Handout A: Surface Water on Mars
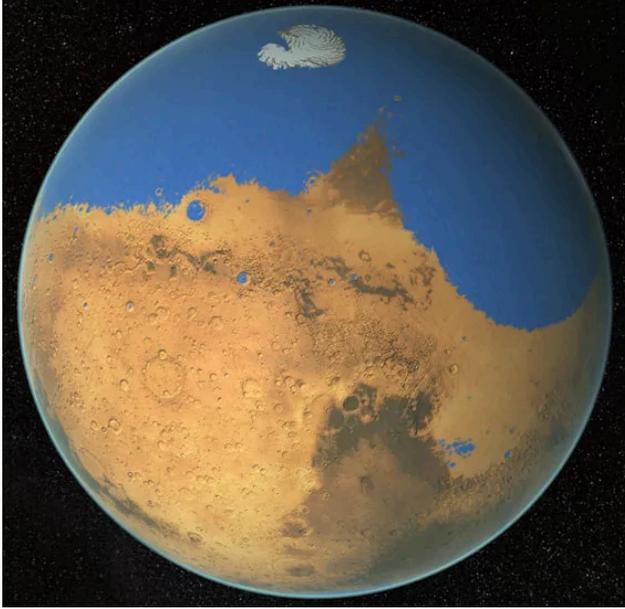

Figure 1. Simulated surface waters of Mars, produced from combined data gathered by NASA's Mars Reconnaissance Orbiter and MAVEN. Image from NASA Goddard (2015).
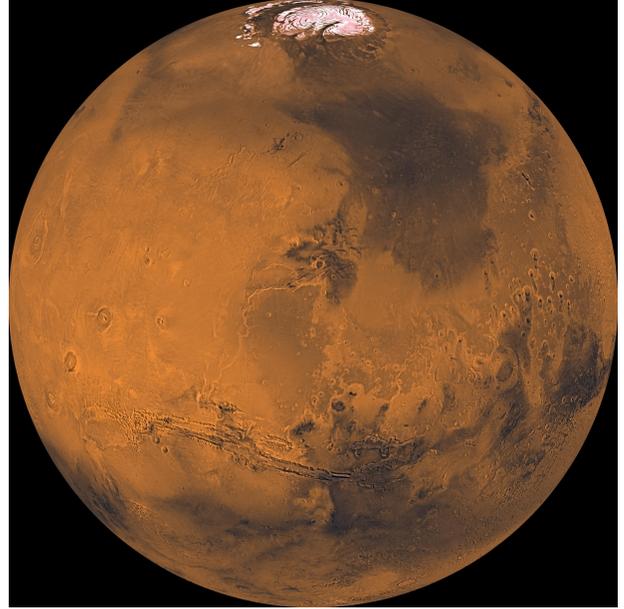

Figure 2. Current surface view of Mars, produced from data gathered by NASA's Viking Orbiter. Image from NASA JPL (1998).

Look at the images above. Then, watch ▶ NASA | Measuring Mars' Ancient Ocean from 2:33 - 2:55.
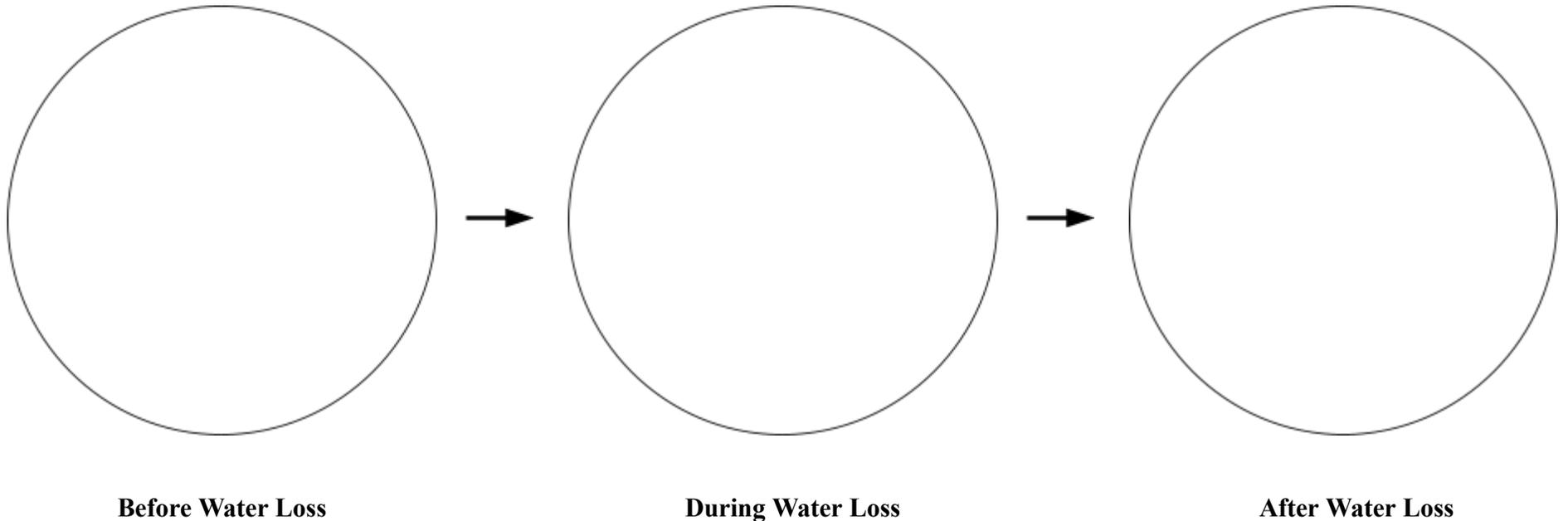
Individually, observe what similarities or differences you see between the two (What do you see?) and reflect on those observations (What do you think about that?). Finally, share with your group and identify some questions you have or things you might need to investigate or know (What does it make you wonder?).

