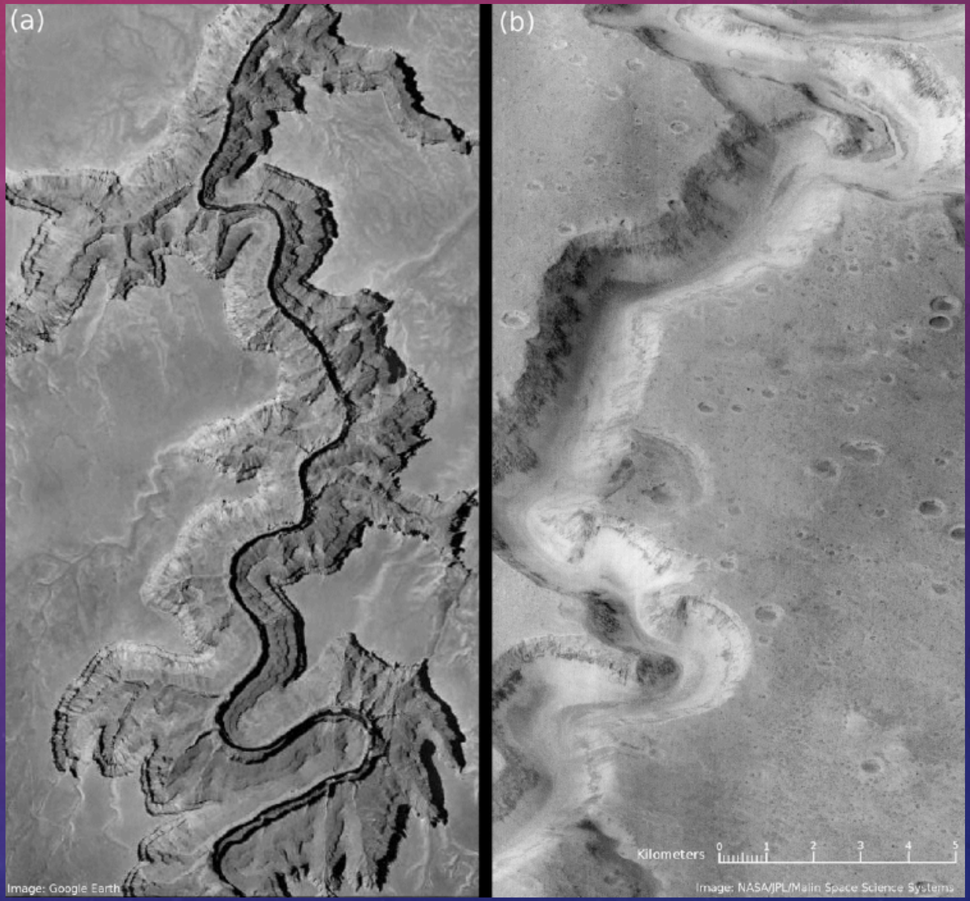
ASTR201 Mars rubric /15 + /6 + /15 + /15 + /15 + /18 + /6 + /10(neatness) = /100

Grade Value	0	1	2	3	Weight
Objective & Introduction	Content missing	Basic content. Non-scientific jargon and wording. Difficult to understand sentences.	Acceptable content. Some attempt at scientific terminology. Sentences acceptable.	Excellent content. Proper use of jargon and scientific wording. Assumptions noted and justified.	5
Grade Value	0	1	2	3	Weight
Procedure	Content missing	Basic content. No special equipment described, minimal description of procedure, no discussion of measurement uncertainties.	Acceptable content. Special equipment noted, important points of procedure noted, basic discussion of measurement uncertainties.	Excellent content. Special equipment addressed and discussed, procedure detailed and informative, measurement uncertainties noted.	2
Grade Value	0	1	2	3	Weight
Observations, Tables & Graphs	Content missing	Basic content. Incomplete information. Tables missing title, or other details. Graphs missing titles, labels, and/or too small. Sketches lacking detail.	Acceptable content. Minor details missing from graphs, tables and sketches, but all major details present.	Excellent content. Tables and graphs complete. Observations thorough.	5
Grade Value	0	1	2	3	Weight
Calculations	Content missing.	Basic content. Many calculations missing. Units and significant figures ignored. No detailed calculations at the end of the report.	Acceptable content. Most calculations present, but some details missing. Units and significant figures use inconsistent.	Excellent content. All calculations included. Units and significant figures present in all calculations.	5
Grade Value	0	1	2	3	Weight
Answers & Results	Content missing.	Basic content. Questions answered simplistically; answers show lack of insight. Results not clearly discussed. Units neglected. No link between objective and results.	Acceptable content. Questions mostly answered correctly. Results mentioned, with spotty units. Weak link provided between objective and results.	Excellent content. Questions answered in detail. Clear connection between objective and results. Units clearly included.	5
Grade Value	0	1	2	3	Weight
Discussion	Content missing.	Basic content. Lacking discussion about expectations, assumptions, and consistency. No discussion about broader context.	Acceptable content. Limited discussion of expectations, assumptions and consistency. Limited discussion of broader context.	Excellent content. Expectations, assumptions and consistency clearly and correctly addressed. Broader context discussed.	6
Grade Value	0	1	2	3	Weight
Conclusion & References	Content missing.	Basic content. Conclusion unclear or lacking insight. References limited or missing.	Acceptable content. Correct conclusion but limited. Some references included.	Excellent content. Conclusion correct and focused. Detailed references included.	2

