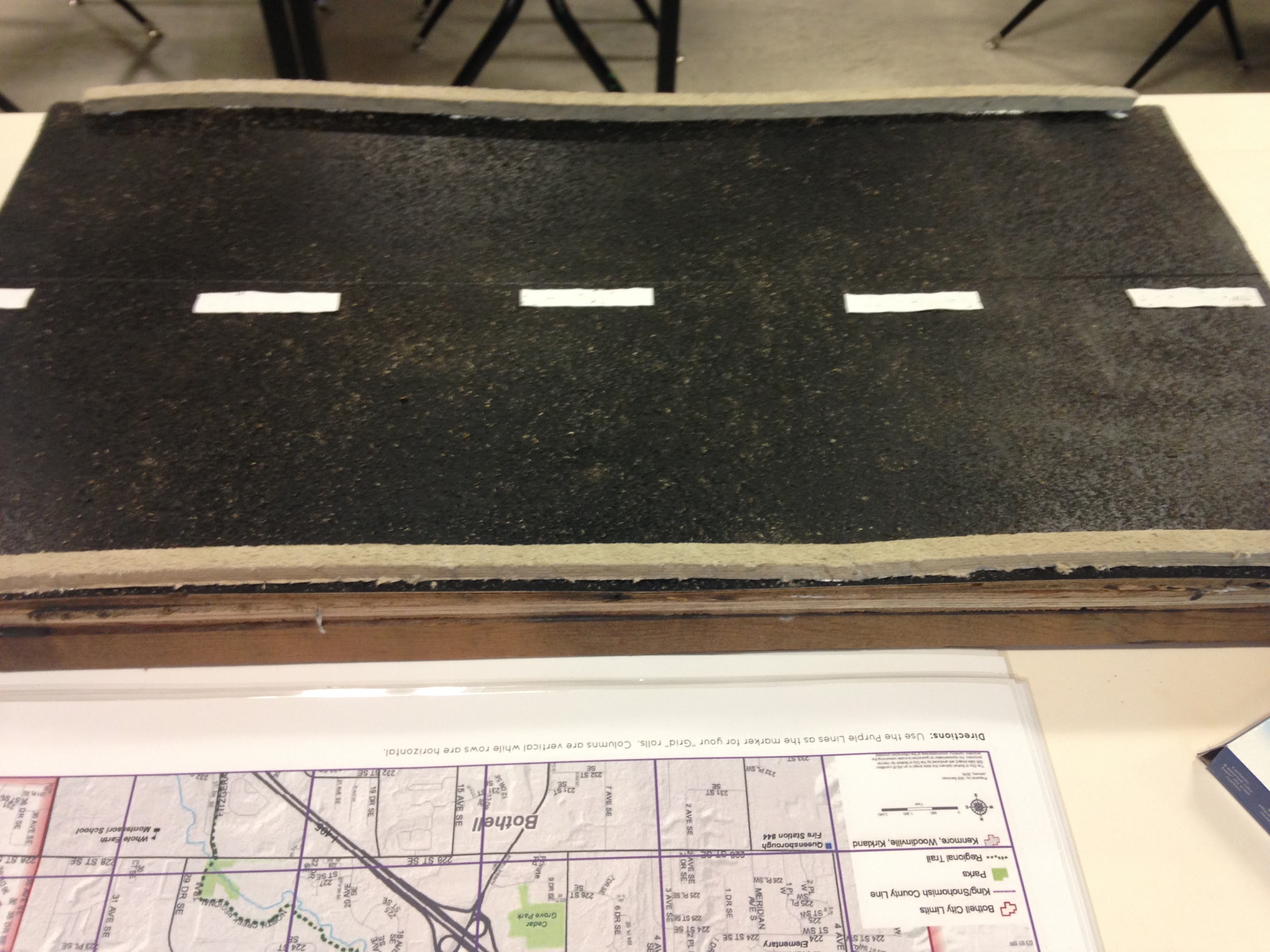
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| **Lesson 3:** Identifying problems, criteria, & constraints |



**Figure 1.** Demonstration “road” to show road flooding as a potential catastrophic weather event.

**Problem Statement:**

The city of **Bothell** needs your help! In the event of a natural disaster (e.g., earthquake, fire, flood, land/mudslides, and storms), power goes out, methods of communication and transportation are often lost or damaged, medical care is needed, and basic survival resources need to be maintained and distributed to those in the disaster area. Often, resources are low or have been damaged/contaminated. Your goal is to aid the community in the event of a disaster, with each group in charge of an area within the city affected by the disaster. Groups will identify two problems that can occur within a city grid, then develop a physical solution (build/repair) or a conceptual solution to a problem in future lessons.

