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| **Chemistry of Coatings**  **A scientific inquiry lesson: Engineering** |

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Lab Partner: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| **Objective** |
| The goal of this inquiry lab is to use your knowledge of the scientific method and engineering design matrix and come up with an process to determine the optimum ratio of epoxy to hardener to create the strongest resin bridge in the most cost effective way. Make sure you view the [rubric](https://docs.google.com/document/d/1jZzeuwSjmU7KmdUTUXq9FDieknSCVf_yy9dzBcPebe8/edit?usp=sharing) for how you will be graded in terms of the use of the engineering design matrix. When the rubric splits, you will follow all grading that is in black. |

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| **Discover-Homework** |
| Think about it: “How are great discoveries made?” [Watch this video](https://sites.google.com/site/mrsdiazstudentresources/1-21-gigawatts)! Notice the process Doc Brown goes through to address the problem of how to send Marty back in time. Cite two pieces of evidence that Doc Brown and Marty used to figure out how to send him back to the future. |
| **Answer:** |

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| **Learn-Homework** |
| All scientists need to know about the Scientific Method and the importance of the steps for any experimental design. Engineers follow a similar process using the engineering design matrix. Compare and contrast the steps of the scientific method and engineering design process by clicking on the links below. Make sure to make AT LEAST two comparisons and two differences between the two.  [Overview of the Scientific Method](http://www.sciencebuddies.org/science-fair-projects/project_scientific_method.shtml#overviewofthescientificmethod) and [Overview of the Engineering Design Process](https://www.sciencebuddies.org/engineering-design-process/engineering-design-process-steps.shtml). |
| **Notes:** |

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| **Pre-Lab Questions**  To help answer these questions, see the attached links provided. |
| 1. Define a [polymer](https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/polymers.htm).   Link: [All about epoxy resins](https://www.thoughtco.com/what-is-epoxy-resin-820372)   1. How is an epoxy resin an example of a polymer? 2. List three industries/products where epoxy resins are used. 3. What is the most common epoxy: hardener ratio commonly used in epoxy resin systems?   [Scientific Method and Engineering Design](https://www.sciencebuddies.org/engineering-design-process/engineering-design-compare-scientific-method.shtml)   1. Identify whether the following prompts should use the scientific method or engineering design matrix:    1. Why are some tomato plants and tomatoes larger than others?    2. I need a better support frame for my tomato plants.    3. How can I capture the sun’s energy to heat water?    4. Is it possible to turn soil into energy with a microbial fuel cell?    5. How does changing the level of oxygen affect the exothermic oxidation of iron powder? |

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| **Purpose**  In one sentence state the purpose of this design challenge. |
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| **Procedure/Design**  Using the following criteria you must design a beam that will pass the test along with being the most cost effective. |
| Important Criteria:   1. You must not use more than 10 mL total of part A and part B 2. Part A costs $0.10/1mL and Part B costs $1.00/1mL. 3. In order to have a successful structure it must not fall/bend beyond 15% of the original height. If it goes past this point it will fail! |

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| **Data/Prototype**  Come up with your own data table to record all relevant measurements and information. |
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| **Conclusion**  State whether the beam you designed passed or failed. Make sure to cite specific examples and supply potential sources of error. |
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| **Post-Lab Questions/Conclusion** |
| 1. Why do you think the design of the beam created passed or failed? 2. What is the ideal ratio between epoxy and hardener after conducting this experiment? 3. How would knowing what the scientific method design group tested be helpful in your experimental design? (Use the class discussion to guide this answer) 4. Extension: What would you do next time you would design this beam? Be specific! |

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| **Extension: Redesign**  If given time and materials refine the experimental procedure using what you know now about the scientific method and engineering design to get the most cost effective beam with a close to ideal ratio! |
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