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| Lesson 6: Build & Test |

Problem Statement:

The city of Bothell needs 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…

* Build & Test - Students will build their first attempt at a physical solution or analyze their conceptual solution using a PUGH chart.
* Testing a plan - Students will test their plans in a real time disaster scenario. There will be 3 trials where the physical solution will be tested.
* For conceptual plan groups, teacher will review how to use a PUGH chart and students will design their own PUGH chart, using their problems criteria and constraints.
* Students with a conceptual solution will develop a presentation to discuss their solution.
* By the second class period (2 class periods for this lesson) conceptual groups will present their solutions.

Lesson Standards (NGSS, CCSS, CTE):

* MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
* MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions already in place, to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
* MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Materials:

* Google Powerpoint - Disaster Strikes Lesson 6
* Physical Models:
  + Materials needed to build physical models of proposed student solutions..
* Example Road/Bridge Model Materials: popsicle sticks, toothpicks, index cards, wooden dowels, clay, cotton balls, soil, straws, spoons, yarn, rocks, sand, legos, rubber band, sponges, small wooden planks, cardstock, small plastic cups
* Student Worksheet to record and document plan.
* Conceptual Models:
  + Access to internet and computer devices to develop powerpoint presentations. Students could also develop a mini model display of their conceptual idea with advertisement using construction paper, cardstock, fabric.
  + Student Worksheet to record and document plan.
  + Copies of class evaluation tool “Disasters Strikes” - Conceptual Plan Evaluation for all class members.
  + PUGH Chart examples for student practice. Blank PUGH chart for students to construct their own PUGH chart based on their proposed solution.
  + Area for conceptual solution presentations with access to internet, document camera.

Lesson Preparation:

* Student Worksheet to record and document plan.
* Materials listed above for physical models - preparing access to these materials for student evaluation/collection before building model.
* Copies of class evaluation tool “Disasters Strikes” - Conceptual Plan Evaluation for all class members.
* Copies of PUGH chart examples and implementation of PUGH chart for each member of conceptual solution groups.
* Copies of class evaluation tool “Disasters Strikes” - Conceptual Plan Evaluation for all class members.
* Presentation area for whole class to view presentation of conceptual groups.

Time Required:

80 Minutes ( 2 class periods)

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. Each group should have 3-4 students.

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

* Review testing procedure and guidelines with students, use google powerpoint #4 which shows an example of testing physical models with the 25 mL water test.
* Conceptual solutions will be using the Disaster strikes - Conceptual Plan Evaluation form.
* Guide students with examples of how to evaluate criteria and constraints.
* Prepare students with access to document camera/projectors to present their conceptual plans to the class.

LESSON PROCEDURE:

* PHYSICAL SOLUTION GROUPS:
* Teacher will lead introduction to “Testing a Plan” with Google powerpoint Lesson 6 which shows examples of how to evaluate and record the 25 mL water test on physical models and examples of displaying information for conceptual solutions.
* Teacher will model safety guidelines in pouring water on models, collection of water, and clean-up.
* Physical model groups will conduct their tests and record data on the data table in their PBL Disaster Strikes Step 4: Build and Test
* CONCEPTUAL SOLUTION GROUPS:
* For conceptual plan groups, teacher will review how to use a PUGH chart as an evaluation tool of the effectiveness of a proposed solution. Students will practice with a guided worksheet with several examples of PUGH chart analysis. Then students will design their own PUGH chart, using their problem’s criteria and constraints.
* In addition, conceptual groups are finalizing their presentation to share their solution with the class.
* Teacher will support conceptual solutions with access to presentation materials, internet, powerpoints, prezis, moviemaker, for group presentation to the class.

DAY 2 - Second Day of Lesson 6: Build and TEST - For all students

* Students of conceptual plans will then present their solutions to the class.
* All students (conceptual and physical solution groups) in the class will evaluate the conceptual solutions by filling out the Disaster Strikes - Conceptual Plan Evaluation forms.
* Students will turn in the Disaster Strikes - Conceptual Plan Evaluation forms after all presentations are given for the conceptual solutions.
* Conceptual Solution students will evaluate the Conceptual Plan Evaluation forms and determine percentages according the the rankings on the evaluation of their forms. Percentages will be calculated to determine if 75% of the classmates total ranking score results in a passing of the proposed solution.
* Once ranking percentages of conceptual solutions and all tests on physical solutions are complete, students determine if their solutions need to be redesigned and re-tested.

Accommodations:

* Accommodations can be made with PUGH charts in supporting students with other examples of PUGH charts to provide personal meaning to the analysis process. For example, one of the PUGH chart practice steps is to evaluate the best place to study. If a student is still processing how to use and analysis the PUGH chart, maybe narrow down the problem to - where is the best student place at the student’s house, “Where would be the best place for me to study at home?”
* Accommodations for conceptual solution teams would be for the teacher to know the group members and facilitate the presentation process for all students to have a speaking role, if needed. Checking on with each group on how they are presenting and ensuring that each team member is presenting and all the “talking” is not centered on one member.