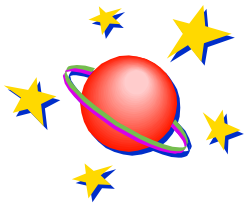
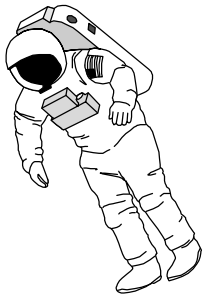




NASA WANTS YOU. . .

CENTER I: DESIGNING A ROBOT ARM - TIME LIMIT=30 MINUTES

NASA wants to be prepared for any kind of emergencies. Your company has been invited by NASA to design the **most efficient** and **least expensive** robot arm for their planetary exploration rover. This robot arm has to be able to lift an emergency escape pod, and bring it back safely to base. Therefore, you'll be provided with the following:

1. $7,000 to buy the components you and the members of your team feel are necessary to build a model of the most efficient and cheapest robot arm.

2. NASA will loan you a model of a rover and a model of their escape pod so that you can test your robot arm design.

3. The attached price sheet to help you figure out what you can buy.

4. The attached rubric to show you how you will be evaluated for this activity.

Guidelines:

1. Remember that you have a limited amount of time to decide which components to buy, to build your arm and to test it. Therefore, you must work well with your colleagues and listen to one another. Part of your success (grade for this activity) will be determined by how well you work together.

1. When you have completed a test of your robot arm, take a photo to keep in your company's records.

2. When you finish building your robot arm and complete the price chart, answer the Extension Questions on page 2.

Project Objective: To design an efficient and low cost robot arm that can lift and safely bring back an escape pod. The best design will get a contract from NASA.

ROBOT ARM COMPONENT PRICE LIST - TOTAL BUDGET=$7,000

COMPONENT	PRICE PER UNIT	NUMBER OF UNITS	TOTAL COST
Motor	$1673		
Grab arm set	$650		
2 1/2 inch connector	$325		
4 1/2 inch connector	$575		
7 1/2 inch connector	$750		
10 inch connector	$1,125		
2-way connecting pieces:			
a. 3/4 inch	$50		
b. 1 inch	$75		
c. 1 1/4 inch	$125		
d. 1 1/2 inch	$150		
90º angle- connecting piece	$200		
3-way connecting piece	$250		
Cables	$79		

Hint: Remember that you have limited time to complete this activity. Use your multiplication skills to figure out what you can afford to buy.

**** Complete the price sheet above. On the back, show two different strategies your team members used to calculate the cost of your robot arm. (You can work in groups, but each member of the team must complete and show the calculations)**

EXTENSION QUESTIONS (Make sure to write in complete sentences)

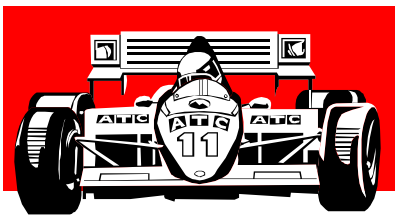
1. What aspects of this activity did you find difficult and why?

2. What aspects of this activity did you enjoy and why?

3. This activity shows how mathematics, science, and technology are used by scientists in their work. Give an example of another activity about space exploration that would help people understand how mathematics, science and technology are important subjects that affect our lives?

4. Members of your team probably used different methods to do the calculations necessary for buying robot arm parts. In what way was your method different from that used by your colleagues?

Galaxy Race



Galaxy Race

CENTER II: GALAXY RACE

You've been waiting for this moment all your life. You have finally been invited to participate in the most important race in the galaxy!! **The Mars Galaxy Race.** People from Earth and all the colonies come to this annual event. Money raised at this event is used to support scientific research on all the major diseases affecting humans. The winner of the race gets to decide how much money is set aside to fight each major disease.

In preparation for the race, you and your team members must work together to practice controlling your race rover around many obstacles. Remember that the surface of Mars is very rough and you may encounter different obstacles. Nobody knows the exact location of the race on Mars, so you must be ready for anything.

Guidelines: To practice for this race, you need to do the following:

1. Avoid knocking the flags on your course.
2. You must place four more obstacles on your course, and avoid running into them.
3. Measure the distance (d) your rover travels over your course.
4. Have at least two team members use stop watches to measure the time (t), it takes your rover to travel the distance of your course. Then calculate the average time (add the two time values and divide by two), and write in chart below.
5. Have a member of your team take a photo of your racecourse, rover and your team.
6. Calculate the velocity (v) or speed of your race rover after each trial on the data table below. Find the average velocity for your 3 trials (add the 3 velocities & divide by 3).

