Student Guide | **Secondary Level**

Design Packet for OPSPARC Missions

Be the spark to a new NASA spinoff!

OPTIMUS PRIME SPINOFF PROMOTION & RESEARCH CHALLENGE

NASA GODDARD

OPSPARC

spo.gsfc.nasa.gov/OPSPARC

https://opsparc.gsfc.nasa.gov/

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Contact Information

NASA's Goddard Space Flight Center Strategic Partnerships Office
8800 Greenbelt Road. Code 102. Greenbelt, MD 20771

NASA Official: Darryl Mitchell
partnership@gsfc.nasa.gov

https://opsparc.gsfc.nasa.gov/

Design Process Steps

1. Identify the Problem

- State the problem clearly.

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.

3. Brainstorm Possible Solutions

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

4. Select a Design

- Choose two or three of the best ideas from the brainstormed list.
- Make a sketch of each design.
- Select one design to construct.
- Justify your choice by listing reasons for selecting the design.

5. Create

A. Plan and Build a Model or Prototype

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

B. Test and Evaluate the Model

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

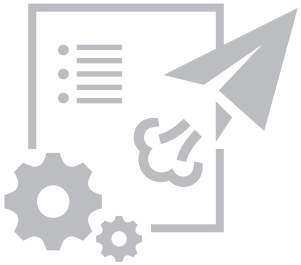
C. Refine the Design

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

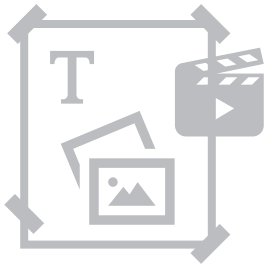
6. Share

- Explain your ideas to others.

Take the Challenge!



You will learn about NASA spinoff technology. Just like an engineer, you will use an Engineering Design Process to modify one of the identified NASA or spinoff technologies to solve a real-world problem.



Using a combination of text, images, and videos, you will create an Adobe Spark Page to share your ideas with NASA.

Be sure to put your best effort into your work -- only THREE teams will be selected as semifinalists. TWO of the THREE teams will have a chance to work with college students to build virtual models of the spinoff design, develop a marketing plan, and create presentation spaces, all in a 3D, multi-user virtual world.

Let's get started!

TEAM BUILDING TASK

Design Team Mission Patch

This is the Space Transportation System (STS) - 114 crew's mission patch.

Each crew member is named on this patch. Symbols on the patch honor aspects of the mission.

You and your team will use an Engineering Design Process to create your own team mission patch that symbolizes your individual strengths AND aspects of this challenge.

IDENTIFY THE PROBLEM

My team needs to create an OPSPARC mission patch.

IDENTIFY THE CRITERIA AND CONSTRAINTS

- What must we include in the mission patch?
- What might be some limitations to our design?

BRAINSTORM POSSIBLE SOLUTIONS

Individually, brainstorm ideas to represent your interests and talents. Record your ideas and sketches here.

SELECT A DESIGN

Plan and build a prototype

- Share your ideas with your team.
- Work to develop a rough draft of ONE mission patch. Be sure everyone's ideas are somehow represented in the patch.

TEST AND EVALUATE THE MODEL

Refine the design

- Create a final copy of your team's mission patch.
- Does your mission patch include all required criteria? Are there ways to improve it?

SHARE THE DESIGN

Use the mission patch to introduce your team to others. Record your introduction and description in writing, audio, or video.

Post these items in your Adobe Spark Page:

- An image of the team mission patch; and
- A written, audio, or video description and introduction for the team.

TASK Spinoff Scavenger Hunt²

Let's find out more about NASA spinoffs.

NASA Spinoff Scavenger Hunt²

NASA technology, re-designed, solves problems and improves life in your home, neighborhood and community.

RESEARCH - Spinoff Scavenger Hunt #1

Task:

- Explore the spinoff resources found in the Resource Section of the website. In particular, travel through the NASA Home & City website searching for NASA spinoffs.
- Jot down 8 - 10 spinoffs you think you may find in your home, neighborhood or community.

SEEK - Spinoff Scavenger Hunt #2

Task:

- Search for these NASA spinoffs in YOUR home, neighborhood or community.
- Capture your discoveries by photos or sketches.
  - Consider ways to PROVE that your photos were taken IN your home or community. *No images taken from the Internet.*

DESIGN - Create a Spinoff Collage

Task:

- Share your findings in an image collage. Your collage must:
  - Include 8 - 10 images of spinoffs you've found in your home or community.
  - Be saved as a PDF or JPEG. You may use Adobe Spark Post or any other tool to create the PDF or JPEG.
  - Indicate how many people collaborated in this mission.

