NASA HUNCH

Physics I & II

Wyoming Indian High School

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Course Syllabus
Physics 1 & 2
NASA HUNCH

School Name	Wyoming Indian High School	Prerequisites	Life science Physical Science Physics 1 for Physics 2
Teacher Name	Scott Krassin	SCED CODE	03152G0.5012 03152G0.5022
Course Name	Physics I & II F/S	# of credits	.5 per semester

Course Descriptions

The Design and Prototyping HUNCH Program is a way for students of all skill levels to develop innovative solutions to problems posed by life on the International Space Station or lunar surface. Many of the projects are items personally requested by the International Space Station Crew to help ease living conditions aboard the station, giving students the opportunity to really make an impact on the lives of Astronauts. Other projects come from Flight Crew Systems and Operational groups at NASA that need more idea development.

High school students United with NASA to Create Hardware or HUNCH is an innovative school-based program that partners NASA at the Johnson Space Center, Marshall Space Flight Center, Langley Research Center, Goddard Space Flight Center, Glenn Research Center, Kennedy Space Center, and AMES Research Center with high schools in states across the nation. The partnership involves students fabricating real-world products for NASA as they apply their science, technology, engineering and mathematics skills as well as learning to work in teams and think creatively.

This NASA program is expanding and giving students opportunities to develop hardware for the International Space Station and the lunar surface. Some hardware items are necessities that the astronaut crew has personally requested to help ease their living conditions while aboard the Space Station or the lunar surface and other requests have come from Flight Crew Systems and Operational groups at NASA.

Wyoming content and performance standards

Science Inquiry	3-5-ETS1-2, 3-5ETS1-3, MS-EtS1-3, HS-ETS1-5
Defining Engineering Design Problems	HS-ETS1-1, HS-ETS1-5
Solutions for Engineering Design Problems	HS-ETS1-1, HS-ETS1-2, HS-ETS1-3, HS-ETS1-5

Course Materials & Resources

NASA Hunch Design and Prototype Projects for 2019 - 2020 www.nasahunch.com

Flo Gold : NASA HUNCH Mentor florence.v.gold@nasa.gov

Glenn Johnson : Design and Prototype Project Manager glenn.f.johnson@nasa.gov

Unit of Study & Timeline

Proficiency Standards	Scientific Inquiry Defining Engineering Design Problems Solutions for Engineering Design Problems
1 Semester	Designing and brainstorming prototypes Preliminary design review Complete Engineering, design and development Elements A-F Engineering notebook
2 Semester	Building and testing prototypes Critical preliminary review Complete Engineering, design and development Elements F-M Engineering notebook

Course Grading Component

1st semester

Florence Gold's (NASA representative) School viste presentation	25pts
Preliminary Design Review Presentation	25pts
Engineering, Design and Development Elements A-F	50pts
Research Notebook	5pts/week

2nd Semester

Critical Design Review	40 pts
Engineering, Design and Development Elements G-N	100 pts
Research Notebook	5pts/week

<table>
<tr><td>Content:
All WIHS Science classes</td><td>Unit: Scientific Inquiry</td><td>Grade: 9-12</td></tr>
<tr><td colspan="3">Proficiency Standards:
3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</td></tr>
</table>

3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. MS-ETS1-4. Develop a model for a proposed object, tool, or process and then use an iterative process to test the model, collect data, and generate modification ideas trending toward an optimal design. HS-ETS1-5. Evaluate the validity and reliability of claims in a variety of materials.		
Core Resource:		Instructional Timeline: 9th - 12th grade
		Sample Tasks
4.0	The student will: • Develop a hypothesis that addresses a problem or question of choice and create a valid experiment to test the hypothesis using the scientific method (for example, create a hypothesis about the effectiveness of various brands of the same household goods [such as the absorbency of paper towels] and test this hypothesis by designing a valid experiment in which the independent, dependent, and control variables are identified, and your conclusion is explained clearly (The 6 questions are addressed that are found in the conclusion of the writing a scientific paper rubric).	Application of # 3 a new or different problem.
3.0	The student will: ● Students use inquiry to conduct scientific investigations to pose problems and identify questions and concepts to ○ design and conduct an investigation ○ collect, organize, analyze and appropriately represent data ○ communicate the results in a scientific format.	Projects: Let it swing States of matter Friction research write up
2.0	The student will know vocabulary: *analysis*, *conclusion*, *constant*, *control*, *control group*, *dependent variable*, *experiment*, *experimental group*, *hypothesis*, *independent variable*, *measurable*, *observation*, *variable* The student will perform basic processes such as: ● Identify a problem or pattern in nature ● Develop a hypothesis ● Design an experiment ● Conduct the experiment ● Collect and analyze data ● Make and interpret data/charts/graphs ● Clearly and accurately communicate the results of the investigation ● Effectively research concepts & determine reliability of sources (e.g., internet, books, journals)	

