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Zombie Apocalypse

*A 9th-12th grade activity, though relates best to a 10th grade Biology class

Objectives: Students will be able to use a model of a zombie outbreak to collect data, organize data on an Excel sheet, create a scatter plot with data, and analyze/interpret what the created graphs mean, as well as a couple sample graphs.

Model Description: A zombie gets introduced into an environment of humans!

Main Question: What is the projected human casualty rate?

The model takes place in a "city" setting (buildings, subway, parking garage, plaza etc.)

There are 2 main variables being tracked-

- How contagious is the zombie (**x**% between 5%-95%, by 5% intervals), and
- Population size (25, 50, and 100).

Our "Agents":

- Zombie- Chases humans! He may not be very good at it, but he tries.
  - When he comes into contact with a human he has **x**% chance of turning him into a zombie.
- Humans move randomly about the city.
  - If they survive 3 encounters with a Zombie without being turned into a Zombie themselves, they become a new kind of human: a Hunter
    - If a human cones into contact with a Hunter 2 times, that will also transform him into a Hunter
- Hunter: Chases and kills Zombies! He is 5x "faster" than a Zombie
  - A Hunter is a human that has survived 3 encounters with a Zombie, or has encountered another Hunter twice.
  - Once a Hunter is created, he has a chance to kill various numbers of adjacent Zombies
    - If next 1 Zombie, there is an
      - 80% chance he will kill the Zombie
      - 20% chance he will be changed into a Zombie
    - If next 2 Zombies
      - 65% chance he will kill both Zombies
      - 35% chance he will be changed into a Zombie
    - If next 3 Zombies
      - 35% chance he will kill all 3 Zombies
      - 65% chance he will be changed into a Zombie
    - If next 4 Zombies
      - 10% chance he will kill all 4 Zombies
      - 90% chance he will be changed into a Zombie
    - If next to > 4 Zombies
      - 100% chance he will be changed into a Zombie
- Counter: Keeps track of the number of Zombies and Humans (including Hunters)
  - Used to keep track of how many humans (if any) survive the zombie apocalypse.

Main Activity: Students will run the model on Agentsheets to collect raw data, then record that data onto an Excel sheet, and plot graphs of the data to identify patterns.

Science and Engineering Practices: lesson outline as utilized with this model

1. Asking questions (for science) and defining problems (for engineering)
   - Asking questions and predicting what they think might happen given the above conditions
   - Have students "guess" what the scatter plots will look like (linear, exponential etc.), and their reasons for thinking so

2. Developing and using models
   - Using the created model to test their predictions

3. Planning and carrying out investigations
   - Have students work with a partner
   - Divide out differing variables to partners, collect data to share with class (so each pair doesn't have to do every simulation)
   - Fill in 10 trials for every **x**% of each population (25, 50, 100) to calculate human casualty rate

4. Analyzing and interpreting data
   - Collect all data from all groups and plot onto graph
   - Discuss the "why?" behind the type of curve the data creates
   - Discuss what a "normal" curve for this system would look like

5. Using mathematics and computational thinking
   - Discuss outliers, smooth or choppy patterns (and why are they that way)
   - Discuss differences between raw data pattern and "normal" pattern
   - Discuss statistical validity of outliers

6. Constructing explanations (for science) and designing solutions (for engineering)
   - Zombie Apocalypse Worksheet- Applied new knowledge to questions

7. Engaging in argument from evidence
   - Using data & worksheets, discuss and debate with classmates about the system we created- tell the "story" of our class created graphs

8. Obtaining, evaluating, and communicating information
   - Given model and data & worksheet, discuss/debate with classmates the impact of changing other variables in the model

Cross Cutting Themes:

- **System Model**- Using a created model of a zombie/virus outbreak
- **Stability and Change**- Introducing a "patient zero" into a stable environment, then observing and recording the change that is caused
- **Patterns**- The data collected will create a very specific growth pattern when plotted onto a graph
- **Scale Proportion and Quantity**- Different variables will have a drastic impact on the results, including percent chance of becoming a zombie with contact, and population size

Biology and Math Standards:

- Living Environment Performance Indicator 5.2: Viral/disease growth in a population
- Living Environment Performance Indicator 6.1g: Predator/Prey relationship
- Living Environment Performance Indicator 3.1: Survival of the Fittest
- CCSS.Math.Practice.MP4**:** Model with mathematics.
- CCSS.Math.Content.HSS-ID.A.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
- CCSS.Math.Content.HSS-IC.B.6 Evaluate reports based on data.

Reflection Questions

Why is this lesson important?

- It models a contagious virus/disease growth pattern in a population, which is done in a "fun" way using a zombie apocalypse theme (because everything is made more interesting when zombies are involved), but applies to simple everyday experiences such as the spread of the "common cold." It also generates a graph of this type of growth pattern that not only comes very close to defining a "normal" curve, but illustrates the statistical significance of outliers.

How will I assess student learning?

- After using the model, and filling in a few class generated graphs, the students will be given a worksheet with questions requiring them to apply what they have learned. After completing the worksheet (which will be turned in so I can look at how well each student has grasped the overall concepts), there will be class discussion/debate about the activity, why it creates the type of growth pattern it does, the validity of outliers, and how to alter the variables to change the outcomes.

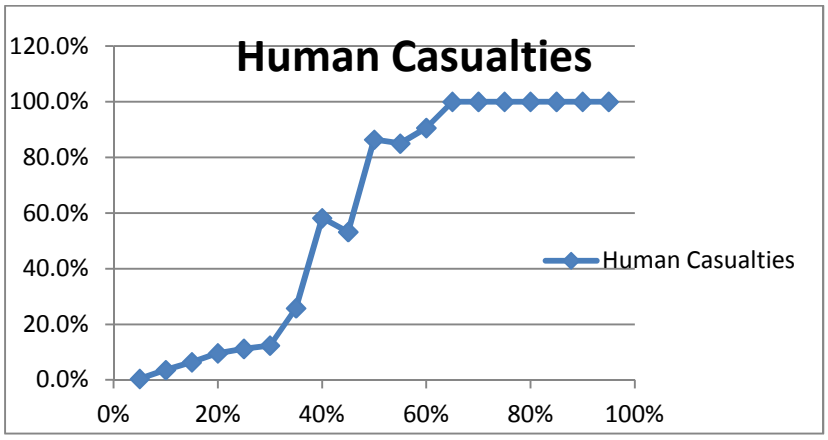
How will I use the concept of abstraction to teach science and math?

- This model will allow the students to take an abstract idea (such as viral growth/spread pattern) and observe how it "plays out" based on defined parameters, which cannot be done in a lab, or even in real life. In essense, using the model makes the "abstract" a concrete, observable, and measurable phenomena that can be analyzed.

How will my lesson help students improve math and computational thinking skills?

- This lesson gives students a fun way to "play with" variables, observe outcomes, and plot data onto a graph to analyze the pattern(s) created. The different variables will end up showing both the "normal" curve for this type of system, as well as define the statistical validity of outliers and unknowns that can always affect reality.

Name_____ **Zombie Apocalypse**



Based on what you learned during the class activity, what does this graph tell you?

Your friend looks at this graph and tells you that because it is not close enough to a "normal" curve, that it is not a valid graph. What would you say to your friend?

How could you reduce the outliers, causing it to become a more "normal" curve?

With your new understanding of this type of "normal" curve for viral spread patterns, what would you say the below graph means?