

2nd Semester STEM Project Competition Mars Biosphere Challenge

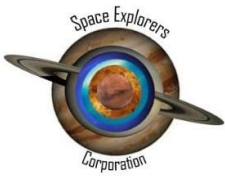


10TH GRADE STEM

BIOSPHERE DESIGN BOOK

Name: _____ Group # _____





2nd Semester STEM Project Competition Mars Biosphere Challenge

Electronic Engineering Journal Guidelines

Each group member must detail their work through the 8 steps of the Engineering Design Process. Students will be graded individually on their contributions to this collaborative assignment.

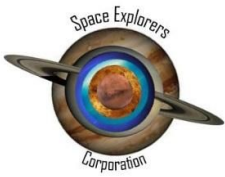
General Formatting

- Create a google doc within shared group folder “2nd Semester Group #1”
- Title document file name as “Engineering Journal Group 1”
- Header in document with company name and number
- Assign each group member a unique color, as shown below
 - Group Member 1 - Red
 - Group Member 2 - Blue
 - Group Member 3 – Green

Notebook Content

- Individual entries for every time work is done on the project
- Including every work period and additional work done individually or as a group
- First entry should be about March 10th ELB and testable prototype decision
- Every entry **must** be dated
- Pictures to support journal entries and prototype development
- Clearly details each individual journey through the EDP 8 Steps

**Engineering Journal will be checked at random throughout the project.
Make sure your Journal is up to date at all times!!!!!!**



2nd Semester STEM Project Competition Mars Biosphere Challenge



STEP 1: Identify the Problem

Mars Biosphere Design Challenge: Design a Mars Biosphere that is the best appearing (form) and achieves the selected performance (function).

AWARDS

1. **Best Appearance and Design (form)**
2. **Best Sustaining Food Web (function)**

DESIGN CRITERIA:

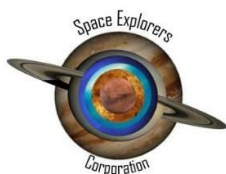
- Design a unique free standing or hanging biosphere
- No prefabricated aquarium or aquarium parts are allowed
- Biosphere will remain in the MHS greenhouse during testing
- Approved materials and organisms
 - Must 3D print a minimum of 1 component
(points added for additional prints)
- Completely sealed – only student input is natural heat & light (no electricity)
- Minimum 2" by 2" Dry access hatch – for teacher use

PERFORMANCE CRITERIA Part 1:

- Must keep all organisms alive for 6 weeks
- Create and maintain an authentic food web

PERFORMANCE CRITERIA Part 2:

- Must create a Biosphere Distress Switch system to alert the colony of problems in the Biosphere, using an electronic switch, battery pack and LED light



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STEP 2: Research the Problem

Individually complete each of the brainstorming questions based on your prior knowledge and what you have learned in Biology.

A. Bottle Biosphere Brainstorm

What are the essential components of a sustainable ecosystem? Remember what you learned about food webs.

Draw a preliminary sketch of how a successful bottle biosphere would be laid out. Be sure to label all materials (ie. soil, sand, water, terrestrial plants, etc.) and highlight the food web within your biosphere.

What are 3 competitive advantages to your design?

1 _____

2 _____

What are 3 drawbacks to your design?

1 _____

2 _____



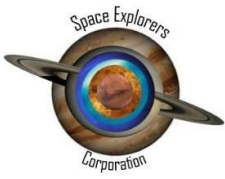
B. *Mission to Mars Research*

This image shows a blank sheet of white paper with horizontal ruling lines. On the left side, there are several short, vertical black lines that serve as margins, creating a series of narrow columns. The rest of the page is filled with evenly spaced horizontal lines, typical of notebook paper. There is no handwriting or other markings on the page.



Mars Atmosphere Research

This image shows a blank sheet of white paper with horizontal ruling lines. On the left side, there are short vertical lines that serve as margins, creating a series of narrow columns. The rest of the page is open space for writing.