Content: **Physics**	Unit: **Defining Engineering Design Problems**	**Grade: 11-12**

<table>
<tr><td colspan="2">NASA HUNCH</td><td></td><td></td></tr>
<tr><td colspan="4">Proficiency Standards:
HS-ETS1-1. Analyze a NASA challenge to specify qualitative and quantitative criteria and constraints for solutions to problems that account for NASA needs and wants.
HS-ETS1-5. Evaluate the validity and reliability of claims in a variety of materials.</td></tr>
<tr><td colspan="3">Core Resource: NASA HUNCH Design and Prototype Projects</td><td>Instructional Timeline:
Aug - May</td></tr>
<tr><td></td><td></td><td></td><td>Sample Tasks</td></tr>
<tr><td>4.0</td><td colspan="2">The student will:
• Develop a strategy to solve a problem given by NASA as an engineering design problem (for example,students fabricating real-world products for NASA as they apply their science, technology, engineering and mathematics skills as well as learning to work in teams and think creatively. Articulate critical criteria and constraints that solutions must conform to solve the problems given to them by the NASA HUNCH program.</td><td>Finished these parts of the Program:
a. Engineering notebook
b. Preliminary design review
c. Complete the Engineering, Design and Development paper Elements A-N
d. Critical Design Review
e. Trip to Houston to present prototype</td></tr>
<tr><td></td><td colspan="2"></td><td></td></tr>
<tr><td>3.0</td><td colspan="2">The student will:
Describe a NASA challenge as an engineering design problem (for example, students fabricating real-world products for NASA as they apply their science, technology, engineering and mathematics skills as well as learning to work in teams and think creatively by identifying qualitative and quantitative criteria and constraints for solutions).
Explain the requirements set by NASA that are criteria or constraints for a specific engineering design problem (for example, quantify issues of design and prototype projects to the greatest extent possible and state them in such a way that one can tell if a given design meets them).
Prioritize criteria related to an engineering design problem (for example, break criteria into smaller, simpler parts and decide which ones are more important than others to inform decisions about trade-offs).</td><td>Develop products for the NASA HUNCH program
Program:
f. Engineering notebook
g. Preliminary design review
h. Complete the Engineering, Design and Development paper Elements A-M
i. Critical Design Review</td></tr>
<tr><td></td><td colspan="2"></td><td></td></tr>
<tr><td>2.0</td><td colspan="2">The students will know vocabulary: criteria, design problem, engineering, qualitative, quantitative, solution, constraints, criteria, design problem, detail, judgment, relevant

The student will perform basic processes such as:
● Give examples of NASA projects that can be addressed through engineering.</td><td></td></tr>
</table>

	• List qualitative criteria and constraints for solutions to engineering design problems. • List quantitative criteria and constraints for solutions to engineering design problems. • The student will perform basic processes such as: • List constraints set by NASA that are relevant to a specific engineering design problem. • Determine if a requirement set by NASA represents a criterion or constraint for a specific engineering design problem. • Determine which criteria and constraints are most important for a specific engineering design problem. • State criteria and constraints at a level of detail that allows for clear qualitative and quantitative judgments about whether they have been satisfied or accounted for. The student will perform basic processes such as: • Explain that criteria may need to be broken down into simpler ones that can be approached systematically. • Make decisions about the priority of certain criteria over others.	