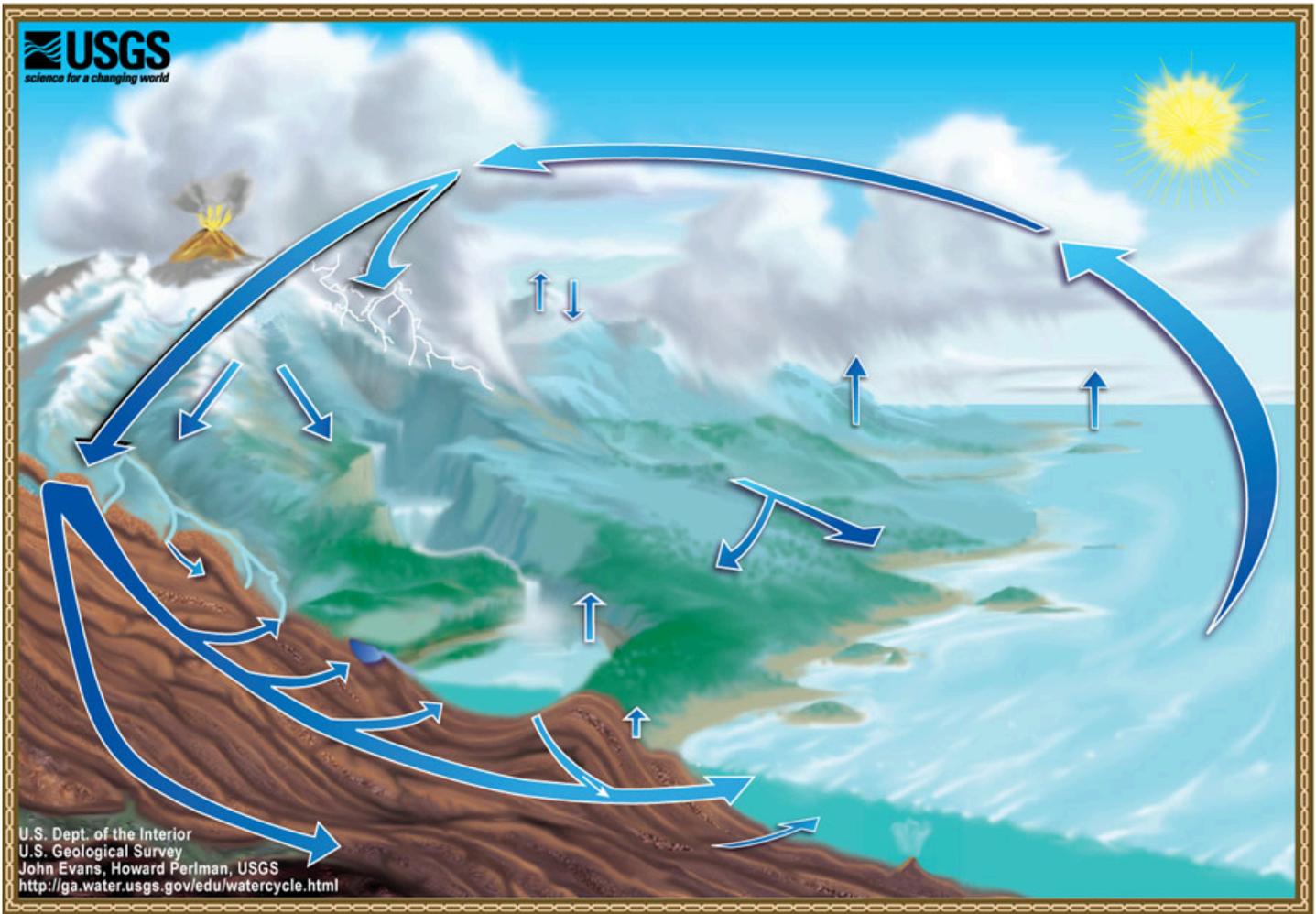| What do you see?	What do you think about that?	What does it make you wonder?

Missing Water on Mars - Initial Model

Think about your observations and questions on the backside of this page. Then, create an initial model of the phenomena showing the change in surface water on Mars, based on the research question: ***What could have caused Mars to lose its surface water?***

Think about visible processes (ex: the change in water coverage) and invisible processes (ex: the role of the atmosphere). Add arrows, drawings, descriptions, etc. to make your thinking visible and, it's encouraged to write down questions: what are things you don't know yet, but may need to know to fully answer the questions?

Before Water Loss   **During Water Loss**   **After Water Loss**

Handout B - Water Cycle Model

U.S. Dept. of the Interior
U.S. Geological Survey
John Evans, Howard Perlman, USGS
http://ga.water.usgs.gov/edu/watercycle.html

Evaporation:

Transpiration:

Precipitation:

Runoff:

Infiltration:

Reservoirs:

1.

2.

3.

NASA Earth's Water Cycle Discussion Questions

1. If NASA can monitor Earth's water, can we monitor/predict water on Mars? And, if so how?

2. What data might we want to collect? **Identify two potential data sources you will need to investigate.**

Sample ideas to think about and discuss:

1. NASA uses satellites and sensors to monitor Earth's water cycle. Scientists might be able to monitor Mars' water cycle by…
2. To predict the presence of water on Mars, we might look for evidence of…
3. To monitor water on Mars, we might want to collect data about…
4. To predict where water currently exists or may have historically existed on Mars, we might look for … in areas of …

Handout C: Investigating the Water Cycle of Mars

Previously, you identified two questions/sources of data you might need to examine in order to fully answer the overall research question, ***What could have caused Mars to lose its surface water?*** Now, you will have the opportunity to explore and find answers to your questions. You may use any source, as long as it is high quality for this portion. Suggested sources are provided. **It is important you keep track of your data collection using the graphic organizer, as this will help you in creating your final model of the phenomenon.**

Some sources to start checking out:
- New water cycle on Mars discovered | Max-Planck-Gesellschaft
- Curiosity Finds Evidence of Persistent Liquid Water in the Past
- Recurring Martian Streaks: Flowing Sand, Not Water? - NASA
- NASA SVS | Flowing Water On Mars
- NASA SVS | MAVEN Infographic: Martian Dust Storms Accelerate Water Loss

Research Question	Data You Need to Collect	What Does that Data Mean? What does it Say?	Importance/Connection to the Phenomenon	Data Source (Include Hyperlink so you Can Go Back to it if Needed)

Background
Up to this point, we have been learning about the major processes involved in Earth's water cycle. In the previous lesson, you examined multiple data sources that described researchers' current understanding of how the surface and atmosphere of Mars has changed over time and connections to the change in water on Mars. Now, you will research desertification, a major environmental impact to Earth's water cycle and connect to the overarching question: ***Could changes that occurred to Mars' water cycle potentially mirror future changes to Earth's water cycle?***

Your Task
You will create an infographic outlining the causes, impacts, and potential solutions to desertification. Additionally, you will use what you learned in the previous lesson to draw connections from Mars to Earth's water cycle. This could be a poster, short story, visual/mixed media presentation, etc. Get creative!

Your infographic must contain the following information:
- Define desertification and describe what causes it
- Locate where on Earth this is <u>currently</u> an issue and where it<u> could be</u> an issue/concern in the future
- Describe <u>at least 2 impacts</u> desertification has on the land and connect them to processes of Earth's water cycle
- Describe potential solutions to the impacts of desertification you identified
- Make connections between Mars' water history and Earth's future water story - could we use Mars as a predictive model?

It is suggested that you use a premade template using your school Canva account - there are tons of options out there. But, if you want a general outline, regarding the sections needed, see the diagram below.