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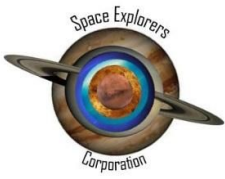
Mars Biosphere Challenge

List any sources used for your Mars research in **APA format**.

C. ***Ecosystem Research***

Define an ecosystem?

What are the essential components of a sustainable ecosystem?



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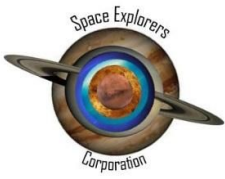
Mars Biosphere Challenge

D. ***Water Cycle Research***

Analyze the water cycle in writing and a diagram.

E. ***Oxygen and Carbon Cycle Research***

Describe the oxygen and carbon cycles and analyze their importance in a successful ecosystem.



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*List any sources used for your ecosystem research in **APA format**.*

Individually conduct thorough research of at least 2 past and/or existing biospheres.

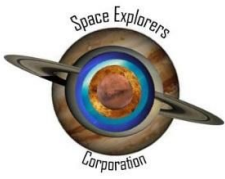
F. First Biosphere (*ie. Biosphere 2 in Arizona*)

Biosphere name: _____ Owner/founder: _____

Biosphere location: _____ Dates in use: _____

Describe the purpose of this biosphere. _____

Analyze the functionality of this biosphere. How does it work?

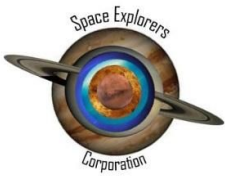


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Mars Biosphere Challenge

If the biosphere failed, explain why and what necessary components were missing.

Analyze the biosphere design and layout in writing and a diagram.



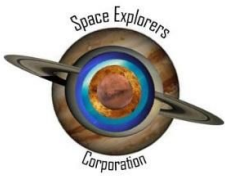
2nd Semester STEM Project Competition Mars Biosphere Challenge

Describe 2 positive design features that improve the functionality of the biosphere.

What materials were used to construct this biosphere and why?

Would these materials hold up on Mars? Why or why not?

List any sources used for your first biosphere research in **APA format**.



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Mars Biosphere Challenge

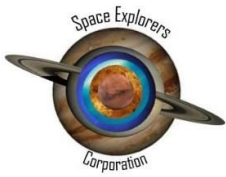
G. Second Biosphere (*ie. Mars on Earth*)

Biosphere name: _____ Owner/founder: _____

Biosphere location: _____ Dates in use: _____

Describe the purpose of this biosphere. _____

Analyze the functionality of this biosphere. How does it work?

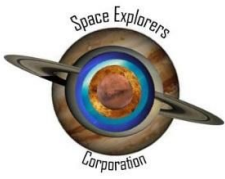


2nd Semester STEM Project Competition

Mars Biosphere Challenge

If the biosphere failed, explain why and what necessary components were missing.

Analyze the biosphere design and layout in writing and a diagram.



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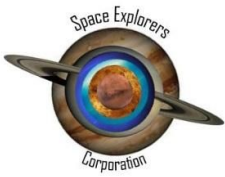
Mars Biosphere Challenge

Describe 2 positive design features that improve the functionality of the biosphere.

What materials were used to construct this biosphere and why?

Would these materials hold up on Mars? Why or why not?

List any sources used for your second biosphere research in **APA format**.



2nd Semester STEM Project Competition Mars Biosphere Challenge

Research Paper Requirements:

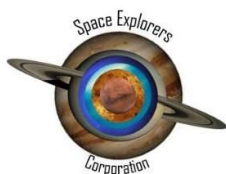
Each member in the group will write an individual research paper for Steps 1 and 2 of the EDP based on the research you have completed in the booklet. Proper APA formatting is required. Reference Owl Purdue for any questions on APA formatting. Cover sheet must include your name, company name, group number and logo. A reference page and in-text citations are necessary. Refer to the student handbook for plagiarism policy.

