

Middle School and High School



DESIGN PACKET

Educational Product

Educators & Students

Grades 6-12

NP-2009-12-229-LaRC

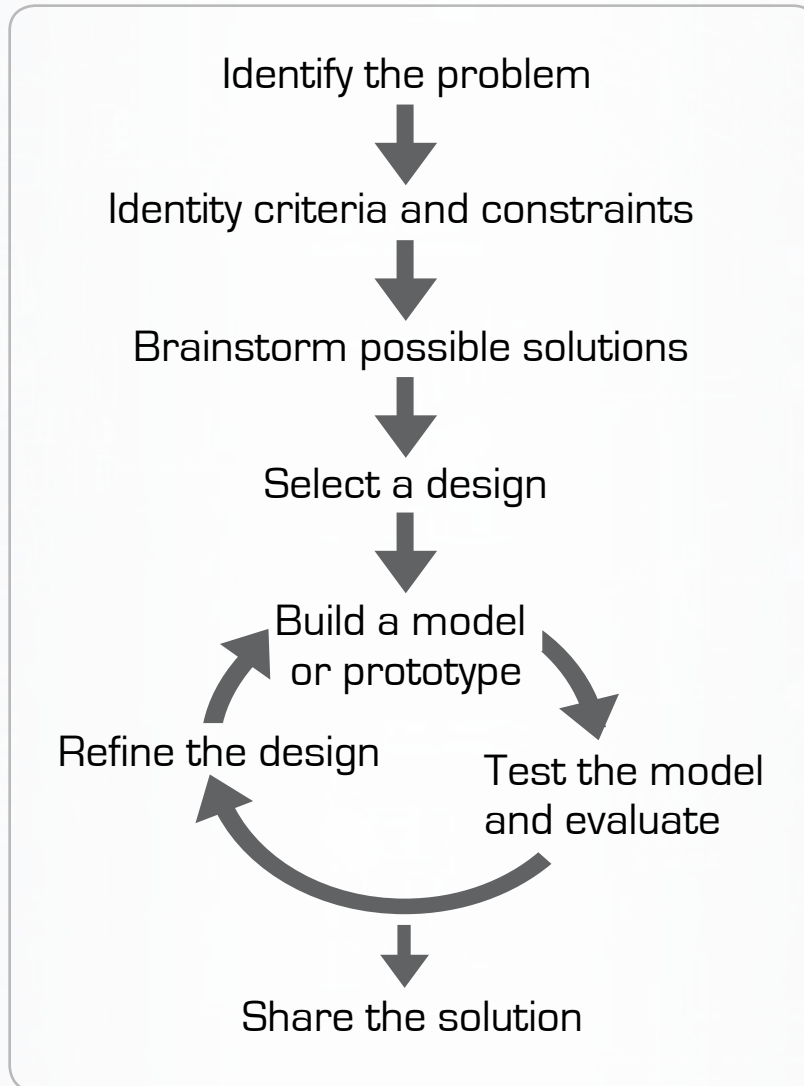
NASA Real World: Mathematics (Grades 6-8)
NASA Launchpad (Grades 9-12)

www.nasa.gov/education/nasaclips



Design Process

Middle School and High School Design Packet



Graphic of Design Process



Steps of the Design Process

1. Identify the problem.
2. Identify criteria and constraints.
3. Brainstorm possible solutions.
4. Select a design.
5. Build a model or prototype.
6. Test the model and evaluate.
7. Refine the design.
8. Share the solution.

Step 1: Identify the Problem



- State the problem clearly.

Step 2: Identify Criteria and Constraints

- Identify the conditions that must be met to solve the problem.

- Identify anything that might limit a solution, such as cost, availability of materials, safety.

- Be specific.

Step 3: Brainstorm Possible Solutions



- Consider what others have done to solve this problem and include prior research.

- Generate new ideas for solutions.

Step 4: Select a Design

- Choose two or three of the best ideas from the brainstormed list.

- Make a detailed sketch of each design.

- Label each sketch with dimensions and include the materials needed to build a model.

- Select one design to construct.

- Justify your choice by listing the reasons you selected this design.

Step 5: Build a Model or Prototype



- Write a detailed procedure for building the model or prototype.

- List the materials actually used to construct the model.

- Follow your procedure and build the model.

Step 6: Test the Model and Evaluate



Test

- Write a hypothesis about your design's performance during testing.
- Use an "If . . . then . . ." format. For example, "If the redesigned model has increased in size (change in the independent variable), then it will fall at a faster speed, (change seen in the dependent variable).
- Decide on a test for the model and try it out.
- Record the results of your tests.

Evaluate

- List the strengths of your design.
- List the weaknesses of your design.
- Discuss what changes, or compromises, in your design (if any) had to be made due to constraints.
- Decide if your design solved the problem identified in Step 1.

Step 7: Refine the Design



- Based on the results of your tests, make improvements on your design.
- Identify the changes that you would make.
- Give reasons for the changes.

Step 8: Share the Design

- Organize your findings. For example, you could make a poster, digital collage, PowerPoint presentation, or short video documentary.
- Present your findings to your teammates for feedback.
- Compare your design to those of your teammates.
- If you were to build this model again, what would you do differently and why?

Design Challenge Evaluation Rubric

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Group Members: _____

Rubric Category	Score
<p>Brainstorm to Identify the Problem and Constraints</p> <ul style="list-style-type: none"> • The problem is identified and explained in detail. • All criteria and constraints are listed and clarified. • Possible solutions are listed from the brainstorming session. • The work others have done to solve the problem is included. 	
<p>Generate Ideas, Possibilities, and Design Choice</p> <ul style="list-style-type: none"> • Two or three ideas are selected from brainstormed list. • Detailed sketches are created for the selected ideas. • Sketches are labeled with dimensions and materials for each component. • One design is selected to construct with reasons for the choice. 	
<p>Build the Model or Prototype</p> <ul style="list-style-type: none"> • Detailed list of materials is included. • Detailed procedures are included and followed. • Materials are handled and stored appropriately. • Safety rules are followed. 	
<p>Test the Model and Evaluate</p> <ul style="list-style-type: none"> • Hypothesis following an “if..., then...” format is developed for the design. • Strengths of the design are listed. • Weaknesses of the design or compromises of the design are listed. • Results are accurately recorded. • Data tables are complete and well organized. • The chosen design effectively addresses the identified problem. 	
<p>Refine the Design</p> <ul style="list-style-type: none"> • Modifications to improve the design are based on test results. • Modifications to the design are documented. • Additional trials are conducted. • Reflections show great insight and understanding of process and goals of project. 	
<p>Share the Design</p> <ul style="list-style-type: none"> • Presentation is well-organized. • Presentation covers all areas of the design process. • Presentation is clearly communicated (verbally or visually) with appropriate data, sketches, graphs or pictures. • Presentation includes contributions from all team members. 	
TOTAL (out of 24 pts possible)	

- 4 (Excellent) = All criteria (procedures, steps, and details) are met or followed with rare mistakes.
 3 (Good) = Most criteria are met with only a few mistakes.
 2 (Fair) = Many criteria are not met and/or there are many mistakes.
 1 (Poor) = Most criteria are not met.
 0 (No effort) = No effort to meet criteria.