

8E – PROJECT: DESIGN AN AIRBAG

Research

Research the design and function of airbags. Watch videos of airbags as they are deployed to better understand how they work. Investigate why current airbag designs are considered dangerous for children.

Keep a record of your results below. Attach a separate paper if necessary.

Procedure

4. Write a balanced equation representing the reaction of sodium bicarbonate with acetic acid. Review the Performance Criteria section for information about the reaction.
5. Use the balanced equation to determine the mass of NaHCO_3 needed to react with 5.00 mL of vinegar. Assume the density of vinegar is 1.00 g/mL. Show your calculations to your teacher for approval.

Analysis

1. In the space below, describe your observations during the reaction and then fill out the table:

Observation	Data (include units)
What was the change in pressure for the first 2 seconds of airbag inflation?	()
How long did it take for the pressure to level off?	()
What was the total change in pressure for the duration of this run?	()
What was the change in temperature for the first 2 seconds of airbag inflation?	()
How long did it take for the temperature to level off?	()
What was the total change in temperature for the duration of this run?	()

Initial Design

Record your response to the following in the space below; attach another paper if necessary:

1. Based on your initial observations, adjust the amounts of sodium bicarbonate and vinegar so that the bag inflates to capacity **WITHOUT** popping or bursting. All changes in measurements must be justified with a calculation and approved by your teacher. Will you change the ratio of baking soda to vinegar? Why or why not?

2. Upon approval of your reactant amounts, test your airbag as before. Describe your observations as before, then fill out the table.

Observation	Data (include units)
What was the change in pressure for the first 2 seconds of airbag inflation?	()
How long did it take for the pressure to level off?	()
What was the total change in pressure for the duration of this run?	()
What was the change in temperature for the first 2 seconds of airbag inflation?	()
How long did it take for the temperature to level off?	()
What was the total change in temperature for the duration of this run?	()

Re-Design

Continue exploring different amounts of reactants to experimentally determine the maximum pressure of the bag before it pops/bursts. Also determine the minimum pressure of the bag for proper inflation. Decide as a group how to best organize data and observations for this phase of the design challenge. Attach your results to your answer sheet.

Summary

Present your findings to your class in an objective and scientific tone. You may use a traditional presentation board, PowerPoint presentation and/or another multimedia presentation device such as Animoto, PowToons and/or iMovie. Each member of the lab team must contribute an equal amount of effort and speaking time to the creation and delivery of the presentation.

The presentation must include the data you collected which will justify the amounts of reactants used for the most ideal airbag. How do the temperature and pressure data support your calculations and suggested amounts of reactants? All calculations must be included as well as reasons for failed designs. Include a discussion of things to consider when the design is taken from the small-scale test you attempted to the large-scale design process car manufacturers use when they develop airbags for implementation in cars.

The presentation should also include justifications for either the use of or banning of child-sized airbags. Would they be helpful or harmful in a collision? Should they be required or optional? Give specific reasons for your response and cite at least 2 reliable sources. Your presentation must be less than 3 minutes long.

Review the criteria in the grading rubric on the next page for details on how you will be graded on the presentation.

Extension

For an additional challenge, you may be asked to explore the following options:

1. Propose other reactant combinations that may generate a safe, inert gas to fill the quart-sized airbag.
2. Read ahead about the ideal gas law. How can it be used to pre-determine the pressure that an airbag may withstand before popping? You will be required to find the pressure of the airbag system.
3. Explore temperature ranges for the most efficient airbag deployment.
4. Test an inflated airbag by dropping weights on it to determine the effectiveness of the airbag when an object hits it with force (i.e. 1 g mass samples, 5 g mass samples, etc.)
5. Test the performance of different kinds of bags as airbags.

Grading Rubric

<i>Criterion</i>	<i>Criterion Not Met (0 pts.)</i>	<i>Needs Improvement (1 pt.)</i>	<i>Satisfactory (2 pts.)</i>	<i>Excellent (3 pts.)</i>
<i>Time to inflate</i>	Inflation time was not included	Inflation time exceeds 2 seconds.	Inflation time is equal to 2 seconds.	Inflation time is less than 2 seconds.
<i>Data Collection & Analysis</i>	Data from the design and re-designed experiments are not included.	Insufficient data collected to prove the effectiveness of the design. Data may be incomplete or erroneous. Data may be disorganized and difficult to interpret.	Data includes appropriate mass of baking soda and volume of vinegar justified via calculations. Evidence of inflation of “airbag” is included to capacity without deflation. Inflation may be slightly less than capacity but does provide some protection upon impact.	Data includes appropriate mass of baking soda and volume of vinegar justified via calculations. Evidence of proper inflation of “airbag” is included to capacity without deflation. Inflation is to capacity and provides protection upon impact. Students have included a graph comparing multiple data runs.
<i>Visual Presentation</i>	The visual presentation was not included.	The visual presentation is missing key information required.	The visual presentation addresses all required components and is simple.	The visual presentation summarizes all required components and is interesting.
<i>Oral Presentation</i>	The oral presentation was not completed.	The student was unable to explain the design, data and/or airbag performance.	The student could address the design, data and/or airbag performance but did not add in any additional, possibly pertinent information for consideration.	The student could address the design, data and/or airbag performance adding information that was pertinent to the presentation.