The minimum requirement for sources must include:

- 1 print source (book)
- 2 databases
- 1 abstract (picture, graph, pamphlet, etc)
- 1 of your choice

All sources used in the research paper will require a source sheet.

Assignment:



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EDP Step 1 (1 paragraph)

You must identify the problem or need and include all design and function criteria. Paraphrase the information you were given in this booklet in your own words.

EDP Step 2 (4+ pages)

Remember the purpose of this project and keep your audience in mind. Your end goal is to pitch your company and your prototypes to NASA in hopes they will invest in your company. You should research NASA's real plans for Mars, specific to your testable prototype, and prototype specific conditions on Mars to show them you did your homework and are knowledgeable about their company. For example, if you are doing a biosphere they don't want to read about the Mars Rover.

When discussing your specific prototype, be sure to include all information on form and function. Discuss successful product designs that already exist along with common prototype successes and failures. Discuss how those existing prototypes work and what materials are used.

Synthesize your research in a thoughtful conclusion and generate ideas for your own product design.

Due Dates:

_____ Minimum of 5 source sheets to be checked by Mrs. Shomphe

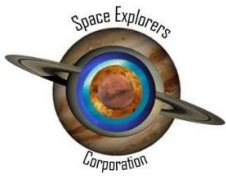
_____ Rough draft due in ELB for peer editing. Must be printed before the start of ELB to not disturb others or inconvenience the class.

_____ Prototype design – brainstorming pictures (due in Homeroom)

_____ Final paper (due in Homeroom)

What you will need in the final packet to be handed in on paper:

1. Checklist (will be provided by the teacher)
2. All rough drafts with peer, parent, and self-editing forms
3. Workbook research
4. Prototype design – brainstorming pictures



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5. Grading rubric

Due in Google Classroom:

6. Final paper with cover sheet and reference page

Late Work:

You will lose 10 points for every day the final assignment is handed in late. Any paper or project handed in after the 5th day will receive a grade no higher than a 50. Hand in all work on time to receive full credit and to be able to participate in all editing activities. Late rough drafts will not be accepted for late credit during the writing process BUT they should still be completed for personal feedback and to receive credit in the final packet.

Research Paper Grading Rubric:

Each group member will submit a unique research paper on their prototype topic that adheres to the rubric below. This assignment is due _____.

Formatting Requirements:

Formatting Requirements:

Separate APA cover page, including

- ☐ Final company logo and company name and number

Possible Points

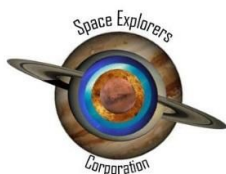
/5

General Formatting

- ☐ Final packet is arranged in the correct order from the checklist
- ☐ Page numbers
- ☐ Times new roman font size 12
- ☐ At least 1.5 spacing

/5

Topic Development and Conventions



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- ☐ Proper spelling and grammar (less than 3 errors)
- ☐ Appropriate vocabulary written in third person
- ☐ Use of strong diction and syntax

/6

Citations and Reference Page (**WARNING: Any paper that is plagiarized will result in an overall grade of a zero! Be sure to check your citations and paraphrase in your own words.**)

- ☐ Properly formatted APA in-text citations
(minimum 1 parenthetical citation per paragraph) /5
- ☐ Separate APA reference page, including
 - Title "References," center aligned
 - Alphabetical order of sources
 - Hanging indentations
 - Retrieval dates included for web-based sources
- ☐ At least 5 different sources *included in your paper*
Must include: 1 print source, 2 databases,
1 abstract source and 1 of your choice /5

Research Paper Documents

- ☐ Handed in on paper:
 - o Brainstorming sheet, source sheets, all rough drafts, parent, peer and self-edit forms
- ☐ Submitted Electronically:
 - o Final Paper

/10

Total /40

WARNING: Any paper that is plagiarized will result in an overall grade of a zero!
Be sure to check your citations and paraphrase in **your own words**.

