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| **Standard(s) addressed:** | | |
| |  |  | | --- | --- | | **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.** | | **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 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.** | | | |
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| **Targets:** (What will students know and be able to do as a result of this lesson?) | | |
| * **Experiment using the scientific method** * **Discuss and use buoyancy and surface tension terminology** * **Participate in the engineering design cycle** | | |

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| **Assessment:** (How will you and your students know if they have successfully met the target?) |
| **Students will be assessed throughout the creation and testing of their raft. The teacher will use observation and direct conversation to individually assess the abilities and understanding levels of each student. Students will complete a worksheet. An exit note may be provided by the teacher about buoyancy and density.** |

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| **Instructional Activities:** (In what learning experiences will students engage? Consider higher order thinking, multiple intelligences, multimodal, and/or multimedia input.) |
| **Activity Time: 90 minutes**  **Setup: Set up station(s) with bin(s) of water to test various objects**  **Sink or Float?**  **Have each participant record the object(s) to be tested on their activity sheet.**  **Also, have them hypothesize (predict) whether each object will sink or float.**  **Allow the participants to test their objects and record the results.**  **Discuss why they think that some objects floated, while others sank.**  **Also, introduce the appropriate terminology:**  **Density-a measure of the “heaviness” of an object for a given volume. For example, a small dish of popcorn is less dense (“heavy”) than the same dish filled with raisins.**  **Buoyancy-the tendency of an object to float or rise when placed in a liquid. The liquid exerts an upward force on the object. If the object’s density is low enough, it will float.**  **Continue with a demonstration and discussion of surface tension. Demonstrate that a paper clip will sink if just dropped into the water. However, it can be made to float if it is placed very carefully onto the surface of the water.**  **Why does this happen?**  **Surface Tension-the molecules of a liquid are pulled together at the surface of the liquid, thus allowing the liquid to resist external forces.**  **Ask participants about other things that may “float” due to surface tension? (e.g. canoes, kayaks, fishing boats, water striders, etc.)**  **Introduce the Raft Competition**  **Task participants with an engineering task: design, construct, and test a raft that will hold the most number of pennies. It is up to the session leader to determine whether participants can use as much foil and straws as they would like, or if there are restrictions. The task is more realistic if all participants are restricted to the same number of straws and the same amount of foil. After all, in engineering design and construction there are typically cost and resource limits to building things. To encourage participants to model the engineering design process and use the**  **scientific method, have them complete their design and hypothesis prior to beginning construction on the raft.**  **Suggestion: Release materials to participants only after review by the session leader of the design and hypothesis.**  **Upon completion of the construction and testing, discuss the results.**  **What raft shapes were used? Which worked better? How does surface tension factor into the results? (e.g. spreading the weight of the pennies across the surface of the water through use of the foil)**  **What different folding methods were used to connect the straws to the foil?**  **What kind of boat(s) use structures similar to the straws in our rafts? (e.g. pontoon boats, catamarans)**  **What was the most number of pennies that a raft held?** |

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| **Resources/Materials Required:** |
| **-Water**  **-Bins/tubs (to hold water**  **-Objects to test (ping pong ball, penny, cork, ice cube, paper clip, packing peanut, raisin, apple. Lead weight, etc.)**  **-Straws**  **-Foil**  **-Towels (for cleanup and to dry objects)**  **-Pennies (lots)**  **-Activity Sheet** |

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| **Student Engagement:** How will you get and hold student attention? |
| **Lesson Hook: Teacher will show a quick video of various objects being placed in water-some will sink and some will float. The teacher may also complete a demonstration about density using household supplies. The video and demonstration will spark discussion.**  **Students will be engaged through the engineering process as they work to build a raft by hand. Students will also be engaged through the use of the 1:1 computers in the classroom and will work collaboratively with their peers.** |

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| **Differentiation:**  (How will you adjust the lesson to appropriately challenge ALL students?) |
| **Students will be grouped prior to the lesson by the teacher based on ability level and behavior issues.**  **Differentiation will occur through the natural engineering design process that incorporate a variety of learning styles. Two versions (levels) of the worksheet will be provided.** |

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| **IEP/504 Modifications/Accommodations:** (What curriculum modifications and/or classroom accommodations will you make for Students with Disabilities in your class? Be as specific as possible.) |
| **-Hear instructions orally and be given a written list of instructions**  **-Give responses in an oral/written form**  **-Work in a different setting (fewer distractions)**  **-Take more time to complete the task/frequent breaks**  **-Use an alarm to help with time management**  **-Answer fewer/different questions**  **-Individual redirection** |

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| **Suggestions for Consideration and Reflection:** |
| What went well?  What did you learn?  What adjustments will you make moving forward?  What did your assessment results indicate?  Was this lesson rigorous enough to engage all students? Explain.  Were the modifications/accommodations sufficient to facilitate meaningful participation for challenged students?  Would you be willing to share this lesson with colleagues? If no, why not? |
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