STEM Design Challenge developed for : 5th Grade Math Class

STEM Design Challenge Project Title: Don't Lose Your Marbles

Created/Adapted by: Diane Everson

STEM Design Challenge Project Placement and Pacing

Placement: After review of finding measuring in centimeters, identifying 90˚ angles

Pacing: One week – (5 days) 60-minute time periods

Overview: Student teams build a prototype of a water slide. The water slide that is the highest, has the most 90˚ angles, and is the safest will secure the contract to build the new water slide.

Objectives:

Math –

1. Measuring in centimeters
2. Constructing 90˚ angles
3. Multiplying and Adding
4. Extension Option: Multiplication of Decimals

Science –

- Determine most effective water slide design
- Analyze design based on height and steepness, 90˚ angles with safety in mind
- Evaluate height and angle adjustments trade-off with regard to performance
- Modify water slide and/or building materials
- Evaluate water slide overall performance

STEM Design Challenge Problem:

The Wild River Water Parks is a company which builds and operates large water parks near U.S. rivers. These parks are popular for their elaborate but safe, water slides.

Wild River Water Parks will be building a new park and has chosen your city. It needs a new water slide to attract people from miles around.

Student teams will design, build and name this water slide. The Design Team with the winning prototype will have the opportunity to secure the contract to build the water slide and the water park will be named after the new slide.

*Students create a freestanding structure will have a track on which a marble can travel down and land in a paper cup.

Materials List Per Two-Man Team:

- 6 drinking straws
- 10 Q-tips
- 6 index cards
- ¼ stick modeling clay
- 12" masking tape
- 1 small paper cup
- Scissors
- Meter stick
- Marble

Preparation:

1. Browse the internet, collecting images of water parks and water slides. Bookmark them into Favorites, to be able to access them with the class. Look specifically for variety of angles, sizes, and heights in the designs.
2. For each pair of students, copy one of each:
    - Wild River Water Parks, Inc. memo
    - Water Slides Procedure and Conclusion handout
3. Set up materials area. Students will gather building supplies from this area.

Procedure:

1. Create partner teams.
2. Distribute Wild River Water Parks, Inc. memo to teams. Using document camera or overhead projector, read memo to class.
3. Using document camera or overhead projector, show the data table (included in Water Slides Procedure and Conclusion handout) and discuss how the team earning the most points will be awarded the winning contract, and the privilege of naming the water park.
4. Review the scoring criteria with the students:
    - You will be awarded points for the height of the structure at the point where the marble begins its ascent down the track.
    - Points will be awarded for each right angle turn in the track.
    - You will be allowed 5 marble rolls. You will start each marble at the top of the track and let it go.
    - You will receive points for each marble that successfully travels all the way down the track.
    - Additional points will be awarded for marbles caught in a container at the end of the track.
    - You will receive points for meeting the following criteria:
        - 1 point – for each centimeter of height
        - 5 points for each 90° angle turn in the track
        - 1 point – for each marble that successfully travels the entire length of the

track, but does not land or stay in a container at the end of the track
- 5 points – for each marble that travels the track and stays in a container at the end of the track

5. Browse the internet as a class using a document camera and show images of water slides. Discuss with the class the design details (angles, height, slope of slide, width of slide). Discuss the factors in designing a water slide that may pose safety issues.
6. Distribute Water Slide Procedure and Conclusion handout. Together, partner teams select a name for their water slide, and complete the Problem and Prediction section. Successful completion of this is their "ticket" to move to the design phase of the unit.
7. Partner teams gather their building materials and discuss possible ways to begin their prototype. Encourage students to draw it on paper before beginning the building process to agree on a basic design, including the number of 90˚ angles they will include.
8. Partner teams begin the design process, testing and revising throughout the process. Students test their waterslide by rolling their marble down the slide into the cup at the bottom. Students may not hold the slide steady; it must be free-standing.
9. Allot a time block to allow partner teams to complete the Procedure section of the Water Slide Procedure and Conclusion handout.
10. Prior to test slides, student enter the following data into their data tables:
    a. Students measure the height of their slide in centimeters and record the height.
    b. Students count the number of 90˚ angles in their slide. Record the total.
11. Students will now test their slides. Each partner team will get 1 practice slide, and then will complete 5 slides (marble rolls). After each slide, students record their points into their data table. All other students at this time are watching, waiting for their turn. *Use a digital camera to take pictures of the process.
12. Finally, students finish the Conclusion and Data Table sections of Water Slides Procedure and Conclusion handout. The handout is submitted to the teacher for review. After all handouts are turned in, and accuracy is checked in the teams' data tables, a winning team is awarded the contract to build the water slide and name the new water park.