Content Requirements:

➤ EDP Heading Format

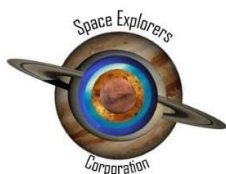
- ☐ Bold, center aligned subheading for each major heading
(i.e. EDP Step 1: Identify the Problem or Need)
- ☐ Bold, left aligned subheading for each research section or subheading /4

➤ EDP Step 1: Identify the Problem or Need Specific to Your Testable Prototype

- ☐ Problem is completely restated with all design and function criteria /3

➤ EDP Step 2: Research the Problem

- ☐ **Target audience research**
 - NASA's real plans for Mars specific to your prototype /14
- ☐ **Life on Mars**
 - Prototype specific conditions specific to your prototype /14
- ☐ **Prototype Form and Function**



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- At least 2 successful existing product designs for your prototype
 - Positive prototype design functionality
 - Common prototype failures and problems
 - Prototype functionality (How does it work?)
 - Prototype materials
 - Prototype material characteristics and properties
- /30
- **Summary**
- Thoughtful conclusion summarizing your research
 - Synthesize information to generate your product design ideas
 - Overall WOW factor – Make your paper stand-out!
- /16

Total /80

All assignments are due in classroom by midnight of the specified date. Late work will be penalized 10% per day, **including vacations and weekends**. Reports more than 5 days late will receive a grade no higher than a 50.

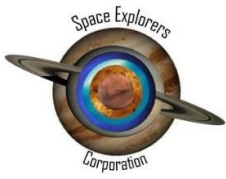
STEP 3: Develop Possible Solutions

H. Connect Your Research to Your Mars Biosphere

You must synthesize the extensive research you completed on Earth biospheres to your Mars biosphere design.

Argue the best engineering solution based on the research conducted.

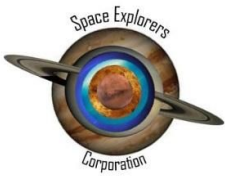
How should the biosphere be laid out? Describe and sketch your proposed biosphere bottle labeling each component.



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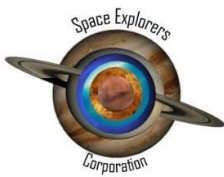
What materials will be used to build your biosphere and **WHY?** (Refer to your research!)



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List any sources used for your biosphere research in **APA format**.

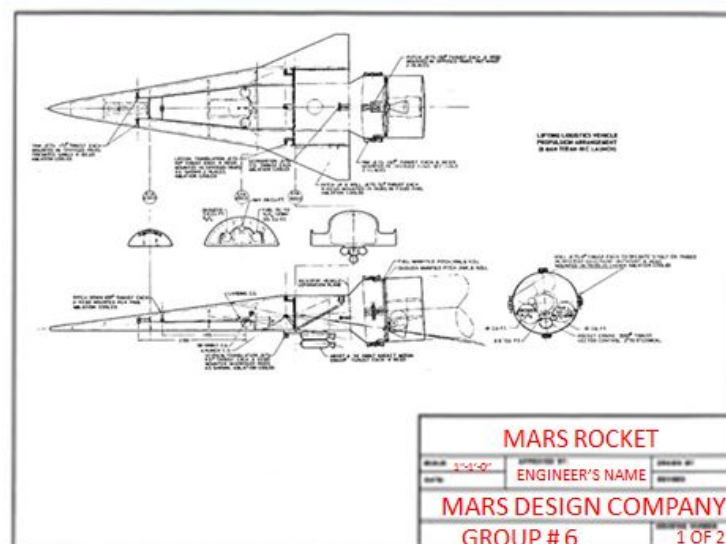
STEP 4: Select the Best Possible Solution

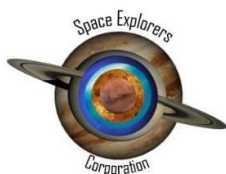


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Share your individual sketches with your group members. As a group design the best possible engineering solution for your proposed Mars Biosphere.

