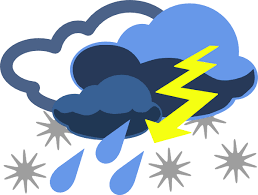
**Purpose:** To **design** *solutions* to *problems* created as a result of a *catastrophic event*.

**Investigative Question:** *How does a catastrophic weather event affect the city of Bothell?*



**Instructions:**  You willuse the **Engineering Design Process** to complete a challenge. You will receive a stamp for each step you complete. You will only receive a stamp once each step is completed fully and accurately by EVERYONE in your group. When you complete a step, your entire design team presents their work to receive a stamp before proceeding to the next step.



**Step 1: Identify the Problem**

In this step of the **Engineering Design Process**, you will identify the problem, including any *criteria* (requirements) and *constraints* (limitations).

|  |  |
| --- | --- |
| **Problem:** Is this problem physical or conceptual? (Circle One):  **Physical / Conceptual**  **Describe: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | |
|
| **Criteria (Requirements):** Identify at least three| |
| **Constraints (Limitations):** Identify at least three| |

**Step 2: Gather Information**

In this step of the **Engineering Design Process**, you will gather information and consider ideas.

|  |
| --- |
| **Figure 1.** Functional Diagram of Solution (Physical) or Brainstorm for Conceptual Solution |
| Create a *functional diagram* of your physical *solution*. A functional diagram does not have to show high detail and objects can be drawn as boxes. The functional diagram focuses on what each component in your solution should do. A conceptual solution may only have a list of resources needed to address the problem. |

***------------- MAKE SURE STEPS 1-3 ARE STAMPED BEFORE CONTINUING -------------***



**Step 3: Develop a Plan**

In this step of the **Engineering Design Process**, you will create a detailed, labeled design sketch and your group will determine how to use the budget.

|  |  |  |
| --- | --- | --- |
| **Materials:**  Your group will have $25 to purchase materials at the store for physical solutions. Each provided item is $2 unless otherwise listed. Home items are $2/each for small (fits in hand), $3/each for medium (slightly bigger than one hand), and $4/each for large (2 hands or larger). | | |
| *Biodegradable Materials*  Popsicle Stick - $1  Toothpick (x5)  Index Card (x2)  Wooden Dowel  Baking Soda (10 mL)  Clay (5 cm piece)  Cereal (10 mL)  Cotton Ball (x5)  Soil (15 mL) | *Nonbiodegradable Materials*  Straw - $1  Spoon  Yarn (10 cm)  Rock (10 mL)  Sand (10 mL)  Legos (x10)  Dominoes (x10)  Rubber Band  Sponge (2 cm x 2 cm) | *Other (From Home)*  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

1. Create a diagram of your system. Be sure to label the materials within your solution.

|  |
| --- |
| **Figure 2.** Diagram of Solution (Initial Design) |
| For a physical solution, this diagram should be a detailed figure and system analysis of your solution. For a conceptual solution, this is a detailed, step-by-step diagram of your solution, including any materials you may include in your conceptual solution. |

1. Determine the quantity and cost of all materials you will need to build your physical solution ($25 budget) or the proposed budget for your conceptual solution (no limit).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item Description** | **Cost per Item** | **Quantity** | **Total Cost** | **Balance** |
| Starting Budget: | | | |  |
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|  |  |  |  |  |
| Budget Remaining: | | | |  |
| **\*\*Reminder:** Did you come in below budget? During the redesign process, you may need to purchase additional materials. | | | | |

***------------- MAKE SURE STEPS 1-4 ARE STAMPED BEFORE CONTINUING -------------***



**Step 4: Build and Test, Evaluating Effectiveness**

In this step of the **Engineering Design Process**, you will build and test your solution, and/or evaluate its effectiveness.

1. **\*\*PHYSICAL SOLUTION ONLY\*\*:**  Build your physical solution. Collect data while you test your design. What *quantitative* measure are you using to test your physical solution?

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| --- | --- | --- |
| **Quantitative Measure of Stress: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | |
| **Trial 1** | **Trial 2** | **Trial 3** |
|  |  |  |
| Survived? **YES / NO** | Survived? **YES / NO** | Survived? **YES / NO** |

1. **\*\*PHYSICAL SOLUTION ONLY\*\*:   
   Evaluate the effectiveness of your physical solution:** Use the “Effectiveness of Physical Solution” guide to evaluate how well your solution performed according to the criteria you set in Step 2. ***Make sure to tape the evaluation onto this page in the space below.***
2. **\*\*CONCEPTUAL SOLUTION ONLY\*\*:   
   Evaluate the effectiveness of your conceptual solution:** Use the “Effectiveness of Conceptual Solution” Pugh chart to evaluate how well your solution would perform according to the criteria you set in Step 2. ***Make sure to tape the evaluation onto this page in the space below.*** You will also be creating a presentation to discuss your conceptual solution. See the “Presentation Guidelines for Conceptual Solutions” to guide your presentation.

**PHYSICAL SOLUTIONS ONLY:**

**Step 5: Redesign**

In this step of the **Engineering Design Process**, you will redesign your solution to increase reliability (more successful trials), durability,

1. Create a labeled diagram of your redesigned system. Redraw the parts of your system that you are changing below. Give reasons for the modifications you made.

|  |  |
| --- | --- |
| **Figure 3.** Diagram of System (Redesign) | |
| Modification 1 (Draw): | Reasoning: |
| Modification 2 (Draw): | Reasoning: |

1. Determine the quantity and cost of all materials you will need for your redesign.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item Description** | **Cost per Item** | **Quantity** | **Total Cost** | **Balance** |
| Remaining Budget after First Model: | | | |  |
|  |  |  |  |  |
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|  |  |  |  |  |
|  |  |  |  |  |
| Budget Remaining: | | | |  |



**PHYSICAL SOLUTION ONLY**

**Step 6: Build and Test Again**

In this step of the **Engineering Design Process**, you will build and test your redesigned solution, and evaluate its effectiveness.

1. Build your physical solution. Collect data while you test your design. What *quantitative* measure are you using to test your physical solution?

|  |  |  |
| --- | --- | --- |
| **Quantitative Measure of Stress: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | |
| **Trial 1** | **Trial 2** | **Trial 3** |
|  |  |  |
| Survived? **YES / NO** | Survived? **YES / NO** | Survived? **YES / NO** |

1. **Evaluate the effectiveness of your physical solution:** Use the “Effectiveness of Physical Solution” guide to evaluate how well your solution performed according to the criteria you set in Step 2. ***Make sure to tape the evaluation onto the back of this page.***