*****Do NOT include any photos that include YOU or YOUR friends.**

Post the collage in your Adobe Spark Page. Be sure you label the post and provide a brief explanation of what is represented in the image.

TASK

Engineering a New Innovation

Use these steps of the Engineering Design Process to create the NASA spinoff technology.

IDENTIFY THE PROBLEM

What problem will be solved with the newly designed spinoff technology? State the problem clearly.

IDENTIFY THE CRITERIA AND CONSTRAINTS

Which technology/spinoff are you re-designing for your new spinoff?
How does the original technology or spinoff work?

What criteria and constraints should be considered as you design the spinoff?

What criteria will be the most difficult to meet? Why?

BRAINSTORM POSSIBLE SOLUTIONS

What have others done to solve the problem?

Generate new ideas for solutions.

Sketch ideas.

SELECT A DESIGN

Choose one design to construct. Justify the selection of the chosen design.

PLAN AND BUILD A MODEL OR PROTOTYPE

Develop a plan for building a prototype.

TEST AND EVALUATE THE MODEL

Test the prototype. Describe the strengths and weaknesses of the model.

REFINE THE DESIGN

Make improvements to the design. Justify the changes.

SHARE THE DESIGN

Describe what you have learned throughout this process.

TASK

Design Review

Engineers share their ideas with others through Design Reviews. Organize your work so that you could share your ideas with other engineers and Subject Matter Experts (SME).

Create a Design Review Video (<3 minutes) that answers these questions:

- What is the problem being solved by the newly created spinoff technology?

- How did the original technology work and how have you adapted or modified this technology?

- How did you build and test your model?

- How does the science, math, and engineering support this work?

- What makes this spinoff technically feasible?

- What have you learned through the engineering design process?

- If you were able to talk with Subject Matter Experts (SME) or engineers, what would you ask them to help you improve your spinoff design?

You may use Adobe Spark Video to create the video.
Once completed, be sure to post the video in your Adobe Spark Page.
Beside your video, also post:

- The problem statement and video.
- A brief introduction to the video, in text.

RUBRIC

Secondary Level

NASA OPSPARC Final Product	Score
Mission Patch (8 pts)	
• Image of an original mission patch.	(__ /4)
• Introduction of each team member and description explaining the mission patch.	(__ /4)
Spinoff Scavenger Hunt[2] (8 pts)	
• Collage includes 8-10 spinoffs.	(__ /4)
• The images are *real* (not from the Internet).	(__ /4)
Design Review (28 pts)	
A video (<3 minutes) includes these components:	
• Problem statement addresses a real-world problem.	(__ /4)
• Description of how the original technology is adapted to create the spinoff. Students must use one of the technologies identified for the specific topics. Not following this criterion will disqualify the students' work.	(__ /4)
• The process of building and testing the model.	(__ /4)
• A justification of how science, math, engineering support the design.	(__ /4)
• A justification that the spinoff is technically feasible.	(__ /4)
• Explanation about what has been learned through the engineering design process.	(__ /4)
• Questions the team would ask a Subject Matter Expert (SME) or engineer to improve the spinoff design.	(__ /4)
	_____ /**44**
***Note: Judges may award up to 8 additional points for unique and exceptional work. (__/8)	(__ /8)
	Total _____ /**52**

Assessment

4 (Excellent) = All criteria (procedures, steps, and details) are met or followed.
3 (Good) = Most criteria are met with only a few errors.
2 (Fair) = Many criteria are met, but work has significant errors.
1 (Poor) = Most criteria are not met.
0 (No effort) = No effort to meet criteria.

Semifinalists Selected to Move into InWorld OPSPARC

Using the rubric included in this packet, three teams will be selected as semifinalists for both grades 7 – 8 and grades 9 – 12. The top two semifinalist teams for each grade band will work with a college mentor to further develop the spinoff design, construct virtual models, develop a marketing plan, and build an InWorld OPSPARC presentation within NIAUniverse. NIAUniverse is a physics-based modeling and simulation virtual world.

If your team is selected, your college mentor will contact your coach to arrange a time to virtually meet with you and your team and begin this work.