Race Rover	**Distance (d=inches)**	**AverageTime (t=seconds)**	**Velocity = d/t**
Trial 1			
Trial 2			
Trial 3			
			Average=

Hint: To calculate the average velocity, you must add all three velocity values and then divide by three.

Extension Questions

1. Think about the features of the Mars' surface, what other factors do you think could influence the speed of your rover?

2. You hear that another team has a rover that is three times faster than yours. What is the velocity of that rover?

3. You also hear that the team from the Moon Base has a rover that is 2 times slower than yours. What is the speed of their rover?

4. You now must decide who will drive the rover on behalf of your team, who would you vote for to be the main driver and why?

5. If you could change something about this activity what would change and why?

CENTER III: WHAT DO HUMANS WEIGH ON DIFFERENT PLANETS?

Mariana, Monica, Jasmine, Maria, Jose, Miguel and Tony have been selected to explore the solar system. Maria—who is the mission commander—said to Tony—who is the communications specialist--that if he could play basketball on Mars he could jump almost three times higher as he would on Earth. Is Maria right?

Guidelines:

1. Use the table to figure out if Maria is right. You can use a calculator for this activity.
2. If Maria weighs 150 pounds and Tony weighs 180 pounds, what is the weight of Maria and Tony on each of the planets in the solar system? Hint: To find what a person would weigh in the gravitational field of another planet, multiply the person's weight on Earth times the gravitational pull listed in the table below.

Planet	Gravitational Pull (compared to Earth)	Period of Revolution (compared to earth)
Mercury	0.38	87.9 days (0.241 Earth years)
Venus	0.91	224.7 Earth days (0.615 Earth years)
Earth	1.0	1.0 Earth year
Mars	0.38	686.9 Earth days (1.88 Earth years)
Jupiter	2.54	11.9 Earth years
Saturn	0.93	29.5 Earth years
Uranus	0.8	84.0 Earth years
Neptune	1.2	164.8 Earth years
Pluto	????	248.5 Earth years
The Sun	28	Not applicable

Extension Questions:

1. Using the table provided above, you could also calculate how old you are in different planets. To calculate, for example, how old you would be in Jupiter, you would have to divide your actual age by Jupiter's period of revolution (that is, how long it takes

for the planet to rotate around the sun in Earth years). Select three planets and calculate your age if you were on each of these planets.

2. If you could play basketball on any of the planets of the solar system, where would you prefer to play, and why? (Hint: Remember that not all planets are solid bodies).

3. Create 2 additional story problems for a member of your group using the table above. Be sure to make an answer key to check their work. Exchange your problems with a friend.

ASSESSMENT

Center I: Robot Arm Activity ---Evaluation Rubric (0= poor to 4=excellent)

At the end of this lesson the student was able to:

	Poor	Fair	Good	Excellent
1. Work collaboratively with other team members	0	1	3	4
2. Successfully complete price table	0	1	3	4 (X2)
3. Show two different strategies for calculations	0	1	3	4 (X2)
4. Design a robot arm	0	1	3	4
5. Complete the mission (lift a escape pod)	0	1	3	4
6. Complete extension questions	0	1	3	4 (X2)

TOTAL SCORE _____

Center II: Galaxy Race ---Evaluation Rubric (0= poor to 4=excellent)

At the end of this lesson the student was able to:

	Poor	Fair	Good	Excellent
1. Work collaboratively with other team members	0	1	3	4
2. Successfully complete velocity table	0	1	3	4 (X2)
3. Design course with four obstacles and 2 flags	0	1	3	4
4. Complete the obstacle course using the rover	0	1	3	4
5. Complete extension questions	0	1	3	4 (X2)

TOTAL SCORE _____

TEACHER NOTES:

1. Make a list of the possible intended learning outcomes (ILO's) for each of the centers mentioned here and connect them to the Standards and Benchmarks for your District/State.

2. Suggested student grouping: Divide your class into four groups (paying attention to gender, ethnicity and ability…) and follow the chart below. Note that the grab arm center has two identical stations (A & B)

Center	Session I (15 min each)	Session II (15 min each)	Session III (15 min each)	Session IV (15 min each)
I. Robot Arm - A	Group 1	Group 1	Group 3	Group 3
Robot Arm - B	Group 2	Group 2	Group 4	Group 4
II. Galaxy Race	Group 3	Group 4	Group 1	Group 2
III. Weight	Group 4	Group 3	Group 2	Group 1