Content: **Physics** **NASA HUNCH**	Unit: **Solutions for Engineering Design Problems**	**Grade: 11-12**

Proficiency Standards:

HS-ETS1-1. Analyze a NASA challenge to specify qualitative and quantitative criteria and constraints for solutions that account for NASA needs and wants.

HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

HS-ETS1-5. Evaluate the validity and reliability of claims in a variety of materials.

Core Resource: NASA HUNCH Design and Prototype Projects	Instructional Timeline: 1 school year

Unit Vocabulary Words: *aesthetics*, *constraint*, *cost*, *cultural*, *design problem*, *engineering*, *environmental*, *impact*, *qualitative*, *quantitative*, *reliability*, *safety*

		Sample Tasks
4.0	The student will: ● Adapt a solution to an engineering design problem that is appropriate for one situation to a similar but unique situation (for example, after designing a solution to a NASA Hunch project, build the prototype and test the prototype against a variety of situations that simulate space and lunar conditions as realistic as possible. Present the solution to the NASA team representatives.	Finished these parts of the Program: j. Engineering notebook k. Nasa ppt presentation l. Complete the Engineering, Design and Development paper Elements A-M Have a prototype designed and built capable of being tested in a micro G condition or on the Lunar surface. m. Make presentations (PDR,CDR and in Houston).
3.0	The student will: **Evaluate possible solutions to engineering design problems according to a range of constraints and impacts** (for example, evaluate a solution according to constraints such as cost, safety, reliability, and aesthetics, and social, cultural, and environmental impacts). **Use technological simulations to evaluate possible solutions to engineering design problems** (for example, create prototypes and test with computer simulations and use the built prototype to test different ways of solving a problem, see which solutions are more efficient or economical, model the	Develop and build prototypes for the NASA HUNCH program n. Engineering notebook o. Nasa ppt presentation p. Complete the Engineering, Design and Development paper Elements A-M Have a prototype designed and built capable of being tested in a micro G condition or on the Lunar surface.

	impacts of specific solutions, or to consider interactions within and between systems relevant to the problem).	q. Make presentations (PDRandCDR).
2.0	The student will perform basic processes such as: ● List constraints on possible solutions to an engineering design problem. ● List potential impacts of a possible solution to an engineering design problem. ● Qualitatively describe how well a possible solution takes into account constraints. ● Quantitatively describe how well a possible solution takes into account constraints. ● Qualitatively describe the potential impacts of a possible solution. ● Quantitatively describe the potential impacts of a possible solution. The student will perform basic processes such as: ● Use physical models to evaluate possible solutions to engineering design problems. ● Describe ways that a computer could be used to simulate a possible solution to an engineering design problem. ● Use a computer to simulate a possible solution to an engineering design problem. ● Collect data from computer simulations. ● Organize data from computer simulations. ● Draw conclusions from data from computer simulations.	

I will insert the NASA HUNCH Design and Prototype Projects for each year.

Web (zoom) Conference Expectations:

· Students will show up on time for the web conferences that have been scheduled.

· Students will have their work downloaded on the computer that they are using for the web conference so that they can share their work on screen

· Students will come prepared with sketches, drawings, and updates to their project.

· Students will have detailed questions to ask about the project.

· Students will have visibly progressed in their project from one web (zoom) conference to the next.

<u>Preliminary Design Review Expectations:</u>

Student should be able to have these items present at the Preliminary Design Review

You should have a trifold along with your prototype. Your trifold should include your problem trying to solve, your designs (from start to where you are now with main points of what changed along the way),design specifications and constraints, any testing you may have done at this point, pictures taken along the way and this should look professionally done.

1. Identify and describe the specific criteria for and constraints to the design of a project. (These specific criteria and constraints should be defined from the requesting NASA project)

2. Show how design ideas have gone from concept #1 to final concept design. Show this visually and written summary of the changes (drawings, photographs, and documentation). Make sure that the designs are well drawn with measurements on the drawing.

   a. If you have a larger assembly, please show your separate component parts as well.

