa went through the process of photosynthesis and the alfalfa that used the carbon dioxide grows. In the end we haven't completely answered our question, but we will continue on in future years until we do so, while adding to our model and making it more realistic.

## **Research:**

### **Alfalfa**

Alfalfa is a plant that has numerous uses. Some of these uses include animal food, medicinal uses, grazing, and even used for diets, and lowering cholesterol. The reason why alfalfa is used for so many purposes is because it is rich in fiber, nutrients and vitamins, but there are some downsides. Alfalfa is toxic to itself so it won't reproduce itself if there is a crop that already exists. For this reason, it is necessary to plow a crop that has finished before planting the next season's crop. It is also harmful to your intestines if you consume too much, and is most likely unsafe if you take alfalfas seeds for too long.

### **Photosynthesis**

Photosynthesis is the synthesis of sugar from light and water, with oxygen as a waste product. Without photosynthesis we would not be here on this earth today. Photosynthesis is the creation of oxygen that nearly all life depends on. It occurs in higher plants, algae, some bacteria, and some protists. Photosynthesis occurs in photoautotrophs which are plants that can synthesize food directly from inorganic compounds like the sun, water, and carbon dioxide.

### **Carbon Dioxide**

Carbon dioxide is a chemical compound composed of two oxygen atoms each covalently double bonded to a single carbon atom, that is also known as CO<sub>2</sub>. (Carbon is element number 6 and oxygen is element number 8.) As of 2011, carbon dioxide accounted for 84% of all greenhouse gas emissions from human activities. Those human activities that are increasing the levels of carbon dioxide in the atmosphere (which is changing earth's carbon cycle) is the combustion of coal, natural gas, and oil which is used for electricity, transportation, and industry. This carbon dioxide combustion is constantly being exchanged between the atmosphere, ocean, and land surface, and is being absorbed by many microorganisms, plants, and animals. Due to all of these emissions the CO<sub>2</sub> levels are expected to grow about 1.5% every fifteen years.

### **Air Pollution**

The most common and obvious form of air pollution is the smog floating over cities around the world, but generally any substance that people let into the atmosphere that has damaging effects to living things is considered air pollution. Air pollution is everything from CO<sub>2</sub> to methane to chlorofluorocarbons (CFC) or sulfur dioxide. All of these chemicals are also associated with climate change.

### **Problem Definition:**

Oxygen is essential for all living things in this world. Without it there would be nothing. But what if it all just disappeared? Well, with all of the pollution in the atmosphere it might just happen. That is where we step in. During this challenge we are going to measure how much photosynthetically advanced alfalfa is needed to fight off pollution. If this simulation works we can see how long it will take until the pollution in the air is gone or at least significantly

decreased. If the pollution in the air is gone, in theory, it would reverse global warming. We are going to measure how long it will take to do so.

### **Problem Solution:**

The solution to the pollution, that we are modeling is the photosynthetically advanced alfalfa (we have found this data with the actual experimentation using micronutrients). We chose alfalfa because it has many uses (medicinal, herbal, food, economic, animal food, etc.), because it is easy and fast to grow and finally because it is easy to enhance with micronutrients through the growing process. Since the dead alfalfa will be no longer of use to us in real life we could feed it to the farm life or put it in a compost for making better soil.

### **Expected Results:**

Our respected results, for this year's challenge, were to be able to prove that we can save the world by using photosynthetically advanced alfalfa, but before that happens we expected to find that alfalfa can reverse pollution in a very reasonable amount of time. We also wanted to accomplish this year's challenge successfully and hopefully become a finalist.

### **Data/End Results:**

Upon completing this years challenge we have gathered this data:

#### **Starting Data:**

Alfalfa: uses slider, anywhere from 1 to 101 alfalfa

Carbon Dioxide: uses slider, anywhere from 1 to 101 carbon dioxide

Water: uses slider, anywhere from 1 to 101 water

Sunlight: uses slider, anywhere from 1 to 101

Overall Agents: Anywhere under 4000 agents

**Preliminary Ending Data:**

Alfalfa grows at the carbon dioxide initiator point but not directly correlating to the amount, but does grow with the water and sunlight properly. The oxygen release needs to be honed to correlate as an inverse reaction to the carbon dioxide excess. The alfalfa planted does correlate to normal growing standards, but is not meshing with the carbon dioxide/oxygen processing on the large scale. It does work on the small scale as verified with real time experimentation. Further coding work is still being perfected to place this program on the same scale as professional scientific research. Initially the agents were produced off of a sun cluster and then modified to include the slider variables but the initial sequence was not supporting the goal of the intent of the program. The sequence then had to be modified to correlate with the intent of the program to put the alfalfa growth in the right sequence.

