Coach Guide | **Secondary Level**

Design Packet for OPSPARC Missions

Be the spark to a new NASA spinoff!

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

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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.

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.

5. Create

C. Refine the Design

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

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.

6. Share

- Explain your ideas to others.

Coach Project Checklist

1. Assist students with registration. All students need parent/guardian consent.

REGISTRATION OPTIONS:

- Students sign up individually online. They will need to know their parent/guardian email or have their parent/guardian present.
- Coach sends home "Letter to Parent."
- Coach initiates registration. Parent consent still required. See Forms & Materials at OPSPARC website.
- For those not able to register and/or give permission online, use the Online Registration form. See Forms & Materials at OPSPARC website.

2. Carefully review rules, timeline, and guidelines found at the website.

3. Use this Guide to help students complete OPSPARC tasks. Review the rubric with students to help students understand how their work will be assessed.

4. Help students submit their final projects by the due date *.

5. Three teams will be selected as semifinalists for both grades 7 – 8 and 9 – 12. The top two semifinalist teams for each grade band will work with a college mentor to further develop their 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. Each semifinalist team will complete a 30-minute presentation to NASA and industry researchers that will include a tour of their virtual world and a Q&A session with the panel of judges.

6. The winning teams will be selected based upon the virtual presentations and invited to NASA's Goddard Space Flight Center for tours, workshops and an award ceremony.

* See website for dates

Coaches:

Use this step-by-step guide to support secondary students (grades 7–12) through the OPTIMUS PRIME Spinoff Promotion and Research Challenge.

Students will:

- Create a Mission Patch through a team-building activity;
- Discover spinoffs in the world around them through research and a scavenger hunt;
- Research one of the NASA technologies and/or spinoffs provided in the Resource Section;
- Think like engineers and create a spinoff that solves a problem; and
- Organize and share their thinking through text, graphics, video, and their own website using Adobe Spark tools.

Your students have access to the Adobe Spark suite of production tools. The final product for this mission, a website, will be created within Adobe Spark Page. Tasks described within this guide may be created using Adobe Spark Post (for graphics) and Adobe Spark Video (for video production). You and your students may choose to use other graphics and video editors, but the final product, the website, must be developed within Adobe Spark Page.

Introduce the Mission using this Mission Scenario.

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. *You must use one of the technologies provided in the Resource Section.*

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

Let's get started!

Help students work through the following tasks to complete their Spark Page.

TEAM BUILDING TASK

Design Team Mission Patch

Background: Teamwork is an important component to any successful NASA mission. Each crewed mission into space requires a hand-picked team of astronauts. One of the first tasks for the crew is to work with a graphic designer to create a patch that represents the unique talents of the crew and the challenges of their mission. The mission patch includes all of the crew names and the graphic design depicts aspects of the mission and important attributes of each team member.

Share this example with students:

Space Transportation System (STS) - 114 (July 2005)
The STS 114 patch design signifies the return of the Space Shuttle to flight and honors the memory of the STS-107 Columbia crew.

- The blue Shuttle rising above Earth's horizon includes the Columbia constellation of seven stars, echoing the STS-107 patch and commemorating the seven members of that mission.
- The crew of STS-114 will carry the memory of their friends on Columbia and the legacy of their mission back into Earth orbit.
- The dominant design element of the STS-114 patch is the planet Earth, which represents the unity and dedication of the many people whose efforts allow the Shuttle to safely return to flight.
- Commander Eileen Collins and Pilot James Kelly are named at the top of the insignia, with Mission Specialists Wendy Lawrence and Charles Camarda named below.
- Against the background of the Earth at night, the blue orbit represents the International Space Station (ISS).
- Mission Specialists Soichi Noguchi, Stephen Robinson and Andrew Thomas, who worked on the Station during spacewalks, are named on the orbit.
- The red sun on the orbit signifies the contributions of the Japanese Space Agency to the mission and to the ISS program.
- The multi-colored Shuttle plume represents the broad spectrum of challenges for this mission, including Shuttle inspection and repair experiments, and International Space Station re-supply and repair.

Task:
Production Tool: Adobe Spark Post or other graphic editor.
Use the Secondary Student Design Packet to guide students through the design of their OPSPARC team mission patch.

Their mission patch must:
- Include images that reflect something about EACH member of the team.
- Include images that represent NASA OPSPARC.

The team must also write or record an audio or video message for others that uses the mission patch to introduce the team.

Tip:
Teams are often most successful when each member of the team takes an active role to support the team.

For this mission patch project AND for all OPSPARC tasks, consider assigning roles for the students. Some possible roles are listed below:
- Task Manager -- responsible for making sure the tasks are completed
- Researcher -- responsible for gathering information and research
- Recorder -- responsible for taking notes and recording ideas
- Graphic Designer -- responsible for creating images
- Materials Manager -- responsible for gathering and returning materials

Be sure each team posts these items in their Adobe Spark Page:
- An image of the team mission patch; and
- The description and team introduction in text, audio, or video.

TASK

Spinoff Scavenger Hunt²

Production Tool: Adobe Spark Post or other graphic editor.

Help students follow the directions found in the Student Design Packet. For this task, students expand their understanding of NASA spinoff technology by completing scavenger hunts through:

- Spinoff resources gathered in the Resource Section on the Website. One engaging resource is the NASA Home & City website (https://homeandcity.nasa.gov/)
- In their home or community.

