

## NASA Engineering Challenges: Scoring Criteria

The NASA Engineering Challenges program is a competition between six different teams from three different Community Colleges. The following rules and scoring criteria are meant to make this competition equitable for all teams. Your final competition site is at the Kennedy Space Center and you will be competing in four different challenges: High Altitude Balloon Experiment Challenge, Hydro Powered Rocket Challenge, Robotic Vehicle Challenge, and a Multimedia Deliverable Challenge. The Balloon, Rocket, and Robotic Challenges are all introductory versions of NASA's traditional challenges/projects targeted at four year universities. The Multimedia Deliverable Challenge will require you to document your preparation leading up to the final competition and upload a video to YouTube. This will also give you a way to share your project with your University, peers, and anyone else in the world including potential internship or job prospects.

### **1. Multimedia Deliverable**

In this challenge you will create a video and upload this video to YouTube for judging. Videos can only include authorized content, including - without limitation, music, images, film clips and other intellectual property. You can use any type of video editing software you wish. If you do not have any editing software, YouTube has a free editing program built into its site.

#### Video Criteria:

- a) Design, create, edit and complete a 5 to 10 minute video based on your team and what they did during the practice/preparation part of the competition. The minimum time for your video is 5 minutes and the maximum is 10 minutes. Your video will be played at the competition held at the Kennedy Space Center in June.
- b) Your video must be able to stand on its own without the need for a presenter. One should be able to watch the video and know how your team prepared for the challenges.
- c) Include your test failures and triumphs for a given challenge. For example, show a successful rocket launch and one that was not so successful and explain why.
- d) Use at least four of the following elements: Titles, opening or ending credits, Narration, Music, Transitions, Special Effects, Chroma Key, Video Clips, and Still Images.
- e) Share the video on YouTube.

#### Judging Criteria: 100 points

- 1) 25 points – Your team will receive 5 points for each of the completed 5 components (a. through e.) of the Video Criteria for a total of 25 points.
- 2) 60 points – All three challenges are represented in your video with a wide array of settings and different situations.
- 3) 15 points – Attention to Detail: Video quality is good, sound is clear, titles and credits are visible, video follows a logical order and makes sense.

## 2. High Altitude Balloon Experiment Challenge

You and your team are to develop an experiment to be placed in a payload package on a weather balloon and collect the desired data for analysis. The proposal will have a 2 page minimum with a 4 page maximum (not inclusive of the sensor layout diagram). You will write a proposal for your experiment as a team and scored on the following:

### Proposal – 80 points:

- Title of Proposal/Question being answered - What question do you want answered with your experiment? (10 points)
- Significance of the question - What is the significance of your question? Why did it need to be asked? (15 points)
- Background science related to the question - What is the science related to your particular question and research? (20 points)
- Budget and parts list – Provide a list of sensors and a detailed parts list, including the necessary tools to assemble your payload. Also, a detailed list of websites where items can be purchased. All items must be purchased from a United States seller. A cost for each item must be included with a total item budget that does not exceed \$100. (10 points)
- How will analysis of data be conducted? - How will your collected data be examined? (15 points)
- References (10 points)

### Payload integration and data retrieval – 20 points:

- Assembling your sensors, batteries, etc. in the payload enclosure. (10 points)
- Retrieving data from your sensors. (10 points)

## 3. Hydro Powered Rocket Challenge

The challenge itself is simple to outline: You will be given two chances to launch your rocket to a specified altitude and then two chances to achieve a specified speed. The better of the two launches will count towards your final score. The accuracy of each result will be calculated as a percentage and the two will then be averaged for a final score.

### Scoring Example:

The challenge asks you to launch your rocket to an altitude of 50ft and then to a speed of 50mph.\* Your two launches for altitude reach 40ft and 55ft. Your two launches for speed reach 47mph and 54mph. The percentages will be  $A, S = 1 - |(X/50) - 1|$  where X is the result you achieved, A is your altitude percentage and S is your speed percentage. Then the final percentage will be calculated by  $\% = (A+S)/2$ . Since in this case the results closest to the challenge specifications were 55ft and 47mph, your percentages would be 90% and 94% giving a final score of 92%. \*The challenge will not ask for 50ft and 50mph.

