THE PLANETARY SOCIETY

The Planetary Society's ***Red Rover Goes to Mars Training Mission***

Student Navigator Journal Form

Your answers on this form should total 1,500 words or less.

If you have downloaded this form from the Internet, please print it. Fill in your answers, and submit this journal when applying for Student Navigator. Answer all the questions. Please print clearly or type. This form is 7 pages long. You do not have the entire form unless you have all seven pages. Write your name on the back of all 7 pages. Do not write on the Journal Form Line Drawing.

STUDENT APPLICANT NAME: FIRST MIDDLE LAST

Check which LEGO system was used for answering questions #1through #4:

☐ Red Rover, Red Rover
☐ ROBOLAB Team Challenge Set
☐ LEGO MINDSTORMS Robotics Invention System
☐ LEGO Dacta Control Lab

Where was this system located?

NAME OF INSTITUTION (IF IN A HOME, WRITE 'RESIDENCE') STREET ADDRESS

CITY STATE/PROVINCE POSTAL CODE

COUNTRY PHONE NUMBER (NON-U.S. INCLUDE COUNTRY CODE)

First used the system: Date ____/____/____ (MM/DD/YY) Time of day I began work _____ a.m./p.m.

Last used the system: Date ____/____/____ (MM/DD/YY) Time of day I began work _____ a.m./p.m.

Total number of days, hours, or minutes that I used the system: Days_____ Hours_____ Minutes_____
(*Remember, total time on the system is* ***not*** *a factor in the selection of Student Navigators.*)

Instructions: Write the answers to all journal questions in the space right below each question.

Question #1

Part 1. When you first commanded your LEGO robot to move, did it move further than you expected, not as far as you expected, or about as far as you expected?

Part 2. Imagine your robot has ***one*** camera mounted on it. Everywhere your robot moves, the camera takes a picture of the terrain ahead. *If you use the picture to make decisions on where to move the robot next, this is called* ***teleoperation***. What is the difference between the picture of the terrain taken by the camera and the view that human eyes would see looking at the actual terrain ahead? Why are they different? Indicate whether this difference makes *teleoperation* easy or hard to do, when you are trying to make your robot move to one particular place?

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Questions #2 through #4*: Answer these questions by considering the general knowledge and experience you have gained in operating robots on your LEGO system.*

Question #2 Consider this information below, and then answer Part 1 and Part 2.
When student Simonetta first teleoperated her LEGO rover, her first command was to drive forward. For that movement she set the power on the lowest possible setting and set the length of time she should move forward to 5 seconds. She gave her rover three additional commands on the same terrain. The table below shows Simonetta's four commands, the power settings, and the length of time of each movement.

COMMAND	POWER SETTING	LENGTH OF TIME
COMMAND #1: MOVE FORWARD	LOWEST	5 seconds
COMMAND #2: MOVE FORWARD	HIGHEST	1 second
COMMAND #3: MOVE FORWARD	LOWEST	10 seconds
COMMAND #4: MOVE FORWARD	HIGHEST	4 seconds

Simonetta noticed that COMMAND #2 *made the rover travel a longer distance than* COMMAND #3*.*

Part 1. Simonetta's rover is on the same terrain as when it was given the commands above. The rover is ***very far*** from a small rock but can drive straight to it. Simonetta would like to drive the rover to the rock giving as ***few*** commands as possible. It is okay for the rover to drive over and beyond the rock on the last command. Simonetta may teleoperate the rover by giving the same command again and again, but every command given, even if it is repeated, counts as another command. Which one of the four commands above should Simonetta use to get to the rock, and why?

Part 2. Simonetta's rover is on the same terrain as before, but it is ***very close*** to a large rock right ahead. Simonetta needs to touch the rock gently with the touch sensor at the front of the rover. Which one of the four commands above gives Simonetta the most ***control*** and opportunity to refine the course approaching the rock, and why?

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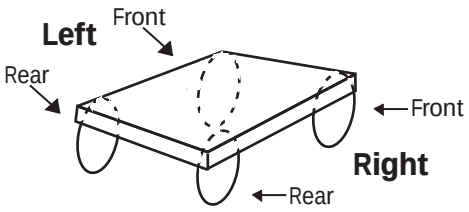
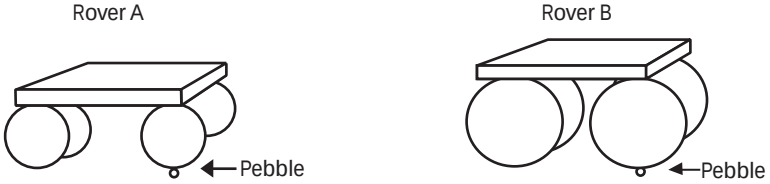
Question #3 Answer Part 1 in the space above the rover drawing; answer Part 2 using the drawing.
Part 1. The rover below (pictured from the top) has four wheels (dashed lines allow you to "see through" the rover to show all four wheels). The rover has two motors, which are not shown. They are identical motors, and the rovers wheels are all the same size. The left motor controls the front and rear left wheels. The right motor controls the front and rear right wheels. The motors always turn the wheels with equal power and for the same length of time. Student Adila gives the rover a command. The command makes the left motor turn the left wheels forward ***at the same time*** the right motor turns the right wheels backward. What do you think Adila commanded the rover to do?