- Help students use Adobe Spark Post to create the Spinoff Collage that will be included in their team's Adobe Spark Page.
- Be sure students label the collage and give a brief explanation of what is represented in the image.

TASK

Engineering a New Innovation

Use the Student Design Packet to guide students through these design steps.

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 your new spinoff?
- What criteria will be the most difficult to meet? Why?

BRAINSTORM POSSIBLE SOLUTIONS

- Consider what others have done to solve the problem already.
- 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.

***Note:** The work the students complete in their Design Packets guides them through an engineering design process. Their ideas will be synthesized in a video within the next task (Design Review) and posted to their Adobe Spark Page.

TASK

Design Review

Production Tool: Adobe Spark Page; Adobe Spark Video or another video editor.

Ask students to create a Design Review video (< 3 minutes) that includes the work they've completed in their Design Packet. These items must be included in the video:

- The problem being solved by the newly created spinoff technology.
- A description of how the original technology is being adapted to create the spinoff technology.
- The process of building and testing the model.
- A justification of the technical feasibility of this spinoff.
  - Does the science, math, and engineering support this work?
  - Is this spinoff technically feasible?
- Description of what you have learned through the engineering design process.
- Questions you would ask a Subject Matter Expert (SME) or engineer to help improve the spinoff design.

Tip:
Prior to students submitting their final product, ask each team to review their own work using the RUBRIC. This rubric will be used to select the semifinalists.

Help students submit their completed Adobe Spark Page:

- Be sure students post the problem statement and video.
- Ask them to include a brief introduction to the video, in text, for their viewers.

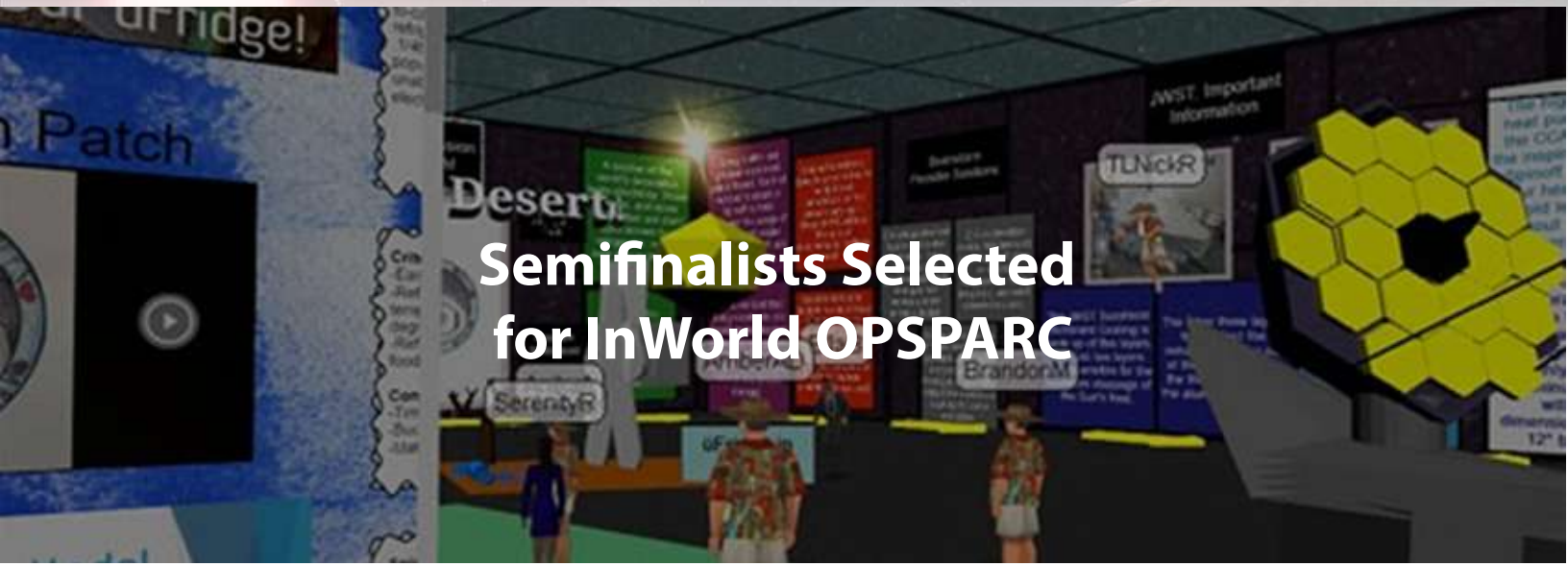
RUBRIC

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 for 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 their 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.

The teams will be introduced to their mentor by email. You will be included in all email correspondence. If your team is selected, please encourage the students to communicate with their mentor and complete deadlines set by the mentor.

The mentor's work is outlined within an InWorld OPSPARC Mentor's Guide. A copy of this guide will be sent to the semifinalist teams and their coaches. College mentors will guide the students through the InWorld OPSPARC tasks, but the mentor will need your help building a strong, collaborative team.

Each semifinalist team will complete a 30-minute presentation to NASA and industry researchers that will include a tour of their virtual world and a Q&A session with the panel of judges.

The winning team will be selected based upon these presentations. A rubric to assess the presentations is included in the InWorld OPSPARC Mentor's Guide.

The winning teams will be invited to NASA's Goddard Space Flight Center for tours, workshops and an award ceremony.