3. Make sure to list and describe the materials that you will use/or have used in your prototype and why you chose those materials

4. Preliminary Review should have a 70% complete design with prototype aspects. Should use less expensive materials that you can “show “your design concept. 3D renderings can help to offset prototype proofs.

PDR Design and Prototype Rubric

These are some of the factors that will be considered for each of the projects being reviewed. Because of the diversity of the projects and problems, there will be other considerations that will need to be taken into account but this is the rubric that will be used in the PDR.

Date: ____________________________ School:___________________________________

Teacher:____

Title of Project (must be the same on the presentation): ________________________________

First and last names of students in group: (use back if necessary)

____

1. Does the presentation identify and describe the specific criteria and constraints to the design of the project?

1 2 3 4 5

2. Does the presentation show how the design ideas have gone from concept #1 to the final concept design?

1 2 3 4 5

3. Does the presentation show visually and in a written summary of the changes (drawings, photographs, and documentation). Make sure the designs are well drawn with precise measurements of the prototype.

1 2 3 4 5

4. Does the presentation make sure to list and describe the materials that you will use/or have used in your prototype and why you chose those materials.

1 2 3 4 5

5. Preliminary review should have a 70% complete design with prototype aspects. Use inexpensive materials to show your design concept.

1 2 3 4 5

Comments:

Video Conference Preliminary Design Review Expectations: (Flo's Schools)

· Students should be familiar with how to zoom conferences. If you need a practice session just contact Flo.

· Students will have their work downloaded on the computer that they are using for the video conference so that they can readily share their work on screen.

· Students will have detailed questions to ask about their project to the mentors.

· The Preliminary Conference is a time to share ideas with others. HUNCH Design and Prototyping final projects usually involve a collaboration between teams' ideas. The end goal is to design or redesign the very best item for the astronauts living and working on the ISS.

1. Identify your project, your school, your teacher and your team members.

2. Describe the specific constraints and or requirements to the design of your product. (These specific constraints should be defined for you on the Design PowerPoint or by your research on living and working in a microgravity environment)

3. Describe how your design meets the constraints of the project. Point out all of the good qualities or attributes of your project ideas.

4. If you have a prototype have it ready to show at the conference.

5. Make sure that your ideas are well drawn with measurements in inches and well labeled.

6. Show results of any testing you have done by a demonstration, video or pictures.

7. Preliminary Review should have a 70% complete design with prototype aspects. Should use less expensive materials that you can "show "your design concept.

8. A great template to use is found at http://www.hunchdesign.com/design-and-prototype-project-list.html

Thank you all for your hard work and dedication to helping the International Space Station Program Office.

Flo

Critical Design Review Expectations:

You should have a trifold along with your prototype. Your trifold should include your problem trying to solve, your designs (from start to where you are now with main points of what changed along the way),design specifications and constraints, any testing you may have done at this point, pictures taken along the way and this should look professionally done.

1. Have all information and Data from the Preliminary Design Review.

2. Have a working prototype along with 3D renderings if possible. Prototype should be 90-95% complete with only some minor tweaks if selected to come to the final Challenge Review in Houston.

3. Testing Data should be present on all components and the whole system. This data should be clear and detailed. Any changes made to design based on testing should be shown either in prototype or by design drawings of what will be changed.

CDR HUNCH Design and Prototype Rubric

These are some of the factors that will be considered for each of the projects being reviewed. Because of the diversity of the projects and problems, there will be other considerations that will need to be taken into account but this is a rating system that will help rate the thought and work put into a project. Students should fill out the top section of this rubric and have a descriptive brochure containing a picture of their project stapled to the form to hand to the reviewer.

Date: ____________________________

School:___________________________________

Teacher:____

Title of Project (must be the same on the presentation):

____

First and last names of students in group: (use back if necessary)

____

1. Does the project satisfy requirement and constraints?

1 2 3 4 5

2. Does the project have a working prototype with a 3D rendering if possible?

1 2 3 4 5

3. Is the Testing data clear and detailed with a performance demonstration showing the success of the design?

1 2 3 4 5

4. Does the documentation allow for the replication of the design including materials used?

1 2 3 4 5

5. Does the project and student exhibit awareness of the microgravity environment and designing with that particular aspect in mind?

