



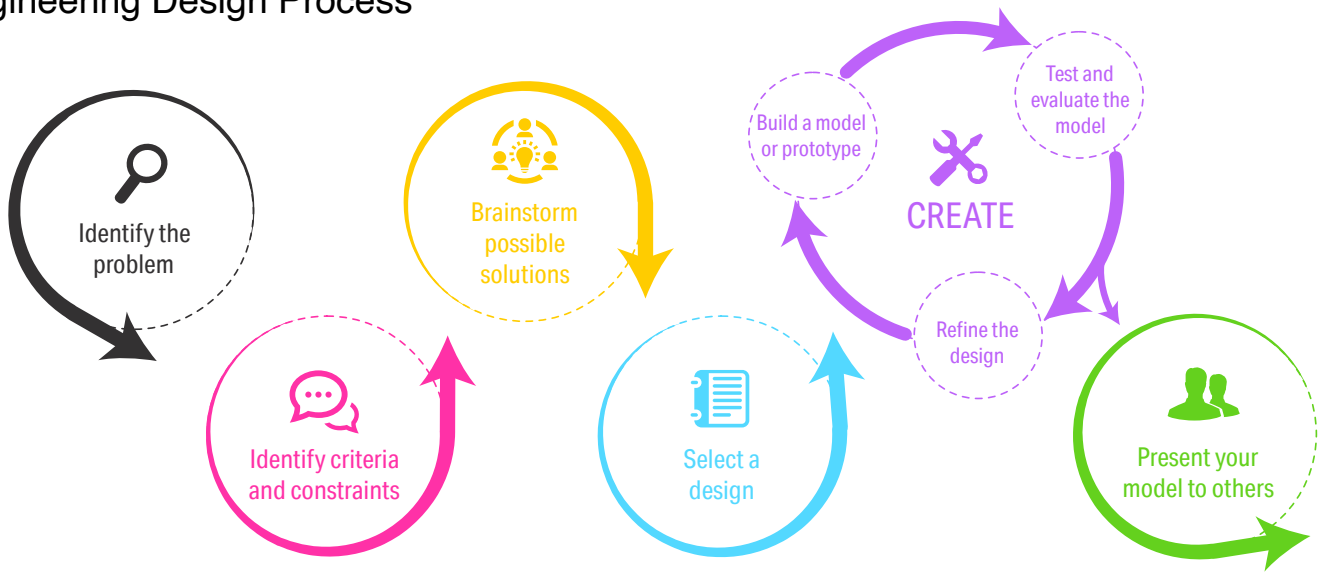
Secondary Engineering Design Packet



Student Packet (Grades 6-12)

www.nasa.gov/education/nasaeclips

Engineering Design Process*



IDENTIFY THE PROBLEM

- Identify the goal, problem, or challenge.
- Ask all questions you have about the problem.



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, and safety.



BRAINSTORM POSSIBLE SOLUTIONS

- Research what others have done to solve the problem.
- Generate new ideas for solutions.



SELECT A DESIGN

- Choose two or three brainstormed ideas and sketch each design.
- Select one design to construct and list reasons to justify your choice.



CREATE

Build a Model or Prototype

- Create a plan to build a model or prototype.
- List materials needed to construct the model or prototype.
- Build the model or prototype.

Test and Evaluate the Model or Prototype

- Test the model or prototype to see if it works.
- List the strengths of the design.
- List the weaknesses of the design.

Refine the Design

- Make improvements to the design.
- Justify the changes.



PRESENT YOUR MODEL TO OTHERS

- Explain your ideas to others.

* An accompanying teacher implementation guide is available on the NASA eClips website.

Engineers use the engineering design process (EDP) to solve problems. Their knowledge of science, mathematics, and other subjects helps them design possible solutions. Work as an engineer to navigate through the iterative steps in the EDP to solve this challenge.



Problem Scenario

Resources to Build Knowledge



Identify the Goal, Problem, or Challenge

State the problem.

Ask all questions you might have about this problem.

What have others done to solve this problem?

Research what others have done to solve this problem.

Person/Group

Their Solution

How did it work?

Identify and describe expected outcomes.



**IDENTIFY
Criteria**



Identify Criteria and Constraints

Identify any requirements. Identify anything that might limit a solution, such as cost, availability of materials, safety. What additional challenges affect possible solutions?



BRAINSTORM



Brainstorm Possible Solutions

Generate new ideas for solutions. Consider what others have done to solve this problem and include prior research.

Select a Design

Make a detailed sketch of the design you want to try from your brainstormed list. Label each sketch, dimensions and the materials included in the drawing.

Make a list of materials you will need. Describe why you have chosen these materials.

Material/Object	Quantity	Reason for Selection



CREATE



Create

Build a Model or Prototype

Follow your plan and drawing to build the model or prototype.

- How did your drawing help you build your model or prototype?
- How would your drawings and notes help others?

If there are any differences between your drawing and your model or prototype, explain why you made these changes.

Test and Evaluate the Model or Prototype

Test your model. Describe the process you use to test your design.

Record your results.



CREATE



Refine the Design

Make changes to improve your model or prototype. Go back and mark any changes you made on your original drawing.

Evaluate the results of the tests for strengths/weaknesses and successes/failures.

- Does your design solve the problem?
- Is it headed in the right direction?

How did the constraints affect the design? Discuss what changes or compromises had to be made.

Peer Review

Share your design with others working on the same challenge to get feedback.



PRESENT

Present Your Model or Prototype to Others

Explain your ideas to others. You might:

- Make a poster or infographic.
- Give a speech.
- Make a short video.
- Make a multimedia presentation.
- Write a letter to NASA convincing them to build your model or prototype.

Be sure to include sketches, pictures, data, or graphs in your presentation.

What did you learn or discover? How does your design solve the problem?

How did you work as a team? What was each person's valuable contribution?

What might be your next problem to solve?

Engineering Design Challenge Checklist for Secondary

Engineering Design Process

My work shows evidence of all parts of the engineering design process.

- ☐ I identified and explained the problem in detail including all criteria and constraints.
- ☐ I researched how others have solved the problem.
- ☐ I listed possible solutions and selected one.
- ☐ I developed a plan for construction that includes a diagram of the solution that explains the parts and their purpose, and a list of needed materials and tools.
- ☐ I followed the plan to create the model or prototype and noted any issues, the cause of the issue, and how to resolve the issue.
- ☐ I tested my solution and recorded the results accurately in organized data tables. I identified the strengths and weaknesses in the design of my model or prototype.
- ☐ I made and documented modifications to improve the design based on test results.
- ☐ I presented my model or prototype to others and explained how I used the design process to solve the problem. I shared what I discovered and learned.

Collaboration / Teamwork

I shared responsibilities for completing the work. I showed an appreciation for the contributions of each team member.

- ☐ I voluntarily engaged in all steps of the project and completed the tasks required by my team role.
- ☐ I listened to the ideas and feedback of team members.
- ☐ I offered solutions and compromises to solve conflicts that came up.

Content Knowledge and Skills

I thoughtfully discussed and applied specific content knowledge related to the design challenge.

- ☐ I explained
- ☐ I discovered
- ☐ I identified
- ☐ I learned