Reading and Writing in Science with the CCSS for ELA Reading and Writing in Science and Technical Subjects

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Physical Science in Motion - Elective 7

The article I have chose for this assignment is “Challenges on Mars Landing” (https://www.nasa.gov/vision/universe/solarsystem/mars_challenges.html) This reading activity will be part of Forces unit. After reading this article, students are expected to distinguish what are the forces acting on a object landing to Mars and develop a scientific model for a safer landing on Mars surface.

Before reading the article, there will be a class discussion about the similarities and differences between Earth and Mars. This will help students to activate their prior knowledge about Solar System, EM SPectrum and Forces.

While reading article, students will annotate with various signs; mark a star for the parts that they found interesting, mark question mark if they have more questions about the section, mark with letter asterisk if it is related with a a challenge regarding landing on Mars. Students identify and write down the landing challenges of a Mars probe while reading the article (in bullet form).

After reading article, students will share their highlights (annotations) within their table group, then working as a group they will model how to overcome challenges with safe landing on Mars. Each group will be given a poster paper to draw and describe the factors Mars probe will face during landing and their solutions (as visual representations of their understanding from the article). Then each student will write a proposal letter regarding their Mars probe design and its specifications with description in order to get approval as a NASA engineer.
Following this activity, students will watch videos of Mars Landing (https://www.youtube.com/watch?v=oNviFQpRvwQ , https://www.youtube.com/watch?v=C0lwFLPiZEE) to see the correlation between the article and the real example of Mars landings (CCSS.ELA-Literacy.RST.6-8.9).

Following this reading activity, students will be assigned to design a Planetary Landing Vehicle where they will apply their understanding from the article in a hands-on scenario (CCSS.ELA-Literacy.RST.6-8.3)

Common Core State ELA Standards

CCSS.ELA-Literacy.RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts.
CCSS.ELA-Literacy.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
CCSS.ELA-Literacy.RST.6-8.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.
CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
CCSS.ELA-Literacy.RST.6-8.3 - Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. (This standard will apply for the hands on activity which will be after reading the article.)

Next Generation Science Standards:

3-PS2-1.Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
3-PS2-2. Make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.
3-PS2-3.Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other.

The Challenges of Landing on Mars

Landing on Mars provides some difficult challenges

Two out of three missions to the red planet have failed, a loss rate highlighted by the fact that -- as NASA's Dr. Firouz Naderi puts it --"Mars is a favorite target."

"We -- the United States and former USSR -- have been going to Mars for 40 years," says Naderi, manager of the Mars Program Office at the Jet Propulsion Laboratory. "The first time we flew by a planet, it was Mars. The first time we orbited a planet, it was Mars. The first time we landed on a planet it was Mars, and the first time we roved around the surface of a planet, it was Mars. We go there often."

One reason for the failures is simple: getting to Mars is hard.

To get there, Spirit and Opportunity, the two Mars Exploration Rovers launched this past June and July, will have to fly through about 483 million kilometers (300 million miles) of deep space and target a very precise spot to land. Adjustments to their flight paths can be made along the way, but a small trajectory error can result in a big detour and or even missing the planet completely.

The space environment isn't friendly. Hazards range from what engineers call "single event upsets," as when a stray particle of energy passes through a chip in the spacecraft's computer causing a glitch and possibly corrupting data, to massive solar flares, such as the ones that occurred this fall, that can damage or even destroy spacecraft electronics.

"Mars is the most Earth-like of the planets in our solar system. It has the potential to have been an abode of life."

--Dr. Firouz Naderi, NASA's Mars Program Office

The road to the launch pad is nearly as daunting as the journey to Mars. Even before the trip to Mars can begin, a craft must be built that not only can make the arduous trip but can complete its science mission once it arrives. Nothing less than exceptional technology and planning is required.

If getting to Mars is hard, landing there is even harder. "One colleague describes the entry, descent and landing as 'six minutes of terror,'" says Naderi.

Spirit and Opportunity will enter the martian space traveling 19,300 kilometers per hour (12,000 miles per hour).

"During the first four minutes into descent, we use friction with the atmosphere to slow us down considerably," says Naderi. "However, at the end of this phase, we're still traveling at 1,600 kilometers per hour (1,000 miles per hour), but now we have only 100 seconds left and are at the altitude that a commercial airliner typically flies. Things need to happen in a hurry. A parachute opens to slow the spacecraft down to 'only' 321 kilometers per hour (200 miles per hour), but now we have only 6 seconds left and are only 91 meters (100 yards) off the ground.

"Now, the retro rockets fire to bring the spacecraft down to zero velocity, and we're the height of a four-story building above the surface. The spacecraft freefalls the rest of the way cocooned in airbags to cushion the blow. It hits the ground at 48 kilometers per hour (30 miles per hour) or 80 kilometers per hour (50 miles per hour) if it is windy. It bounces as high as a four-story building and continues to bounce afterward, perhaps 30 times all together.

"What's inside the airbag weighs 453 kilograms (half a ton). So, the challenge of entry, descent and landing is how to get something that massive traveling at 19,300 kilometers per hour (12,000 miles per hour) slowed down in six minutes to have a chance of survival."

Mars doesn't exactly put out a welcome mat. Landing is complicated by difficult terrain. The martian surface is full of obstacles--massive impact craters, cliffs, cracks and jagged boulders. Even the toughest airbag can be punctured if it hits a bad rock. Unpredictable winds can also stir up further complications. (Explore the landing sites for Spirit and Opportunity)

No matter how hard it is, getting to Mars is just the beginning. "The challenge after we land," says Rob Manning, manager of Mars Exploration Rovers entry, descent and landing operations, "is how to get the vehicle out of its cramped cocoon and into a vehicle roving in such a way as to please the scientists."

The rewards are great. "Mars is the most Earth-like of the planets in our solar system," says Naderi. "It has the potential to have been an abode of life."

The risks are also great. "We do everything humanly possible and try to avoid human mistakes," says Naderi. "That's why we check, double check, test and test again and then have independent eyes check everything again. Humans, even very smart humans, are fallible particularly when many thousands of parameters are involved. But even if you have done the best engineering possible, you still don't know what Mars has in store for you on the day your arrive. Mars can get you."

"We are in a tough business," says Naderi. "It is like climbing Mt. Everest. No matter how good you are, you are going to lose your grip sometimes and fall back. Then you have a choice, either retreat to the relative comfort and safety of the base camp, or get up, dust yourself off, get a firmer grip and a surer toehold and head back up for the summit. The space business is not about base camps. It is about summits. And, the exhilaration of discoveries you make once you get there. That is what drives you on."

NASA Jet Propulsion Laboratory
https://www.nasa.gov/vision/universe/solarsystem/mars_challenges.html