Challenge Final Report Submission Information

Team ID-

MELHS1013

School Name-

Melrose High school

Project's Area of Science-

Biology

Computer language(s) used in your project

Net Logo

Team members grade levels in school (comma separated)-

Senior, senior, senior, sophomore

Team member's email addresses (comma separated)

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Bioterrorism

New Mexico

Supercomputing Challenge

Final Report

April 2, 2018

Team Number: MELHS1013

Melrose High School

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Teacher:

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Mentor:

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Executive Summary:

Our project this year is about bioterrorism and how we might be able to prevent it in the future. We are taking a unique approach to this issue. Our approach is similar to that of using a criminal to fight crime. Finding the best and most effective way of spreading diseases as a form of bioterrorism will better prepare the police forces on how to handle a situation where terrorists turn to biohazards instead of bombs or guns.

Spreading diseases is much more financially plausible than the equipment necessary to make a bomb or even to purchase mass quantities of ammunition for firearms. Another motivation to using bioterrorism is that it can do just as much if not more damage than by other means of terrorism while having a significantly lower chance of being caught or even of being a suspect.

We used NetLogo to build our program and have developed a way to model how people get sick or become infected, and for people to go to clinics to become healthy. The model then has clinics that are set up when there is enough people that become sick in a concentrated area. This can improve their health. When people get sick and do not get better they are taken to the nearest clinic.

Statement of the Problem:

With this project our goal was to find the most efficient and effective way to spread a disease and recover from a bioterrorism attack. We have been doing research on Bioterrorism

and Biological Warfare, and it has caused use to pose many questions. What is biological warfare? Biological warfare is the use of toxins of biological origin or microorganisms as weapons of war. How can it be applicable to our world today? Our world today is constantly looking for technological advances in biological studies and systems of defense. What if someone were to combine the two? Biological warfare has been in used in previous times and has worked very well but was not easily contained. It is also illegal for the United States Government and other international treaty signees to use. However, if a terrorist was to learn how to harness diseases to their own advantage our country would be in a lot of trouble. It has been said that biological weapons are so cost efficient that if a conventional weapon were to cost two thousand dollars, a biological weapon could do the same amount of damage for one dollar.

We have made a program that helps to conceptualize the best ways to help prevent further damage if there was a biological attack, and how to keep people alive as long as possible.

Method:

To build our program we used NetLogo. We have developed a program that spreads diseases and provides clinics for people to attend. The program is designed to mimic the actual biological response when people get sick. Some are affected more than others, and others are affected less so. This is represented by several sliders and buttons used in our model, including: population, infection, intensity, hazard, medicine, wandervalue, infectionrate, clinicvalue, and clinicspacing. Population and wandervalue control the human population in the area and the way people walk, perhaps staying closer to home, or going across town. Infection, intensity, and hazard affect the disease that is spreading, they control how close the people have to be in order

to be infected, how hazardous the disease is, and how many locations have the infection. Clinicvalue, spacing, and medicine affects the medicine, clinic location, and clinic density (how close together clinics can be). The buttons used set up the people and where the infections will be and if the people can recover. Setup infect, sets the original patch color and puts the variable number of people and infection locations randomly through Spaceland. Move (forever), tells the people to move and choose a direction to walk. Terrorize (forever), gives the infection permission to become viable and start infecting people, this is the trigger that a terrorist would use to release the disease. Recover (forever), tells the people that after a certain number of time they need to get better or worse not just stay the same sickness for a long period of time. Notdie (forever), this gives the people survival instincts to go to the doctor and get better. Finally, clinics (forever), tells the clinics to start setting up, when the patch colors are adequate find all locations possible to set up a clinic and select them so they are not too close to each other. This gives the simulation of actually having a town with several clinics or hospitals that people can go to. Once a person becomes sick they leave a path on the ground where the patches change color just slightly, this allows us to track where they go and the locations that have the highest concentration of sick people.

Verification and Validation:

This project is important because there have been a lot of terrorist attacks in the world lately. With such an affordable highly lethal option for terrorist attacks we believe that it will only be a short period of time before bioterrorism becomes on of the main forms of terrorism. If we understand how the diseases spread, and the most effective ways to do the most damage there is a higher chance of the authorities being able to address the situation more effectively and be

able to stop an epidemic sooner. The verification of our modeling of the spread of diseases is based on other programs focusing on epidemiology that work and run similarly to our own program. We feel that this provides a confirmation that is needed and allows for greater credibility of our program.

Conclusion:

This project has a lot more potential that could be easily accessed by anyone wanting to continue and expand upon it. With that said, there are several conclusions to be made: A) If there is an epidemic people need to stay away from the hospitals and clinics if they are not sick. B) Any time there was a hazardous area in the same area as the clinic there was a much higher chance that people would die. The people would go get treatment and before they could leave they would become infected again and have to go back to the hospital and they would die because they could not actually escape the disease. C) Also, any contact with other infected people raised their chances of becoming sicker and dying. Again, going back to the hospital scene where the people would die before they ever left the hospital because there was so much of the contagion around them.

Ultimately the best solution in the case of an epidemic would be to stay away from people who are infected and areas that are infected. The only issue with this program is that it does not account for the immunization or stronger antibodies of the healed people. If someone was to be very sick they most likely would not become that sick again.