	50 - 40 POINTS	39 - 20 POINTS	19 - 0 POINTS
TITLE BLOCK	The Title Block is completed with ALL the following headings & information: <i>Engineer's name, company logo, company name, company number, date, part name, scale.</i>	The Title Block is completed with 2 or less headings & information sections missing	The Title Block is completed with 3 or more headings & information sections missing
MULTI-VIEW DRAWINGS	<u>All required</u> multi-view drawings are completed using the orthographic projection method. Properly displaying ALL 3 views with correct scale, engineering techniques and standards.	Multi-view drawings are completed using the orthographic projection method. Properly displaying views with SOME scale, engineering techniques and standards.	Multi-view drawings are partially completed and/or NOT completed at all
DIMENSIONING	<u>ALL</u> dimensions are illustrated with proper engineering standards. The dimensions allow for the prototype construction.	Dimensions are illustrated with SOME engineering standards. The dimensions allow for the prototype construction.	There are very few dimensions illustrated or there are NO dimensions.
NOTATIONS	<u>ALL</u> necessary notations are used for understanding and prototype construction.	SOME notations are used for understanding and prototype construction.	NO notations are used for understanding and prototype construction.
ISOMETRIC DRAWINGS	<u>All the required</u> isometrics are completed using engineering drawing standards and techniques.	Isometrics are completed using SOME engineering drawing standards and techniques.	Isometrics are completed using little engineering drawing standards and techniques. Isometric NOT completed.





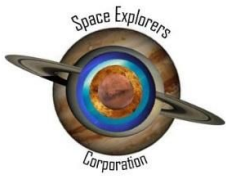
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STEP 5: Construct a Testable Prototype

Utilize the group's Engineering design plans to construct the best testable prototype that addresses all form criteria from STEP 1.

	20 - 18 POINTS	17 – 10 POINTS	10 - 0 POINTS
Prototype Construction	The prototype's parts are constructed with <u>GREAT</u> detail and precision. <u>ALL</u> parts fit with <u>GREAT</u> accuracy and tolerance.	The prototype's parts are constructed with <u>SOME</u> detail and precision. Parts fit with accuracy and tolerance.	The prototype's parts are constructed with <u>LITTLE OR NO</u> detail and/or precision.
Prototype Form & Finish	The prototype is finished with <u>GREAT</u> care. Painting, coloring, detailing, material cutting, assembly and material representations are completed with <u>GREAT</u> detail.	The prototype is finished with <u>SOME</u> care. Painting, coloring, detailing, material cutting, assembly and material representations are completed with <u>SOME</u> detail.	The prototype is finished with <u>LITTLE</u> care. Painting, coloring, detailing, material cutting, assembly and material representations are completed with <u>LITTLE OR NO</u> detail.
Design Plan Utilization	The prototype is constructed following the <u>ENTIRE</u> set of engineering plans. <u>ALL</u> redesigns (if any) are noted and illustrated.	The prototype is constructed following the set of engineering plans. Redesigns (if any) are noted and illustrated.	The prototype is constructed <u>WITHOUT</u> following the set of engineering plans. Redesigns (if any) are <u>NOT</u> noted and/or illustrated.
Prototype Function	The <u>ENTIRE</u> testable prototype's intended function is <u>COMPLETELY</u> demonstrated.	The testable prototype's intended function is demonstrated.	The testable prototype's intended function <u>CANNOT</u> be demonstrated.





