**Team Member Names: Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_**

**Protecting Our City with Levees**

***Design Worksheet***

**Instructions**

Follow the design process in this worksheet to design, build and test your model levee.

**STEP 1: Define the problem.** In this step, you determine what the problem is that you need to solve, and what your design constraints are. These are often given to you.

* **Problem:** Build a new levee system that will maintain the boundary between the lake/river and the city.
* **Constraints:**
	+ **Size:** The real levee must be higher than sea level and wide enough to prevent the surrounding lake or harbor from flooding. Your prototype must be at least as high as the tub, and wide enough to prevent the water on one side of a plastic container from flooding into the other side of the container.
	+ **Budget & Materials:** Each group receives a plastic container in which to build the prototype levee. Each team receives $10 to purchase levee supplies. You may only buy from the following list of approved materials:

|  |  |
| --- | --- |
| **Material**  | **Cost**  |
| 1 cup of sand or gravel  | $1  |
| 5 cotton balls  | $1  |
| 3 straws | $1  |
| 2 popsicle sticks  | $1  |
| 1 foot duct tape  | $2  |
| 1 piece of cardboard | $2  |
| 1 plastic bag  | $2  |
| 1 sponge  | $2  |

 **STEP 2: Gather information:** In this step, you perform experiments that help inform your design.

Take two of the approved materials and test how well they slow down water. To do this, put a small hole in a plastic cup, and put your test material at the bottom of the cup. Measure a specific amount of water in another cup. Then pour the water into the cup with a hole and observe how well the material absorbs the water. Describe what you see.

* Material 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Observations:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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* Material 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Observations:

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**STEP 3: Brainstorm ideas**. When engineers brainstorm ideas, they are open to as many creative ideas as possible. No idea or suggestion is “silly”; in fact, the wilder the idea, the better!

* Discuss ideas for how to build your levee. In the space below, write down and/or sketch every idea suggested.

**STEP 4: Select the most promising concept.** Read through your ideas again, and choose the concept that you think will work best.

* Describe and/or sketch your idea in the space below.

* Use the following table to determine how you will spend your budget on materials.

|  |  |  |  |
| --- | --- | --- | --- |
| **Material**  | **Cost**  | **Amount You Want**  | **Cost**  |
| 1 cup of sand or gravel  | $1  |   |   |
| 5 cotton balls  | $1  |   |   |
| 3 straws | $1  |   |   |
| 2 popsicle sticks  | $1  |   |   |
| 1 foot duct tape  | $2  |   |   |
| 1 sheet of cardboard | $2  |   |   |
| 1 plastic bag  | $2  |   |   |
| 1 sponge  | $2  |   |   |
| **TOTAL**  |   |   |   |

 **STEP 5: Build and test.** Purchase materials and build your levee prototype. Then, with the teacher’s help, test your levee by pouring water into one side of your container.

 **STEP 6: Evaluate your design.** After engineers test their prototypes, they think about how well it worked. This helps them make changes to improve the final, real version.

* Describe what happened when you tested your levee.

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* What did you like best about your levee system design?

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* What changes would you make to your levee system if you were to build it again?

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