Lesson Outline for ALEX

General Lesson Information

Title: Understanding Compound Flooding Game

Overview/Annotation- *A short summary or description of the lesson including activities and science concepts.*
Students will watch a video introducing compound flooding and different ways to reduce its effects. This is followed by a risk-based game where students weigh the costs of adaptation strategies to flooding against the cost of damages to save their town.

Setting or format (outdoors, in groups, lab, etc.): In groups

Intended group size (if groups are used): 2-3

Intended grade level(s): 3

Approximate Time of Lesson (*Ideally break down into 20-50 minute periods*): 40

Researcher Biography

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Brief Description of Research Interests: Compound Flooding and Public Policy

Associated Standards and Objectives

Content Standards- *List Alabama Course of Study Standards that connect to lesson*

SC15.3.15 Evaluate a design solution (e.g., flood barriers, wind resistant roofs, lightning rods) that reduces the impact of a weather-related hazard.*

MA19.3.8 Determine and justify solutions for two-step word problems using the four operations and write an equation with a letter standing for the unknown quantity. Determine reasonableness of answers using number sense, context, mental computation, and estimation strategies including rounding.

SC15.4.17 Formulate and evaluate solutions to limit the effects of natural Earth processes on humans (e.g., designing earthquake, tornado, or hurricane-resistant buildings; improving monitoring of volcanic activity).*

MA19.8A.41 Use mathematical and statistical reasoning with bivariate categorical data in order to draw conclusions and assess risk. [Algebra I with Probability, 32]

MA19.A1.32 Use mathematical and statistical reasoning with bivariate categorical data in order to draw conclusions and assess risk.

Primary Learning Objectives- *Sentences beginning with "Students will be able to…" that describe what students will do in the lesson that relates to how students will be assessed.*

Students will be able to identify flood drivers and their impact.
Students will be able to identify solutions and evaluate their effects.
Students will be able to communicate evidence to support their claim that a designed solution reduces the impact of a weather-related hazard.

Additional Learning Objectives- *Any learning outcomes that are not directly related to the content standards but may relate to other local or national standards*

Preparation Information

Total Duration- *How many minutes will the lesson last? 40*

Materials and Resources- *List of materials teacher will need to gather or prepare for lesson*
Dice (1 set for each group or computer dice website could be use to low costs)
Cash (not required but having physical money like monopoly could be more fun)

Technology Resources Needed- *What technology will teacher and students need for the lesson?*
Method of playing video for class (ex. projector, TV)

Background and Preparation- *Description of information (science content, use of materials, etc.) teacher and/or students will need to know prior to this lesson; list steps for any preparation prior to the lesson*
Discuss what are engineers, and how they design solutions to reduce the impact of weather-related hazards. Problems flooding can cause like infrastructure and ecosystem damage. Natural Hazards can be reduced not eliminated. Some solutions are more effective than others, but the most effective is not always necessary (cost should be weighed against protection). The more information known, the better prepared we can be.

Procedures and Activities

Step-by-step description of lesson that would allow another teacher to successfully complete the lesson (suggest possible reflection or comprehension questions along with examples of correct answers or common misconceptions)

Engagement (sparking interest, introducing phenomenon, engage students' everyday experiences) Show video and discuss with students if they have ever experienced any of those types of flooding. Ask: What are the types of flooding? What are some of the solutions discussed?

Main activity (suggest possible reflection or comprehension questions along with examples of correct answers or common misconceptions)
Game: Each person in the group will pick a city name which they will be representing as the City Planner. Each group will have 3 dice, 1 die will represent the severity of rainfall, 1 storm surge, and 1 the tide. Each city begins with 100 dollars for natural hazard repairs and solutions. Each person will roll a total of three dice per round, and the numbers will be added to get the total damage. Now, at the end of each round, the damage needs to be paid for.

Each person will roll one die, and then use that number to determine if they want to buy a natural hazard solution. Natural hazard solutions can be purchased and used to pay for natural hazard damages at a discount. For example, sandbags can be purchased for 3 dollar that protect against 6 dollars of damage, a sea wall can be purchased for 5 dollars that protects against 10 dollars of damage, and a levee system can be purchased for 7 dollars protects against 14 dollars of damage. Each of these solutions is only good for 1 round because infrastructure ages and needs to be replaced. After deciding to purchase a solution or not, they roll the other two dice. As previously stated, the numbers from the three dice are added and any solution purchased is subtracted. The result is how much money the city will lose. The city cannot gain money if the solution covers more than the damage. The last city with money is the winner.

***If time allows, you can switch it up after 5 rounds and let them roll 2 dice before deciding to buy a natural hazard solution. This can reenforce the importance of having accurate forecasting and information. You could introduce it as ok, the government has upgraded the weather forecasting, and we can now predict what the tides will be as well as rainfall.

Wrap up and Reflection (wrap up activity, reflecting on learning, informal assessments of student learning) Ask: Which natural hazard solution worked the best for you? Did you need the most effective and expensive solution (levee system) or did a cheaper system work well for your city (if you purchased more than one type throughout the game)? How did you weight the possible damage with the cost of the solution?

***How did having damage information from two dice affect your ability to protect your town from danger?

Final product/Summative evaluation (e.g. quiz, presentation, essay, etc., may occur during a later class period) Essay: Write about one point during the game that you should have made a different decision (should/shouldn't have purchased a solution or should have

purchased a different solution). How could knowing the damage from all three dice ahead of time impact the success of your city (shows the importance of forecasts and having as much prior information as possible to make more informed decisions)?

Attachments- *Any materials for the lesson such as video links, worksheets, etc., listed here*