**Conclusion:**

Upon finalizing this years data we have concluded that more variables need to be isolated. In this years model we have added in four variables (the alfalfa, carbon dioxide, water and sunlight), but we still have many we want to add in (growing season, altitude, climate, soil PH, population density, moisture retention, alfalfa life span, etc.) We want to make this model as real as possible so that it could be used for real scientific research. With our model so far we have a general scenario of alfalfa growth when triggered by one of the other three variables, but are trying to hone a direct correlation to carbon dioxide increase and oxygen decrease. As of present, the model shows a general correlation to these two variables but is not giving a realistic scenario of the impact of these variables. The model is showing a simulation of the events that occurred on the experimentation but is only showing it on the same scale as the experimentation. The

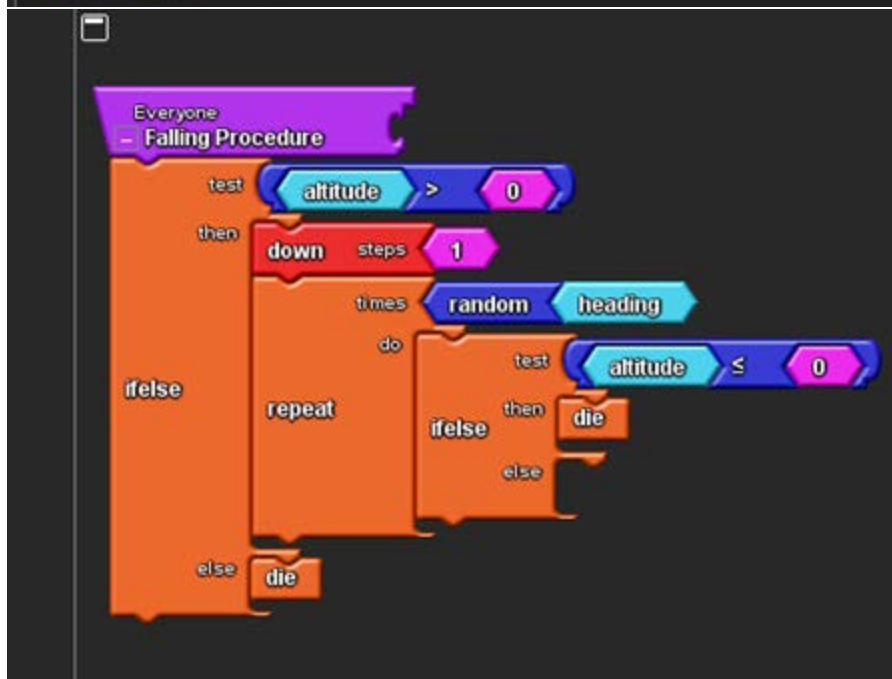
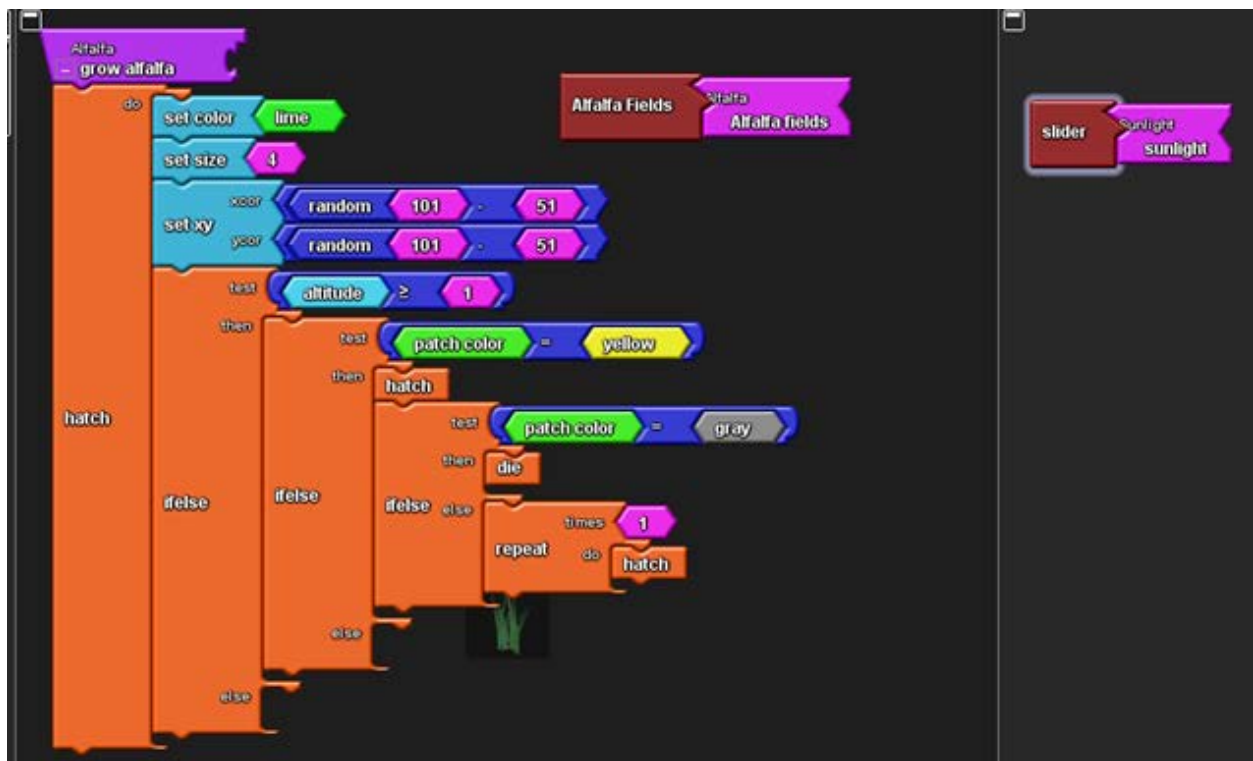
model will show a correlation between real life planting fields by acreage vs carbon dioxide pollution on a real world scale.