Part 2. Assume each of the rover's wheels will leave a line in the sand as the rover moves. Using the drawing, draw the beginning of the rover tracks in the sand, starting from the bottom of each wheel, to illustrate where you think the rover will move because of Adila's command.

Question #4 First consider the information below, and then answer Part 1 and Part 2.
The two rovers below are shown from the side. Rover A has small wheels which are all the same size. Rover B has big wheels which are all the same size. A pebble is stuck to the bottom of one wheel of each rover and won't come off even when the rovers move.



Part 1. If the two rovers travel the same distance on the same terrain, which pebble will have gone around the wheel it is stuck to the most times, the pebble stuck to the bottom of Rover A's wheel or the pebble stuck to the bottom of Rover B's wheel, and why?

Part 2. Rover A and Rover B are at the starting line of a race on identical terrains. The winner of the race will be the rover that is ahead when the rover's motors have turned the wheels one complete revolution. Which rover do you wish you were teleoperating if you wanted to win the race, Rover A or Rover B, and why?

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Questions #5 through #11 require you to study your *Journal Line Drawing* on page 7. Follow these instructions to complete this part of the journal.

The Journal Line Drawing pictures a hypothetical Mars Terrain with many regions. There are many interesting rocks on the terrain. The color of the rocks in the drawing can be determined by whether or not there are lines on the rocks. Diagonal lines indicate a dark reddish color in the area marked by these lines. If a rock has no diagonal lines on it, then consider the rock to be bright reddish everywhere. If a rock has diagonal lines on part of it, then consider the rock to be dark reddish in the area marked by the lines, and bright reddish everyplace else. If the entire rock has diagonal lines across it, then the rock is dark reddish everywhere. (Using the Line Drawing Legend will make it easy to determine the color of each rock in the Line Drawing.) If a rock or any portion of the ground has any other color not found in the Line Drawing Legend, it will be labeled by color. No rocks are named, so any labels indicate color or other descriptive information. Only regions have actual names, such as "Region South America," and the area within the dashed lines, beneath the region name, shows what the rover will encounter if it travels there. (There is no special significance attached to a region name — each region is named for one of the seven continents on the Earth — except to identify it from other regions.)

Your microrover is the same as the *Marie Curie*, with all the same instruments. The expected lifetime of your microrover is seven days and no more. All the areas in the picture that are labeled as regions can be reached by the rover in one day, regardless of which area you are starting from, with time left over to take one APXS (Alpha Proton X-Ray Spectrometer) reading on a rock or soil in that region. (You may assume your microrover may maneuver anywhere within each region necessary to take the APXS reading and that all portions of the rocks or soil in the region may be accessed by the APXS.)

You may not travel to areas that are not labeled as regions.

Your microrover might die in less than seven days. It might die after the first day, or after the second day, or after the third day, and so on. For the purposes of this journal exercise, the rover will last the full seven days, but you must still make your plans for rover travel as if the mission might be cut off at any moment. Therefore the areas you visit first will be the areas where you think you will learn the most about issues of key importance. On two days of your choosing you may take two APXS readings in one region.

You must plan your commands for the rover based on: 1) what you learned in the days before, 2) what you are curious about just looking at the terrain, and 3) what data the other instruments on the lander have returned. The lander is exactly like the Mars Surveyor 2001 lander, and you get to decide what information is coming from the other lander instruments. **You may cite** such "findings" from **other lander instruments** to explain the reasons for your decisions about rover activities. Even though you may not visit areas that are not labeled as regions, you may talk about how those areas are influencing what you do.

When you visit a region, you may describe the features that the rover visits in terms such as "the large rock in Region Africa." If you are mentioning smaller rocks, you may wish to describe them by shape too: for example, "the small rounded rocks or pebbles on the ground in Region Australia."

When you describe what the rover does, you may use simple terms, such as "Command the Rover to Region Europe" or "Take an APXS reading on the large rock there." When you choose a region to visit or a rock to sample, tell why you went there and what you are trying to learn. Why did you go there now, and not before? Why did you go there first? What new insight might be shed on findings from the lander instruments, by bringing your rover to this region? What visible details led you to go there? What are you <u>not</u> able to see that affects your plans for the rover in that region? And where will you go next, and why?

<u>Question #5</u>

What are your Mars Day #1 or Sol #1 rover commands, and why?

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Question #6

What are you Sol #2 rover commands, and why?

Question #7

What are your Sol #3 rover commands, and why?

Question #8

What are your Sol #4 rover commands, and why?

Question #9

What are your Sol #5 rover commands, and why?

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Question #10

What are your Sol #6 rover commands, and why?