MISSION TO MARS

10TH OCTOBER, 2019

SENDING ROVERS TO MARS

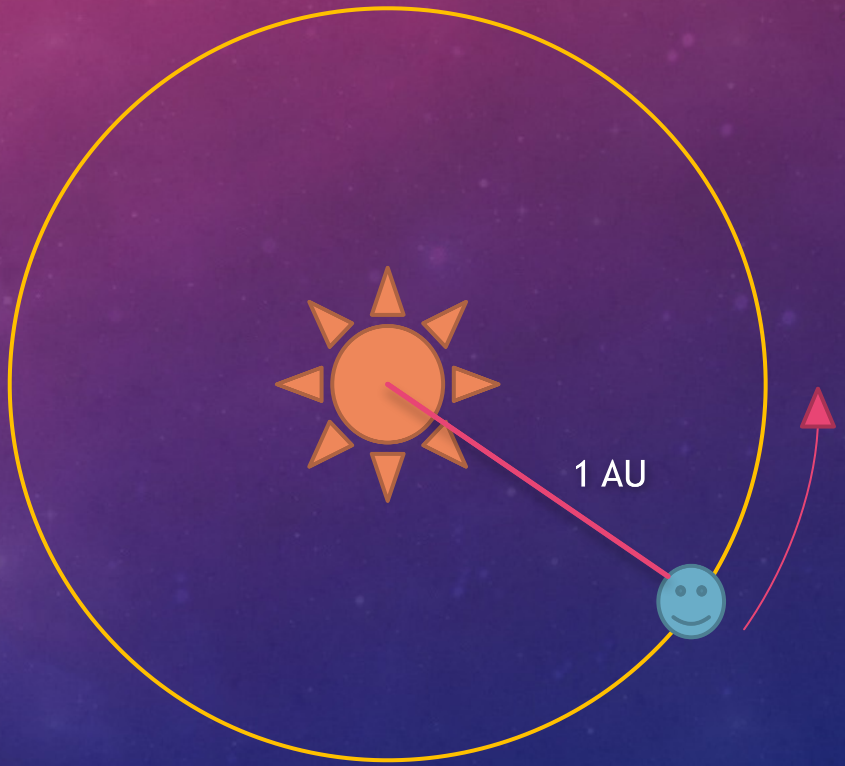


The Grand Canyon   Mars’ Nadedi Valles