**Learning Objectives: Students will…**

* **Identify** problems associated with chosen catastrophic weather event
* **Use** the problem identified to **generate** a physical solution and conceptual solution
* **Determine** criteria and constraints of the physical solution and conceptual solution selected

**Lesson Standards (NGSS, CCSS, CTE):**

* MS-ETS1-1. **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**
* **21st Century Skills**

**Materials:**

* Predetermined and built physical solution for demonstration purposes. (Provided in this plan is the physical solution of a flawed roadway - low spot, poor drainage - to illustrate a problem that could be encountered with flooding)
  + Demo roadway materials:
* a piece of flexible (⅛”) plywood or piece of rigid cardboard approximately 30 cm by 60 cm.
* Support rails under each long side of the cardboard, to which the cardboard will be fastened - the profile of the rails should be shaped (cut) to go from a high point at one end of the rail to a low point in the middle and then back to a high point at the other end. (For our lesson the rails were 60cm long pieces of 1” x 2” with triangular wood shims glued on, so the fat part of the shim was near one end of the rail, and the thin part of the shim was toward the center of the rail.
* Our roadway was spray painted black and sanded to simulate the look of a road.
* A curb on each edge of the rodway way created using modeling clay, rolled out to a cylinder, then pressed onto the board.
* Striping down the center of the road was cut, white name label stickers
* A bowl or plastic bin to hold Water for flood simulation
* Approximately 1 liter of water
* Water containment (large baking pan) or method to clean up water in event of a “Run away” flood
* Google slides presentation for Lesson 3.
* Poster paper for class discussion

**Lesson Preparation:**

* **Physical solution (see Materials)**
* **Demonstration area - Desk or countertop that is visible to students during the demonstration**
* **Group worksheet - identify the problem / criteria and constraints worksheet or Butcher paper for class or small group.**

**Time Required:**

**25-35 Minutes**

**Grouping of students for instruction:**

Students will be in their “anchor groups”, which is their assigned seating. These groups are based on prior performance in order to scaffold each group to have a strong leader, strong academic performer, and a social individual.

(TEACHER SPECIFIC) Brainstorm What Students Know/Need to Know from prior lessons

* As a result of catastrophic weather events, many useful structures to humans can be damaged (e.g., roadways, powerlines, houses, etc.).
* Roadways are the major transport option for vehicles, bikes, and pedestrians. Students should be able to identify where roads are on a map and some of the basic features of roads.

LESSON PROCEDURE:

* After Lesson 2, review some of the common problems that could occur as a result of various catastrophic weather events.
* Demonstration for Physical Solution:
  + Discuss with students some of the things a road needs to be able to do (group brainstorm).
  + Bring out the demonstration road and set up as students discuss.
  + Show the demo to students, which is looking at when a road experiences heavy rainfall and flooding. This can be completed by using a pre-filled bucket of water or a watering can to put water on the roadway.
  + Have students come up in small groups to observe the roadway as you pour water on the surface so they can observe what is happening to the water and the roadway.
* Demonstration discussion for Physical Solution:
  + After students observe the demonstration road, discuss what the criteria and constraints building a road. These can be recorded on a poster board or document for the class to brainstorm during discussion.
    - Criteria examples: Safe - cars can drive on the road, drains water - water is able to leave the roadway somehow…
    - Constraints: Budget - only so much money to build, Materials - only have certain items or materials that are usable or available.
* Discussion for conceptual solution:
  + Example provided is for an “evacuation plan” in the Google slides Lesson 3 presentation.
* Once students have had opportunity to discuss potential criteria and constraints for two example problems, students will then form groups to identify the criteria and constraints for their chosen problem. Groups should be formed based on the problem the students want to create a solution for.

**Accommodations:**

All presented materials will be given in an easily readable font. All presentation materials will be font 24 or higher. Students with vision issues will be seated near to the board or have printed materials. All materials have sentence starters/instructions.

**Extensions:**

If students can successfully identify criteria and constraints for their problem, then students should be able to begin gathering information about their problem or existing solutions to the problem.