1	2	3	4	5

6. Does the project use Commercial Off The Shelf ideas and/or products in order to keep the design from being a complete “from scratch” concept?

1	2	3	4	5

7. Professionalism of PowerPoint and or Presentation

1	2	3	4	5

8. Quality of work that allows you to communicate your design ideas verbally, with drawings, videos, pictures or written

1	2	3	4	5

9. Comments:

Final Review in Houston for Top Projects

· The selection of the top 3 teams per project area will start to be determined after the Critical Design Reviews that have taken place regionally across the country (If there is a close tie between projects, the Lead Design Engineer will determine if a 4th team may come based on project solution status)

· Projects are chosen on prototype development and meeting the project problems that HUNCH is trying to solve.

· Decisions are made by the Lead Design Engineer with NASA HUNCH to determine those coming to represent best solutions

· This Final Design Review in Houston will take place in Late April, 2018 (Exact Date TBD)

· Final review will require a trifold and prototype to come to Houston

· Projects will be reviewed by astronauts, ISS Program office, Crew Flight systems and Engineering staff

Nasa Capstone Schedule

Elements A-M

1st Semester

Component I Researching a problem

Element A
Element B
Element C

Component II Designing a solution

Element D
Element F

2nd Semester

Component III Prototype and Testing

Element G
Element H
Element I

Component IV Evaluation and Reflection

Element J
Element K
Element L

Component V Presentation

Element M
Element N

The grading will be done throughout the semester. Students can work on previous elements, but there will be a hardline cut off for I and II semester.

Nasa Hunch Project
Engineering, Design and Development
Elements A-M

Rubrics Scoring Guide

Wyoming Indian High School

2019-2020

Element A Problem statement

Objectives:

- The problem is clearly and objectively identified and defined with considerable depth, and it is well elaborated with specific detail.

- The justification of the problem highlights the concerns of many primary stakeholders and is based on comprehensive, timely, and consistently credible sources.

- The justification offers consistently objective detail from which multiple measurable design requirements can be determined.

Elements below need to be addressed:

____ Introduction - name your team and describe the purpose of the element.

____ Problem statement - *This should have a paragraph on the problem you are trying to solve based on the info from the video and/or ppt.*

____ Problem background and research

____ Problem constraints - *Prioritized list with sub headings explaining each one.*

____ Justification from NASA - *Quotes from Flo and Glenn*

____ Conclusion (What was learned in element A)

10 Pts	8 Pts	6 pts	4 pts.
All elements above are addressed	5 elements above are addressed	4 or 3 elements above are addressed	2 or less elements above are addressed

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element B: Documentation and Analysis of Prior Solution Attempts

Objectives:

- Documentation of plausible prior attempts to solve the problem and/or related problems is drawn from a wide array of clearly identified and consistently credible sources.

- The analysis of past and current attempts to solve the problem—including both strengths and shortcomings— is consistently clear, detailed, and supported by relevant data.

Reflective Questions to Answer:

_____ What are all of the methods, products, or actions that are being used or have been developed to try and solve this problem and exactly why doesn't each of them actually solve the problem?

_____ How do I/we prove to others that I/we have done an extensive search for possible current solution attempts?

_____ Who has helped me/us identify and state the shortcomings of the solutions attempts found and why should anyone believe them?

Include:

_____ Intro paragraph describing how you found your information and what you learned from prior solutions. Who helped you analyze these solutions. (hint: mentor or other expert)

_____ Patents that address a similar problem that may or may not have made it to development – images, patent number, date of patent, abstract, pros and cons.

_____ Existing/competitive products – images, price, features, strengths and weaknesses.

10 Pts	8 Pts	6 pts	4 pts
All reflective questions and what they include are addressed	5 reflective questions and what they include are addressed	4 reflective questions and what they include are addressed	3 or less reflective questions and what they include are addressed

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element C: Presentation and Justification of Solution Design Requirements

Objectives:

- Design requirements are listed and prioritized, and they are consistently clear and detailed.
- These design requirements presented are consistently objective, measurable, and they would be highly likely to lead to a tangible and viable solution to the problem identified.