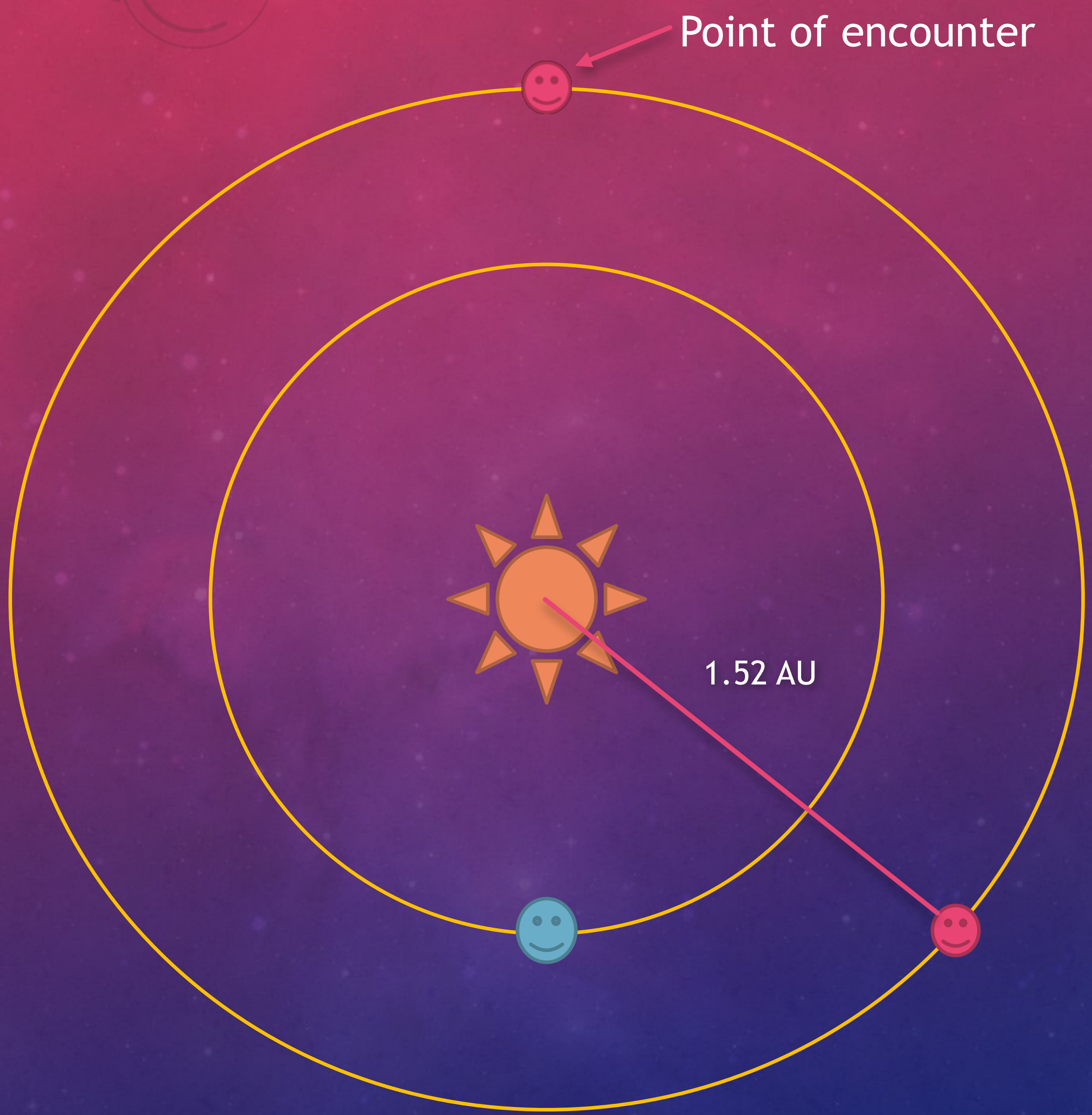
FIRST, WE NEED TO GET THERE

$$P^2 = A^3$$

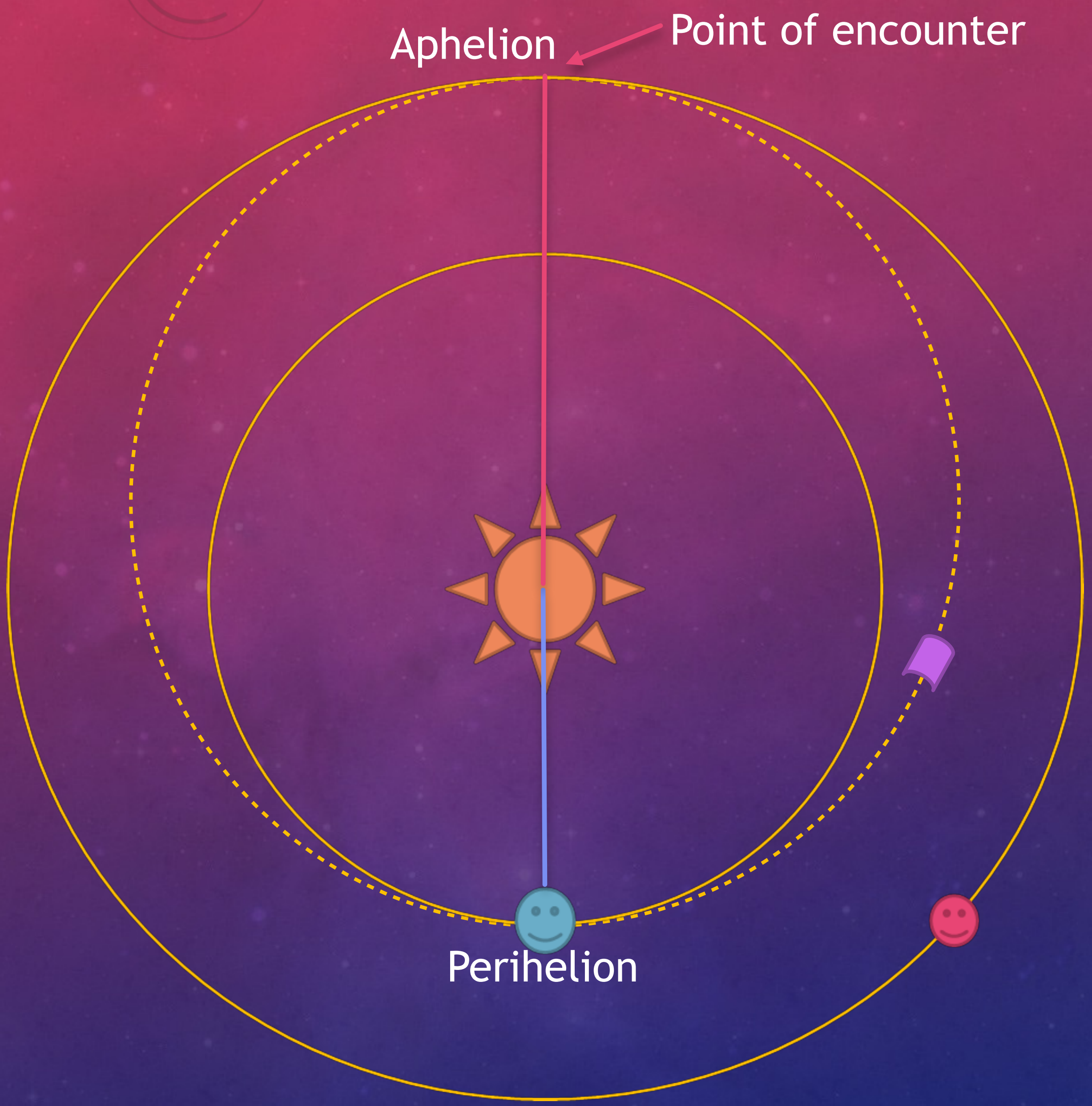
- Where P = Period in years (How long it takes to orbit the sun once.)
- A = Semi-Major Axis in AU. For a circular orbit, A = radius of orbit.
- For the Earth, A = 1 AU
- 1 AU = 1.496e+8 kilometers