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MATERIALS AND PARTS

3D Modeling Materials

2 Liter Soda Bottles

Nylon Cord

Silicone Sealant

Duct Tape

Soil

Sand

Water

Terrestrial Plant

Aquatic Plant

Fish

(1) Electric Switch

(2) Battery Packs

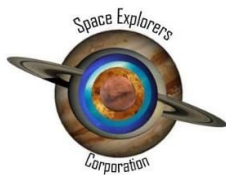
(2) LED Lights

(36") Wire



DESIGN QUESTIONS / PARTS & MATERIALS ACQUISITION

As a group complete and submit the supplies order form on the next page.

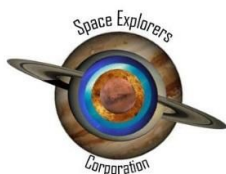


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Company Name: _____ Company Number: _____

Biosphere Prototype Development Supplies Order

Provided Material	Quantity	Intended Purpose
2 liter soda bottle		
Nylon cord		
Silicone sealant		
Duct tape		
Soil		
Sand		
Water (Pond or Tap)		
Maximum of 2 Terrestrial Plants		
Maximum of 2 Aquatic Plants		
1 Fish		
1 Electric Switch		
Maximum of 2 Battery Packs		
Maximum of 2 LED Lights		
Maximum of 36 Inches of Wire		



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Print Parts (3D Modeling Material)		
Purchased Material	Quantity	Intended Purpose

DESIGN/CONSTRUCTION/TESTING RULES AND REGULATIONS

1. All final prototypes must completely resemble the engineering plans (reengineering is acceptable if accompanied by plans)
2. ALL additional materials require a written approval
3. No direct external help – company members only (research and information only) or the group will be disqualified!
4. **BEST APPEARANCE:** WILL BE DECIDED BY A BALLOT
5. **MOST SUSTAINABLE:** Measured and recorded by members of the **SPACE EXPLORERS CORPORATION**.
6. **SPACE EXPLORERS CORPORATION** members have the final decision on any design, testing or time discrepancies. Any rules violations can cause disqualified or added time to the test. It is up to each company to inquire with any concerns or questions they may have. NOT understanding or NOT knowing a rule is NOT a defense for any a rules violation.

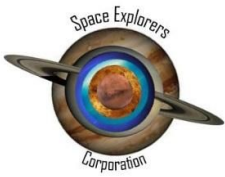
STEP 6: Test the Prototype

Prototype Form: The Biosphere will be judged on form by ballot for the Best Appearance and Design Award.

Prototype Function: The Biosphere function will be tested on the criteria below for the Best Sustaining Food Web Award.

PERFORMANCE CRITERIA Part 1:

- Must keep all organisms alive for 6 weeks



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- Create and maintain an authentic food web

PERFORMANCE CRITERIA Part 2:

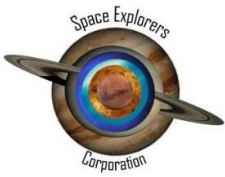
- Must create a Biosphere Distress Switch system to alert the colony of problems in the Biosphere, using an electronic switch, battery pack and LED light

STEP 7: Communicate the Solution

The final Biosphere prototype will be presented by the group at the STEM Expo, including all final design deliverables.

FINAL DESIGN DELIVERABLES

1. Engineering Design Process (8 steps)
2. Brainstorming sketches and notes – minimum of 1 different design per company member
3. Final Drawings – Creo / Hand Sketching or Autosketch – orthographic and isometric (*must be completed before the construction and assembly*)
4. Creo Parts STLs
5. Electronic Engineering Journal
6. **Final Biosphere ready to be sealed by the assigned date**



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Name: _____ Group # _____

Marketing Guidelines and Final EDPs

Target Market

points

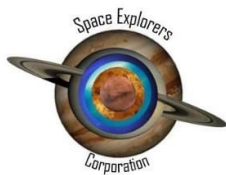
Who is your target market? Who is going to buy your designs (testable and colony prototype)? Be specific and explain why.

Individual Assignment 10

What type of media is appropriate for your audience and why?(Examples: online, newspaper etc.)

What competitive advantage does your company have and explain why?