### **Achievements:**

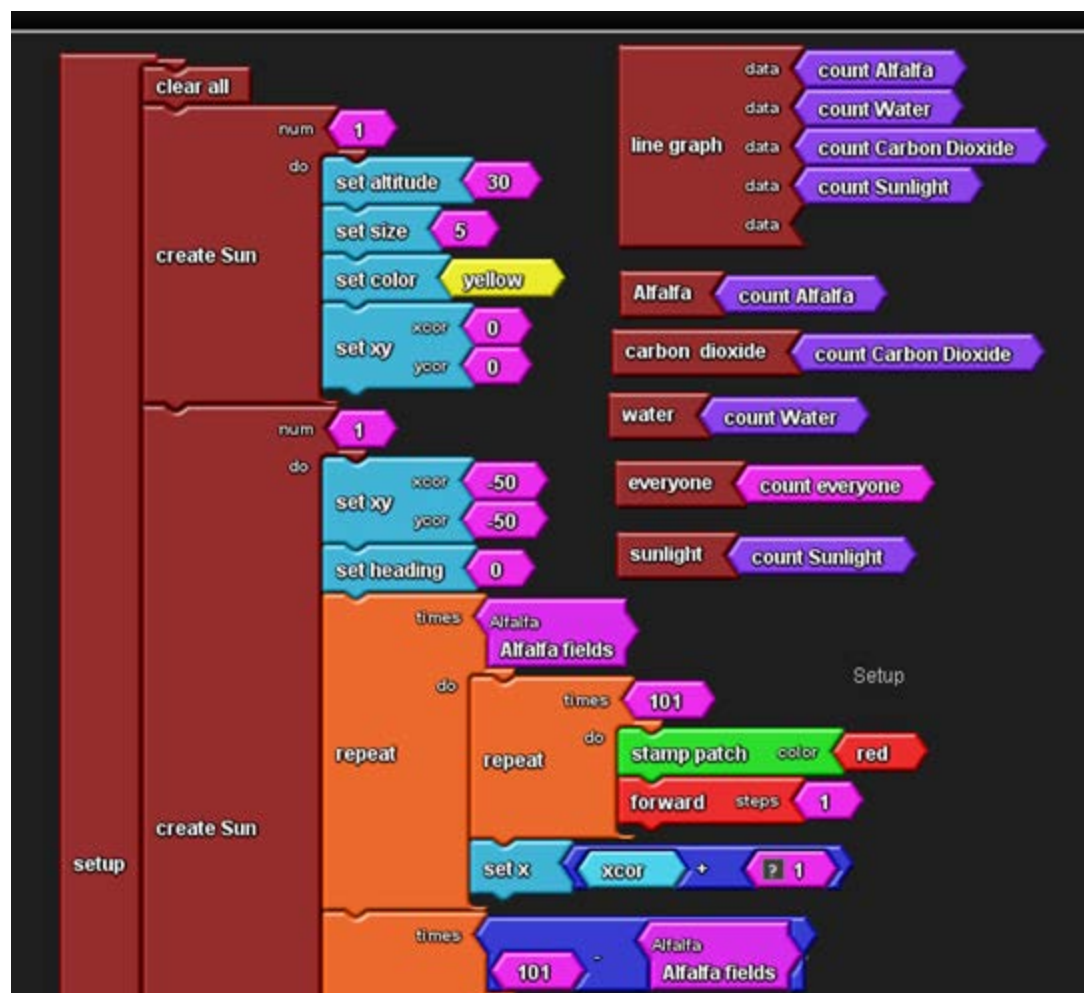
Our most significant achievement was being able to code our new project successfully and to have been able to complete the challenge this year for the second time! It was also amazing to work with different areas of code and to be able to recruit more members for the other Taos Middle School and Taos Charter School teams. We were able to have fun and code something that could possibly help the world in the future. We look forward to competing next year and for years to come after that.