Resources:

- Internet

Evidence:

- Water Slide Procedure and Conclusion

Extension Options:

After completing trial runs, teams complete the income projections of their new water slide. Copy a Profit Projection for each team of students. Students will…

- Determine the price of a water slide ticket. How much will it cost the customer for one ride on the new water slide? Price must be competitive with current market, but allow for the uniqueness of this new, one-of-a-kind slide.
- Complete a profit report for Wild River Water Parks Board of Directors. How much profit will the company generate per week after figuring maintenance/operating costs?

WILD RIVER WATER PARKS, INC.

MEMO

To: Finley Elementary 5th Grade Design Teams

From: Wild River Water Parks, Inc.

Date: _____

Subject: Water Slide Design Competition

Wild River Water Parks is a company which builds and operates large water parks near major U.S. rivers. Our parks are exciting, but safe and family-friendly. Because your community borders the great Columbia River, we have chosen the Tri Cities to build our next big project!

We envision a park that becomes a vacation destination for families throughout the United States. This water park will have several attractions suitable for all age groups. We plan to duplicate the rides from our other successful water parks, but would like to add one major attraction.

A large water slide, after which the water park will be named, will rank the largest water coaster in the whole world! Currently, the water coaster that holds this distinction is *The Master*, located in the Sandcastle Water Park in the UK. Our goal is to build a bigger and better one.

Your challenge, Design Teams, is to create a water slide that is higher, and has more angles than *The Master*. You will work in teams to design, build and name a prototype. At the end of this competition, the Design Team with the winning prototype will secure the contract to build the water slide.

Good Luck!

Wild River Water Parks, Inc.

Water Slides

PROBLEM:

_____

_____

_____

PREDICTION: (What will help the marbles gain speed as they descend? What might slow the marbles down? How many 90° angles to you think will win the competition? What will help stabilize the structure? How will you eliminate friction? What might cause the marbles to "jump" the track?)

_____

_____

_____

_____

_____

PROCEDURE: (What steps did you take to build your water slide? What was your first step? Did you change the design as you went along? How? Why?)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

DATA:

	Tallies		**Totals**
Slide Height (cm) – 1pt. for each cm.	**cm.**	**X 1**	
90° angles – 5 pts. for each right angle in the track		**X 5**	
Successful run, but marble does not stay in container – 1 pt.		**X 1**	
Successful run and marble stays in container – 5 pts.		**X 5**	
		TOTAL:	

CONCLUSION: (Which design provided the fastest and most controlled marble roll? How did you redesign your slide to make it faster? More controlled? As you built higher, what did you find was your biggest challenge? If you could have added materials to the design, what would you have added?)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

WATER SLIDE PROFIT PROJECTION

Water Slide: _____

Name _____ Name _____

Information:

- The new water slide will operate from 9:00 a.m. to 7:00 p.m. daily.
- Maintenance and operating costs will take 50% of total sales revenue.

Complete the Profit Projection below.

- Research and discuss:
  - How much will a ticket to the world's largest water slide would cost?
  - How many people per day could ride the new water slide?
  - Estimate daily profit after deducting maintenance and operating costs. (Show your work).

Cost per ticket	Estimated Tickets Sold Per Day	Estimated Daily Sales	Estimated Profit Per Day
$		$	