How do other aerospace engineering companies market their products and services?
What type of media do they use?



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Updated Brochure **points**

Group Assignment 15

Electronically created tri-fold brochure, including:

- ☐ Company specifics (name, logo, “about”)
Members names, roles and pictures
- ☐ Colony information (name, image, specifics, selling points)
- ☐ Testable prototype information (name, image, specifics, selling points)
- ☐ Link to your website
- ☐ Well-developed and thought out

Website Advertisement **points**

Group Assignment 30

Students are to develop a website to advertise their colony and testable prototype using Weebly.com

Final website must include:

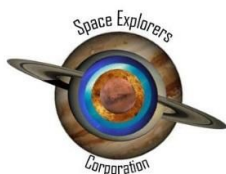
- | | |
|---|----|
| <input type="checkbox"/> Company specifics | /6 |
| ✓ Name and number | |
| ✓ Logo | |
| ✓ Members names and titles | |
| <input type="checkbox"/> Product specifics | /8 |
| ✓ Name | |
| ✓ Price | |
| ✓ 3-D virtual image and/or photograph | |
| ✓ At least 3 selling points | |
| <input type="checkbox"/> Clear understanding of the target audience | /2 |
| <input type="checkbox"/> Appropriate spelling and grammar and sophisticated vocabulary | /2 |
| <input type="checkbox"/> Details the group’s journey through the EDP steps | /6 |
| <input type="checkbox"/> Effort -Advertisement demonstrates hard work and creativity (WOW factor) | /6 |

Final Company EDP Binder **points**

Group Assignment 30

Technical Report

- ☐ Cover page on front of binder
- ☐ Complete Testable Prototype EDP, in order with **each step clearly labeled**
 Steps 1 and 2 - All members’ research papers
 Step 3 - All members’ sketches



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Step 4 - Final testable prototype drawings

Step 5 - 3-D virtual drawing of prototype or photograph of physical prototype

Step 6 - Report testing performance, issues and redesigns with pictures

Step 7 - Final company brochure and website print out

Step 8 - Redesign

Identify at least three changes to the solution to make it more successful

Clearly show or explain why each change will improve the solution

- All members' completed Colony EDP Books

Presentation Display

Prototype

Group Assignment 50 points

- Prototypes are constructed and finished with great care
 - ✓ Colony prototype model maximizes the audience's understanding of the solution
 - ✓ Testable prototype functionality is demonstrated to meet challenge criteria

Poster

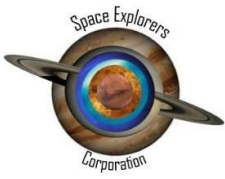
Individual Assignment 50 points

- Tri-fold poster boards are well-thought out
 - ✓ Each member creates a unique tri-fold poster
 - ✓ Tri-folds clearly show a **unified** group project
 - ✓ Highlights important company info (name, logo, members and titles)
 - ✓ Details your journey through EDP steps (including technical drawings)
 - ✓ Maximizes the audience's understanding of the solution
 - ✓ Markets the product to the target audience (advertising strategy)
 - ✓ Overall WOW factor – Make your display stand-out!

Presentation

Individual Assignment 50 points

- Oral presentation
 - ✓ Allows for equal speaking opportunity among members
(Each member presents role specific requirements)
 - ✓ Details the group's journey through the EDP steps
 - ✓ Maximizes audience understanding of the solution
 - ✓ Markets the product to the target audience
 - ✓ Speak clearly and expressively, with enthusiasm
 - ✓ Uses a tone and volume appropriate to audience
 - ✓ Establishes genuine rapport with audience (good eye contact and posture)
 - ✓ Appropriately dressed (business casual attire)



2nd Semester STEM Project Competition Mars Biosphere Challenge

STEP 8: Redesign

Each group member will select one specific component to analyze and improve the Biosphere. Describe in detail your changes below:

Group Member 1:

Group Member 2:

Group Member 3:
