Day 1 - Intro to Mars

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Authors: Jessica Laury
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http://engr.utexas.edu/features/7749-alper-yeast-cells-biofuel

An introduction to the fact that biology isn't always connected to space, especially when we think about the red planet. Because there isn't a lot of traditional biology on other planets, at least not that we know of, SynBio gives us an opportunity to bring life to other planets and more importantly to make those biological systems useful. There are challenges we will face as we bring life to Mars and we can utilize synthetic biology to overcome them. Some problems that will be come thematic over the next 10 sessions.

- Weight matters - Every gram we add to the space ship we add expense to the trip
- The average temperature is -80 Fahrenheit (Consider Shelter Needs)
- There are clouds, dust and wind - sometimes dust storms (Consider Shelter Needs)
- 1/3 the gravity of Earth (Think human physiology, bacteria survival and impacts on plants)
- The atmosphere is 100 times thinner than earth and it is 95.32% carbon dioxide, 2.7% Nitrogen, 1.6% Argon, .13% Oxygen, .08% Carbon Monoxide Compare that to Earth with .04% carbon dioxide, 78% Nitrogen, .93% Argon, 21% Oxygen. (think plants)
- Radiation exposure. increase mutation risk, increase cancer risk (Threat for everything we bring with us that is alive)
    - Throughout the entire trip, astronauts must be protected from two sources of radiation. The first comes from the sun, which regularly releases a steady stream of solar particles, as well as occasional larger bursts in the wake of giant explosions, such as solar flares and coronal mass ejections, on the sun. These energetic particles are almost all protons, and, the proton energy is low enough that they can almost all be physically shielded by the structure of the spacecraft. The second source of energetic particles is harder to shield. These particles come from galactic cosmic rays, often known as GCRs. They’re particles accelerated to near the speed of light that shoot into our solar system from other stars in the Milky Way or even other galaxies. Like solar particles, galactic cosmic rays are mostly protons. However, some of them are heavier elements, ranging from helium up to the heaviest elements. These more energetic particles can knock apart atoms in the material they strike, such as in the astronaut, the metal walls of a spacecraft, habitat, or vehicle, causing sub-atomic particles to shower into the structure. This secondary radiation, as it is known, can reach a dangerous level. (Source 4 actually has proposed solutions to this issue)
- All of the biodiversity we have we will have to bring with us (think micribiome, and natural resistance to viruses/bacteria/illness)
- Mars has ice caps, news of lakes came out this week as well (under ground)

Sources for this set

1. https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-mars-k4.html
2. https://nssdc.gsfc.nasa.gov/planetary/factsheet/marsfact.html
3. https://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html
4. https://www.nasa.gov/feature/goddard/real-martians-how-to-protect-astronauts-from-space-radiation-on-mars
5. https://www.nasa.gov/feature/can-plants-grow-with-mars-soil

Activity Goal - To get students thinking about the differences between Mars and Earth, to encourage critical and creative thinking on how to address some of the challenges created by the Mars climate.

K-5 - Mars Art
Supplies

- Colored Pencils
- Scissors (optional)
- Paper (2 sheets per student)

Distribute colored pencils and paper. Have students draw Mars, on its surface include ice caps, wind, radiation both from solar particles and cosmic rays. On another sheet of paper have students draw earth, decorated with weather and climate conditions from our planet (insure that earth is substantially larger than Mars). Have them draw what they think life could look like on Mars, and what life looks like on Earth. What do houses look like? Are there trees? Why or why not? What is the soil and air like on each planet?

This activity can also be completed with clay and play dough using toothpicks to label aspects of the planet.

6th-8th - Meteorologist on Mars
Supplies

- A way to access the internet for students to conduct research
- Poster board or **white board** for students to use as a "green screen" and put information from their forecast
- Markers for the white board or poster
- Video camera (phones work just fine) if students want to record their brief presentation

Have students get into groups of 3 and do some research on the climate, atmosphere, radiation and lack of current biology on Mars. Have students present in the form of a weather forecast for the red planet, taking 3-5 minutes. Students can get creative, is a solar flare in the forecast? Is there a dust storm on the way? Has another ice cap been found?
Students should comment on the unique climate, the atmospheric concentrations of each gas should be present at some point in the presentation (even if just on a poster in the border of the broadcast). Encourage students to dive into what these climate or weather conditions will mean for life on Mars.

9th-12th - Being the Mars Rover - **Tentative activity - not in love with this one.**
Soil samples on Mars
Supplies

- Soil samples - Have students bring in their own sample, a bag of plant potting soil enriched for growing plants will give fun readings, and simulated martian soil
- Soil testing kit (pH, nitrogen, phosphorus, potassium)
- Large juice can with both ends cut out (for percolation test - will only be applicable if you are taking students out to the field)
- Hand lense
- Pie plate/tray
- safety glasses
- 500 mL plastic bottle

Soil - Have students bring in their own samples from home or from around the school campus. They can collect data using the soil testing kit, measure and record pH, nitrogen, phosphors and potassium
Have students conduct the same tests they did on their soil on potting soil enriched for plant growth and on the simulated martian soil. We aren't going to be able to get the real stimulant martian soil we want to use, but we could make something from sand - but we would be missing the nutrients we need.

Loved this activity
https://www.evergreen.ca/downloads/pdfs/garden_school.pdf
http://www.nbcnews.com/id/25396378/ns/technology_and_science-space/t/test-shows-mars-soil-has-nutrients-life/#.W1ds0thKhR0

This activity does not talk about radiation levels, air quality, water and climate on the planet. This will have to be done either with supplemental lecture or with the 6th-8th grade activity.

Already established activities booklet - Pretty much just used the core sample example as inspiration.
https://mars.jpl.nasa.gov/classroom/pdfs/MSIP-MarsActivities.pdf