Be sure to cite your sources in APA format. Here's a couple good launching points:
- [Defining Desertification](#) (NASA)
- [Desertification | UNCCD](#) (United Nations)
- [What is desertification and why is it important to understand? | World Economic Forum](#)
- [Desertification or Re-Greening Adaptation Lessons Learned in Coping with Late 20th Century Drought in West Africa | NASA Applied Sciences](#)
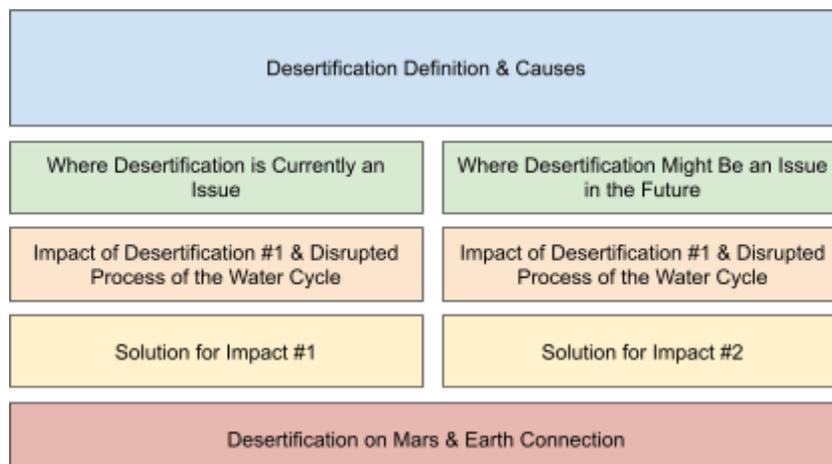
Presentation Peer Review Rubric

Group: _____   **Location:** _____

Component	Present	Absent	Comments
Description of desertification			
Causes of desertification			
ID locations currently impacted			
ID locations that could be impacted in the future			
Description of impact #1			
Connection of impact #1 to a water cycle process			
Discussion of solution to impact #1			
Description of impact #2			
Connection of impact #2 to a water cycle process			
Discussion of solution to impact #2			
Discussion of connection between Earth and Mars			

Identify TWO <u>new</u> things you learned from this research:

Handout E: Missing Water on Mars - Final Model

Think about what you have learned about the water cycle on Earth and Mars. Then, create a final model of the phenomena showing the change in surface water on Mars, based on the research question: ***What could have caused Mars to lose its surface water?***

Think about visible processes (ex: the change in water coverage) and invisible processes (ex: the role of the atmosphere). Add arrows, drawings, descriptions, etc. to make your thinking visible.

Before Water Loss	**During Water Loss**	**After Water Loss**
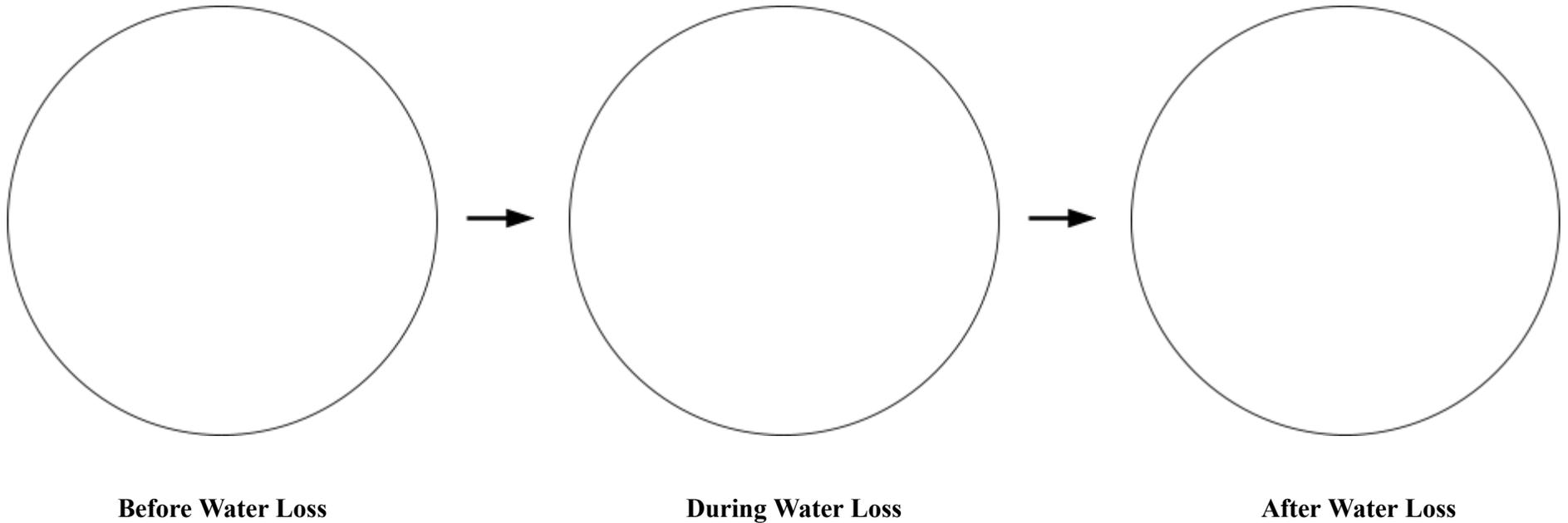
Must Haves:
- ☐ Historical distribution of water
- ☐ Current distribution of water
- ☐ Evidence of water on Mars
- ☐ Role of the thinning of Mars' atmosphere
- ☐ Role of desertification/crust/rocks/surface of Mars