#### 4. **Robotic Vehicle Challenge**

All challenges will be performed on a mock lunar surface. The dimensions of the surface are 16" x 16" (4.9m x 4.9m). Your robot will navigate this surface that includes a rough terrain, inclines, declines, and even craters to avoid. The only vision you will have on the surface is what you will see through the camera attached to your robot (provided the day of the challenge). The camera has a viewing angle width of 60 degrees. All programs executed will be done wirelessly via Bluetooth. The robot you create, whether through a new design or using the schematics given, will have to meet the following criteria:

- Ground clearance of at least 2.5cm from point of contact with a surface to the lowest section of the robot.
- Must include a place to mount the camera (Dimensions: 1.45" x 1.45" x 0.8"). The mounting bracket attached to the back of the camera is part #4552349 named *3x3 Dark Stone Gray TBeam*. We have one pre-attached to the cameras.
- Must have an attached robotic arm with grip capability.

There are two ways for the session for your team to be over. One is if the time limit of 1 hour is reached. The other is if your budget has been depleted, thus leaving an inability to run programs and continue (See Budget). Finally when all teams have performed, the team with the most points will be the victors (See Scoring).

##### Challenges:

There will be 10 objectives at 10 different locations across the surface. Your task is to complete as many of the objectives with the least amount of programs in the allotted time.

You can tackle the objectives in any order you want, and can use as many programs as your budget allows to accomplish each objective. You should attempt to accomplish the challenges in as few programs as possible. The challenges are separated into 3 tiers. Each of the 3 tiers will be of a particular task with multiple locations on the surface:

- Tier 1 Challenge: Four of these. Precision navigation for sample reading.
- Tier 2 Challenge: Three of these. Object obstruction removal and sample reading.
- Tier 3 Challenge: Three of these. Sample transportation and collection.

##### Scoring:

Your team will receive points according to the difficulty of the challenge. This is on top of receiving additional money to your budget for completing challenges (See Budget).

- Tier 1: 15 points each
- Tier 2: 30 points each
- Tier 3: 45 points each

1 point will be converted from every \$1 million the team has remaining.

You must be working to accomplish goals for the entire hour. Competition monitors reserve the right to deduct points for and proportional to excessive idle time.

##### Budget:

- \$150 million is each team's initial budget.
- \$3 million cost for each program that is executed.
- \$6 million penalty for every 30g over the requested max 1.5kg.
- Each challenge is within a tier and will give a particular payout for completion.
  - Tier 1: \$15 million each
  - Tier 2: \$30 million each
  - Tier 3: \$45 million each

Additional time:

In order to clear up any possible mishaps that can occur during the competition the following scenarios have been considered and courses of action listed:

- Robot tips and rolls due to excessive incline
  - no extra time added.
- Robot becomes unable to move because of crater or small hill
  - no extra time added.
- Loss of Bluetooth communications occurs
  - extra time added equaling amount of time communications is out.
- Loss of camera feed occurs
  - extra time added equaling amount of time camera feed is out

In general, if operator error is the cause of the problem, no extra time will be added. Any scenarios not listed will be decided either when possible scenario is brought to our attention beforehand, or if/when it occurs in the field.

## FINAL SCORING CRITERIA AND WEIGHT

Since the Rover Challenge is the most difficult and challenging it will be given twice the weight as the Ballooning Challenge, which is the simplest. The Rocket Challenge will be weighted 1.5 times that of the ballooning challenge. The Multimedia Deliverable will have the lowest available points because it is the easiest to complete.

### **1. Multimedia Deliverable**

- First place = 1.5 points
- Second place = 1 points
- Third place = .5 point

### **2. Ballooning Challenge**

- First place = 3 points
- Second place = 2 points
- Third place = 1 point

### **3. Rocket Challenge**

- First place = 4.5 points
- Second place = 3 points
- Third place = 1.5 points

### **4. Rover Challenge**

- First place = 6 points
- Second place = 4 points
- Third place = 2 points

To determine the final winner, the scores for all 4 competitions will be added up.