- There is evidence that requirements represent the needs of, and have been validated by, many if not all primary stakeholder groups.

Reflective Questions:

____ Now that I know what the problem statement is and why current solutions are not solving the problem well enough, what are the measurable things a new design would have to accomplish (in order of importance) to be seen as a real solution?

____ How did I/we determine each of the design requirements?

____ If the product or system that your team develops is successful, how will you know? Brainstorm a list of benchmarks, against which you can compare your solution, that represent performance expectations that your solution must meet in order to successfully solve the problem. Benchmarks must be measurable. Sometimes a benchmark is a simple pass/fail assessment. Other times a success rate or percentage of success is the goal.

Include:

_____ Intro paragraph on how design specifications, constraints, and parameters were determined.

____ Explicitly state that your list is in order by highest priority.

____ List design specifications.

____ Must be measurable and clear.

10 pts	8 Pts	6 pts	4 pts
All reflective questions and what they include are addressed	5 reflective questions and what they include are addressed	4 reflective questions and what they include are addressed	3 or less reflective questions and what they include are addressed

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element D: Design concept generation, analysis, and selection

Objectives:

- The process for generating and comparing possible design solutions and comprehensive, iterative, and consistently defensible.
- A viable and well-justified design is highly likely based on the process.

- The design solution ultimately chosen was well-justified and demonstrated attention to all design requirements.
- The plan of action has considerable merit and would easily support repetition and testing for effectiveness by others.
    - Justification for each decision step taken in the selection of your final design should be clear and evident.
    - Can you defend the choices made based on matrices, research, calculations, or stakeholder feedback?

Reflective Questions:

_____ What brainstorming or idea generation techniques did you use to help define possible solutions and how can we show that we kept all design requirements in mind throughout the entire process?
_____ What was the best solution to try and why was the best solution to try?

Include:
_____ Multiple design solutions.
_____ Detailed concept sketches, schematics, annotated drawings
_____ Detailed and prioritized list of all design goals and requirements.

- Features desired in final design
- Specifications
- Constraints
- Parameters

_____ Reflection and analysis of design goals and requirements identified and prioritization.
_____ A decision matrix
_____ A final design with justification for selection

10 pts	6 Pts	4pts	2pts
All reflective questions and what they include are addressed	5 reflective questions and what they include are addressed	4 reflective questions and what they include are addressed	3 or less reflective questions and what they include are addressed

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element F: Obstacles of Prototyping

Objective:

- Discuss the obstacles or boundaries that may occur during the construction of the prototype.

- Provide the methods that were used to overcome these obstacles.ce.

Reflective Questions:

- How do I/we show evidence that the proposed design overcomes the obstacles of construction.

(**Include):**

________ List all obstacles that you will encounter building the prototype.

________ List the methods that you will use to overcome the above obstacles.

10 Pts for all of the above criteria.

5 pts if only one was addressed.

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element G Building the Prototype

Objective:

The final prototype iteration is clearly and fully explained and is constructed with enough detail to assure that objective data on all or nearly all design requirements could be determined; all attributes (sub-systems) of the unique solution that can be tested or modeled mathematically are addressed and a well-supported justification is provided for those that cannot be tested or modeled mathematically and thus require expert review.

Criteria:

- Pictures with precise dimensions should be given
- Document the process on how you came up with the design
- Written so that another team could build the prototype

Reflective statements

________ A clear and comprehensive description of the final prototype design.

________ Evidence of how the prototype design or sub systems can be tested or modeled mathematically for each of the measurable design requirements listed in Element C.

_________ Justification for the attributes that cannot be tested or modeled mathematically?

_________ Written context to all artifacts presented that provides the reviewer a full understanding of the related work.

10 pts	8 pts	5pts	3pts
All reflective statements and what they include are addressed.	3 reflective statements and what they include are addressed.	2 reflective statements and what they include are addressed.	1 reflective statements and what they include are addressed.