Software/Tables:

```
breed [people person]
breed [germs germ]
breed [antidotes antidote]
globals [healthy-people]

to setup
  clear-all
  reset-timer
  ask patches
    [set pcolor grey]
  crt population
    [
    set breed people
    set color blue
    set shape "person"
    set size 1
    ]
  ask people [setxy random-xcor random-ycor]
end
;***Setup clears the screen to reset the program
;sets the base color grey and places people around spaceland

to move
  ask people
    [
    lt random wandervalue rt random wandervalue forward 1
    if color < 16 [if pcolor > 0 [set pcolor pcolor - .25]]
    ]
  tick
  set healthy-people count turtles with [color = blue]
  if not any? people [stop]
end
;***Move tells people to walk and move around spaceland
;so that they can come into contact with other infected people and infected areas

to infect
  crt infection
    [
    set breed germs
    set color hazard
    set shape "triangle 2"
    set size 2
    ]
  ask germs [setxy random-xcor random-ycor]
  if not any? people [stop]
end
```

```
;***Infect tells the program to place turtles at a given number of locations
;that a bacteria/infection could be placed to infect people

to clinics
   ask patches [if pcolor < clinicvalue
        [sprout 1 [
          set breed antidotes
          set color 44
          set shape "circle"
          set size 2
    ]]]
   ask antidotes [ifelse any? other antidotes in-cone clinicspacing 360   [die][set color green]]
     if not any? people [stop]
end
;***how the clinics are made and the location chosen
to notdie
  ask people [ if color < 16 [findclinic]]
  ask people
   [
   if any? antidotes in-cone 3 360
     [if color = 13 [set color color + 2]
      if color = 15 [set color color + 2]
      if color = 17 [set color color + 2]
      if color = 19 [set color blue]
     ]
   ]
  if not any? people [stop]
end
;***notdie gives the people opportunities to get "medicine to heal more quickly

to terrorize
  ask people
    [
    if any? turtles in-cone intensity 360 with [breed = germs]
       [colorcode]
    if any? people in-cone intensity 360 with [color = 13]
       [colorcode]
    if any? people in-cone intensity 360 with [color = 15]
       [colorcode]
    if any? people in-cone intensity 360 with [color = 17]
       [colorcode]
    if any? people in-cone intensity 360 with [color = 19]
       [colorcode]
    ]
      if not any? people [stop]
```

```
end
;***Terrorize is the key word to make the program create a
;bioterrorism envioronment where there is an infection that can be spread
;this allows the turtles to respond to the stimuli and get sick then change colors

;***Set intensity slider to change how powerful the virus is
;to change how soon the people are infected

to colorcode
  let colornumber random 100
  if colornumber > 20 * infectionrate [set color 19]
  if colornumber > 40 * infectionrate [set color 17]
  if colornumber > 60 * infectionrate [set color 15]
  if colornumber > 80 * infectionrate [set color 13]
end
;***Colorcode sets the color of the people when they become infected
;and allows the people to change color as they get better or more sick

to recover
  ask people
  [
  every 1 [change]
  ]
    if not any? people [stop]
end
;***Recover tells the people to decide if they get more sick or less sick every 5 ticks

to change
  let recovery# random 100
  if recovery# > 30 [set color color - 2]
  if recovery# < 70 [set color color + 2]
  ask people
    [
    if color < 13 [die]
    if color > 19 [set color blue]
    ]
end
;***Change tells the people how to decide if they get better or worse
;and if they get sick enough they are supposed to die


to findclinic
    let choices other turtles with [ breed = antidotes] in-radius 20
    let closest min-one-of choices [distance myself]
    if closest != nobody [face closest]
    fd 1
```

end
;***Tells the people to find the closest clinic to go to

Significant Achievements:

Our most significant achievement on this project was the coding. No, it is not too advanced, but we were able to do most of it on our own. In years past we have had a lot of help from ‘coding guru’ team-mates, and from our teacher and other scientists that were willing to help. But this year we did a lot of our coding by ourselves as our own project. This is an important thing to learn to do and I think that we learned more this year than we have in the past.

Acknowledgments:

We would like to acknowledge our teacher, Mr. Daugherty for everything that he has done to help and encourage us with this project. Also we would like to thank our parents for working with us and getting us all together to work on our project when we needed to. Thanks also to Randall Rush for helping us with some of questions about epidemiology and diseases that we had. Finally we would like to thank the scientists that help organize this every year and allow us to have such a unique opportunity every year.

Citations:

Personal interview: Randall Rush: attended Hillsdale College, Hillsdale, MI where he graduated with honors with a bachelors degree in biology and a minor in chemistry.

http://www.acphd.org/measles.aspx talked about the measles epidemic and the Disneyland exposure.

https://www.cia.gov/library/reports/general-reports-1/iraq_wmd_2004/chap6.html talked about bioterrorism and biological warfare used in the past.

http://telemedicine.org/biowar/biologic.htm "Biological Warfare and its Cutaneous Manifestations"

https://www.express.co.uk/news/world/863586/north-korea-world-war-3-biological-warfare-plague-missile-attack-usa "North Korea threaten World War 3 with terrifying Plague, Anthrax and Smallpox weapons"