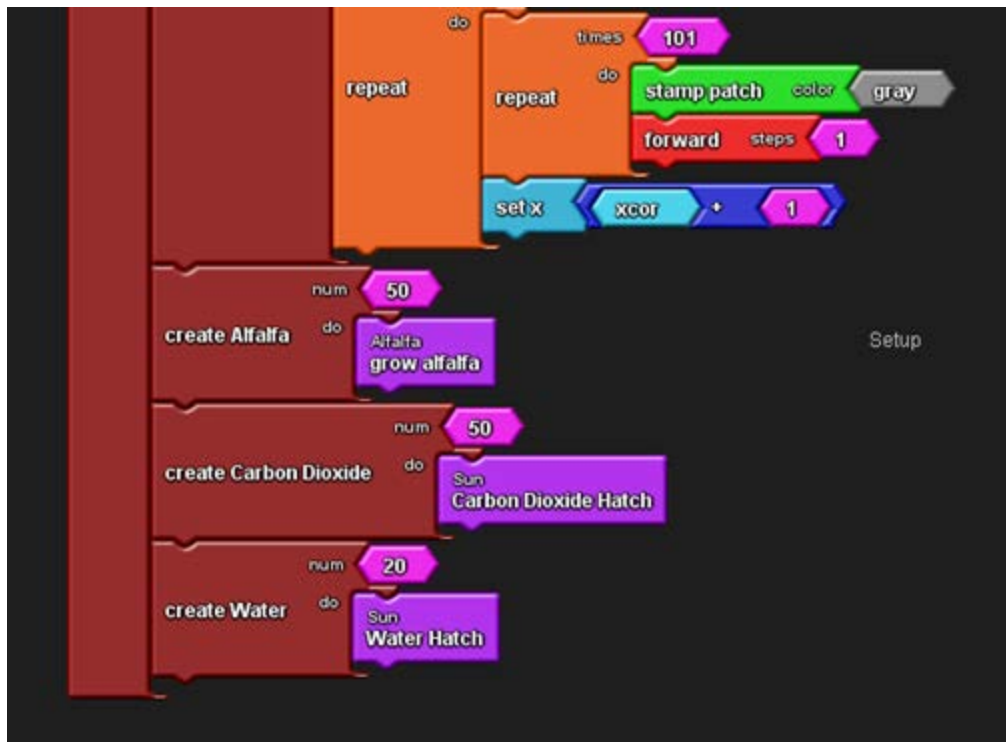
**Software & Code:** The software we used to model was Starlogo TNG and the software we used to create our powerpoint was Microsoft Powerpoint. This is our code:











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