Question #11

What are your Sol #7 rover commands, and why?

Question 12 asks you to describe the way you would handle a conflict between two mission scientists if you were in charge of Mission Operations.

Questions #12

Mission scientists Jacques and Natasha each have strong feelings about establishing evidence for the past existence of water on Mars. The rover is nearing the end of its lifetime. Jacques feels the rover should travel to some rocks that appear in Pancam images to be highly sculpted by wind. For wind to do this, requires airborne sand as an abrasive, and, on Earth, there must be running water to make sand. Natasha feels the rover should go back to the lander and take an APXS reading on the dust that has collected around the magnets. This dust is interesting. Very small particles that are highly magnetic can be interpreted as evidence that iron in the crust of Mars leached out because of groundwater. As head of Mission Operations, you must settle this conflict between these two scientists about what the rover should do next. You agree the rover will probably not last much longer. Jacques and Natasha have good arguments for wanting the rover to go to two very different places to make observations. How will you make your decision, and how does this reflect the way you believe conflicts between people should be handled?

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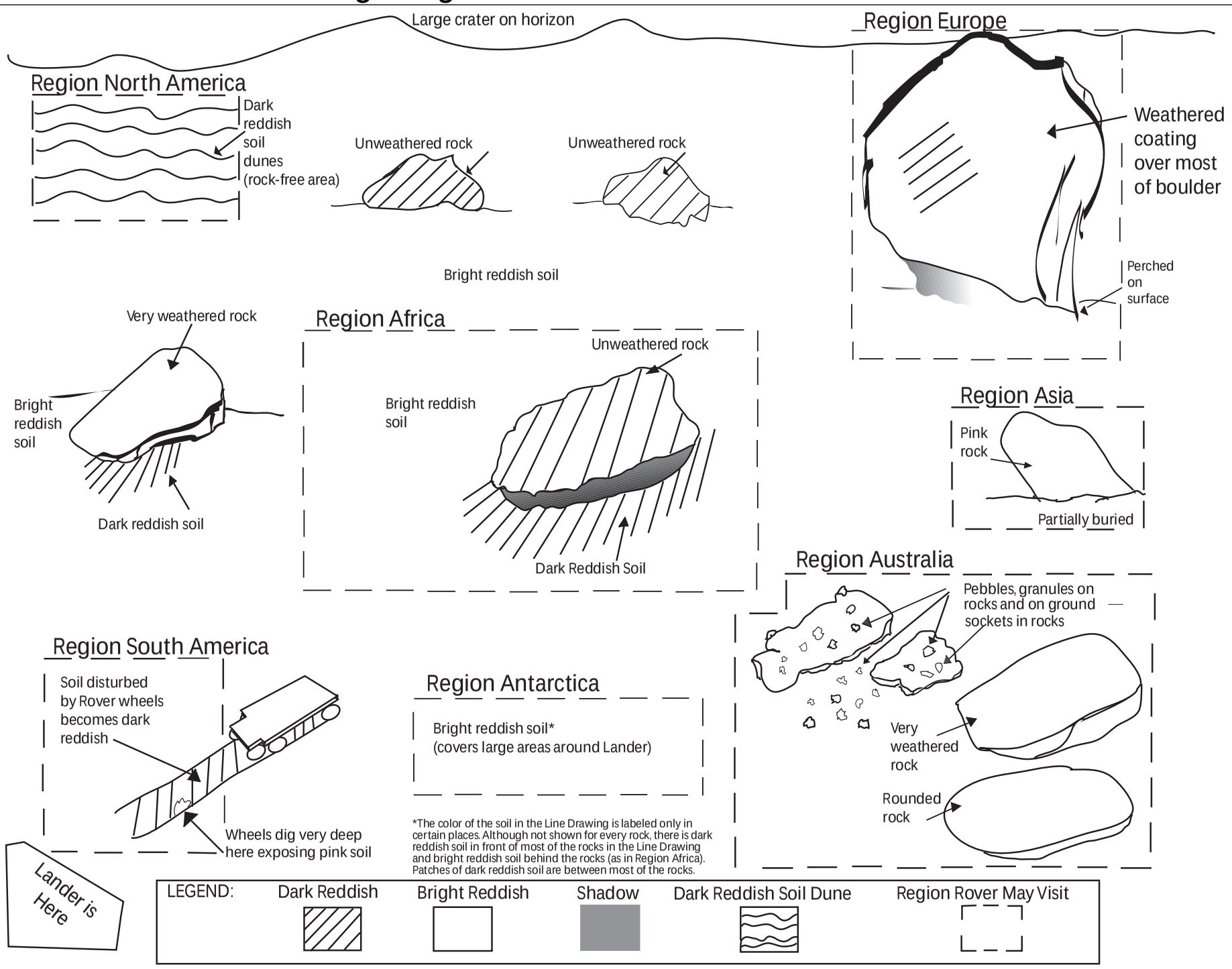
Journal Form Line Drawing – Page 7 of 7



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