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element H

Preface

Ideally every feature of a group's prototype should be validated by a test. Teams may perform several different tests which may be conducted at different phases of the construction process. Encourage students to keep in mind that the collected test data will be evaluated against the criteria they establish in order to determine success or failure. Whether the prototype is successful is not the point.

To define and justify the testing method, students need to demonstrate that they are using sound engineering, scientific, and mathematical principles.

Criteria

- Create a test for each element
- The outcome for each test should be around 90% success
- Make graphs and tables to record the results of your tests
- Make your statements and decisions based on data
- The test should convince NASA of the validity of their design

Prototype Testing and Data Collection Plan

1. Through the conduct of several tests for high priority requirements that are reasonably based on instructional contexts, or through physical or mathematical modeling, the student demonstrates considerable understanding of testing procedure, including the gathering and analysis of resultant data.
2. The analysis of the effectiveness with which the design met stated goals includes a consistently detailed explanation [and summary] of the data from each portion of the testing procedure and from expert reviews, generously supported by pictures, graphs, charts and other visuals.
3. The analysis includes an overall summary of the implications of all data for proceeding with the design and solving the problem.

Essential Items

_____ List what you learned from testing to see if this design met the stated design requirements.

_____ List why others believe my analysis of the data.

The testing plan addresses all or nearly all of the high priority design requirements by effectively describing the conduct (through physical and/or mathematical modeling) of those tests that are feasible based on the instructional context and providing for others a logical and well-developed explanation confirmed by one or more field experts of how testing would yield objective data regarding the effectiveness of the design.

_____ Give evidence that the testing plan addresses each of the design requirements listed.

_____ Give evidence that the testing plan focuses on gaining objective and measurable testing data from the highest priority items on the design requirements list.

______ Give written context to all artifacts presented that provides the reviewer a full understanding of the related work.

30 pts	25 Pts	15 pts	10 pts
All essential items are addressed.	5 essential items are addressed.	4 essential items are addressed.	3 or less essential items are addressed.

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element I
Testing the prototype

Many engineering and product failures are well documented. Most of the infamous examples involve tragedies such as bridge collapses, oil leaks, or an event that has a major negative impact on the environment or people. In fact, many engineering and product failures occur that few people ever hear about. Some products fail because they do not sell – they may not have been marketed well or they may not be desirable. But often a product fails because it does not perform the intended or advertised function or because it breaks easily. A product that does not perform the function for which it was purchased has little value at any cost. A lot can be learned from visiting the clearance aisle where many failed consumer products end up.

Students designed their test(s) in the previous lesson. In this lesson they will carry out their tests and determine whether or not their designs meet the product specifications. Based on testing results, students may have to face some tough decisions about their next steps. If the results of the test(s) indicate that their design does not meet the expectations, they may have to return to a previous step in the design process to rethink and revise the design. The critical design review should provide clarity about how to move forward.

Assessment

Data Results and Testing Analysis

1. Documentation of project evaluation by multiple, demonstrably qualified stakeholders and field experts is presented and is synthesized in a consistently specific, detailed, and thorough way.
2. Documentation is sufficient in two or more categories to yield meaningful analysis of that evaluation data.
3. The synthesis of evaluations consistently addresses evaluators' specific questions, concerns, and opinions related to design requirements.

Essential Questions

______ What do end-users and experts directly related to this project and problem statement think of the testing results and my conclusions about the effectiveness of this idea?

_______ Evidence that several quantitative tests for high priority requirements were created.

Demonstration of understanding of the testing procedures including

_______ gathering and analysis of resultant data

_______ Tests should include multiple trials

______ The analysis of the effectiveness with which the design met stated goals of the design requirements.

______ A consistently detailed explanation and summary of the data from each portion of the testing procedure.

The analysis and overall summary of the implications of all data

______ review what validates the tests performed and the analysis process of those tests.

______ Use of pictures, graphs, charts and other visuals.

Written context to all artifacts presented that provides the reviewer a full understanding of the related work?

10 Pts	8 Pts	6 pts	4 pts.
All essential questions and what they include are addressed	7 essential questions and what they include are addressed	6 essential questions and what they include are addressed	5 or less essential questions and what they include are addressed

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element J

At this point in the design process it is important to have your process and results evaluated by outside experts and stakeholders in the project. Were the results obtained and your analysis unbiased?

Assessment

Documentation of External Evaluation

1. Documentation of project evaluation by multiple, demonstrably qualified stakeholders and field experts is presented and is synthesized in a consistently specific, detailed, and thorough way.
2. Documentation is sufficient in two or more categories to yield meaningful analysis of that evaluation data; the synthesis of evaluations consistently addresses evaluators' specific questions, concerns, and opinions related to design requirements.

Essential Questions

_____ What do end-users and experts directly related to this project and problem statement think of the testing results and my/our conclusions about the effectiveness of this idea?

_____ Documentation of a detailed design review by multiple, demonstrably qualified stakeholders and field experts?

_____ Justification about how well the results have met the design requirements and goals of the project?

____Written context to all artifacts presented that provides the reviewer a full understanding of the related work?

10 Pts	8 Pts	6 pts	4 pts.
All essential questions and what they include are addressed	3 essential questions and what they include are addressed	2 essential questions and what they include are addressed	1 essential questions and what they include are addressed

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element K

Assessment

Designer Reflection on the Process

1. The project designer provides a consistently clear, insightful, and comprehensive reflection on, and value judgment of, each major step in the project.
2. The reflection includes a substantive summary of lessons learned that would be clearly useful to others attempting the same or similar project.

Essential Questions

______ If I were going to do this project over, what should be done differently during the design process to improve the project and how would those recommendations make the project better overall.

_______ Prioritized recommendations to others redoing this project where you would suggest more focus and effort?

_______ Justification why these recommendations might have led to better results for you or your team.

_______ Written context to all artifacts presented that provides the reviewer a full understanding of the related work.

10 Pts	8 Pts	6 pts	4 pts.
All essential questions and what they include are addressed	3 essential questions and what they include are addressed	2 essential questions and what they include are addressed	1 essential questions and what they include are addressed

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element L

Assessment

Presentation of Designer's Recommendations

1. The project designer includes consistently detailed and salient recommendations regarding the conduct of the same or similar project in the future.
2. Recommendations include caveats as warranted and specific ways the project could be improved with consistently detailed plans for the implementation of those improvements.

Essential Questions

_______ Did I document each step of the design process in this portfolio well enough that anyone else interested in the problem could pick up this work and both replicate what I have done as well as continue working from where I ended up.

_______ Recommendations regarding the conduct of the same or similar project in the future should someone choose to continue your work.

_______ Recommendations on how the project could be improved with consistently detailed plans for the implementation of those improvements.

_______Written context to all artifacts presented that provides the reviewer a full understanding of the related work.

10 Pts	8 Pts	6 pts	4 pts.
All essential questions and what they include are addressed	3 essential questions and what they include are addressed	2 essential questions and what they include are addressed	1 essential questions and what they include are addressed

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Element M

Documentation of the critical design and review presentation.

_______ Includes the slide presentation.

_______ List of the stakeholders that you presented to.

_______ Includes the feedback that the stakeholders gave during the presentation.

_______ List of all element citations in appendix format.

10 Pts	8 Pts	6 pts	4 pts.

All essential questions and what they include are addressed	3 essential questions and what they include are addressed	2 essential questions and what they include are addressed	1 essential questions and what they include are addressed

Date	Grade	Date	Grade	Date	Grade	Date	Grade

Group Name

Due Date	**Element**	**Current Grade**	**Previous grade**	**Previous grade**	**Previous grade**
	A				
	B				
	C				
	D				
	F				
Semester 1 ends					
	G				
	H				
	I				
	J				
	K				

	L				
	M				
	N				

Research Notebook Scoring Sheet

Team Members:

Team project:

The Research Notebook will be assessed once a week.   5pts/week

Scoring Sheet

Date	Points	Total

Scoring Sheet

Date	Points	Total