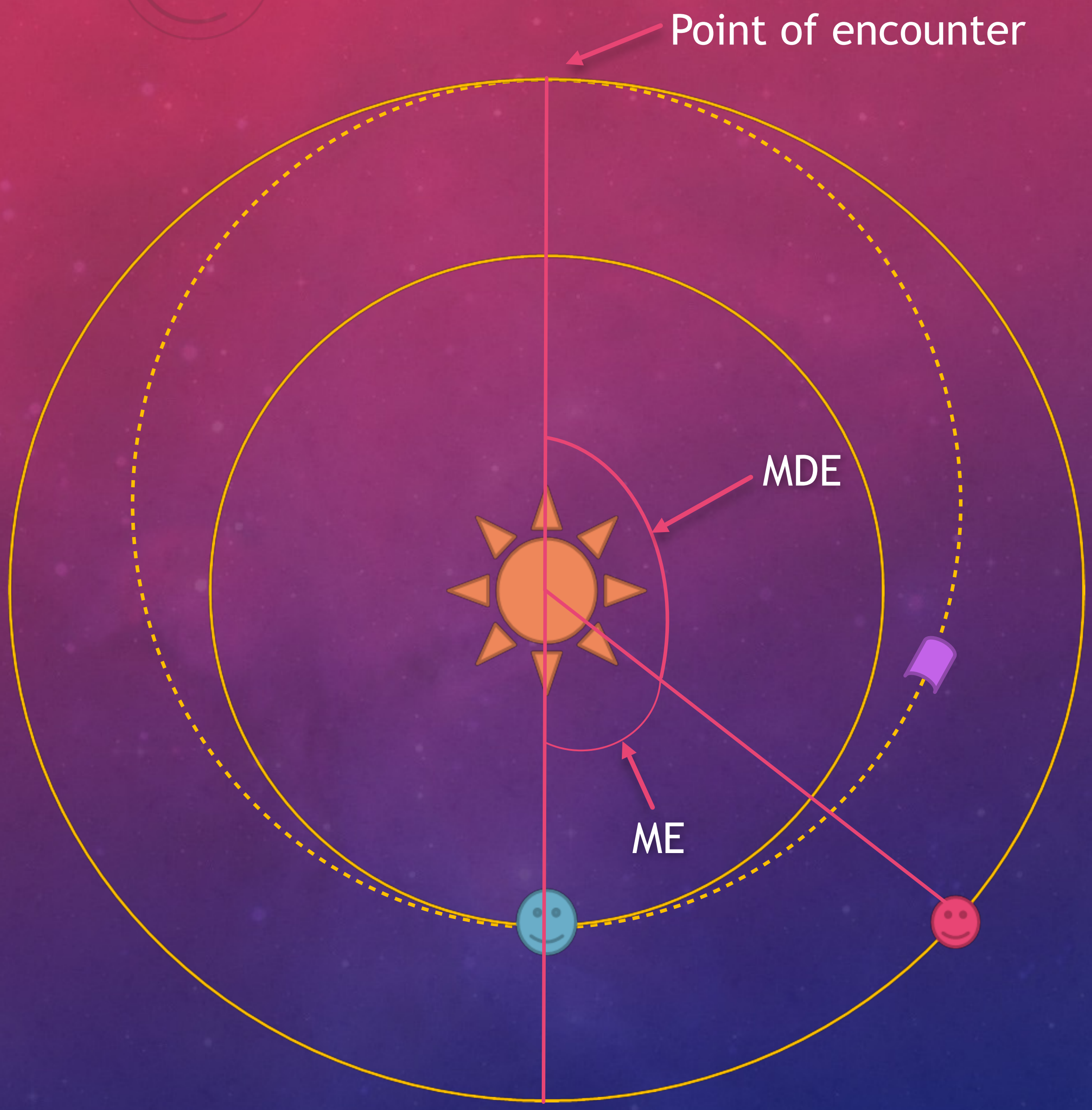
- For Mars, A = 1.52 AU
- Therefore, Mars takes longer to make one orbit.
- We want to send out probe knowing Mars will be 180° from Earth at time of launch at a later time T.



- Probe will have its own obit.
- Total distance traveled = A(Earth) + A(Mars)
- A = (A(Earth) + A(Mars))/2
- Plug this into Kepler's equation to get P(Probe).
- P(Probe)/2 = amount of time in years probe takes to get from Earth to Mars.
- Multiply by 365 to get answer in days. This is T.



- ME = Angle between Mars and Earth when probe is launched.
- MDE = Angle Mars has travelled while probe is in transit.



- P(Mars) = 687 days.
- Therefore, T/687 = fraction of Mar's orbit that probe is in transit.
- MDE = this fraction times 360 degrees.
- ME = 180 - MDE

Angle of Earth

Angle of encounter (Angle of Earth + 180)

Angle of Mars

Launch date = when Angle(Mars) – Angle(Earth) = ME

Arrival date = when Angle(Earth) – Angle(Mars) = ME

Table 1. Heliocentric Longitudes (in degrees) for Earth and Mars

Date	Earth	Encounter	Mars	Mars' Distance (AU)
23-Sep-17	0	180	150	1.66
23-Oct-17	30	210	163	1.66
22-Nov-17	60	240	176	1.66
22-Dec-17	90	270	189	1.64
21-Jan-18	121		203	1.61
20-Feb-18	151		217	1.58
22-Mar-18	181		232	1.55
21-Apr-18	211		248	1.51
21-May-18	240		264	1.47
20-Jun-18	269		281	1.43
20-Jul-18	297		300	1.41
19-Aug-18	326		318	1.39
18-Sep-18	355		337	1.38
18-Oct-18	24		356	1.39
17-Nov-18	54		15	1.41
17-Dec-18	85		33	1.44
16-Jan-19	115		50	1.47
15-Feb-19	146		66	1.51
17-Mar-19	176		82	1.55
16-Apr-19	206		97	1.59

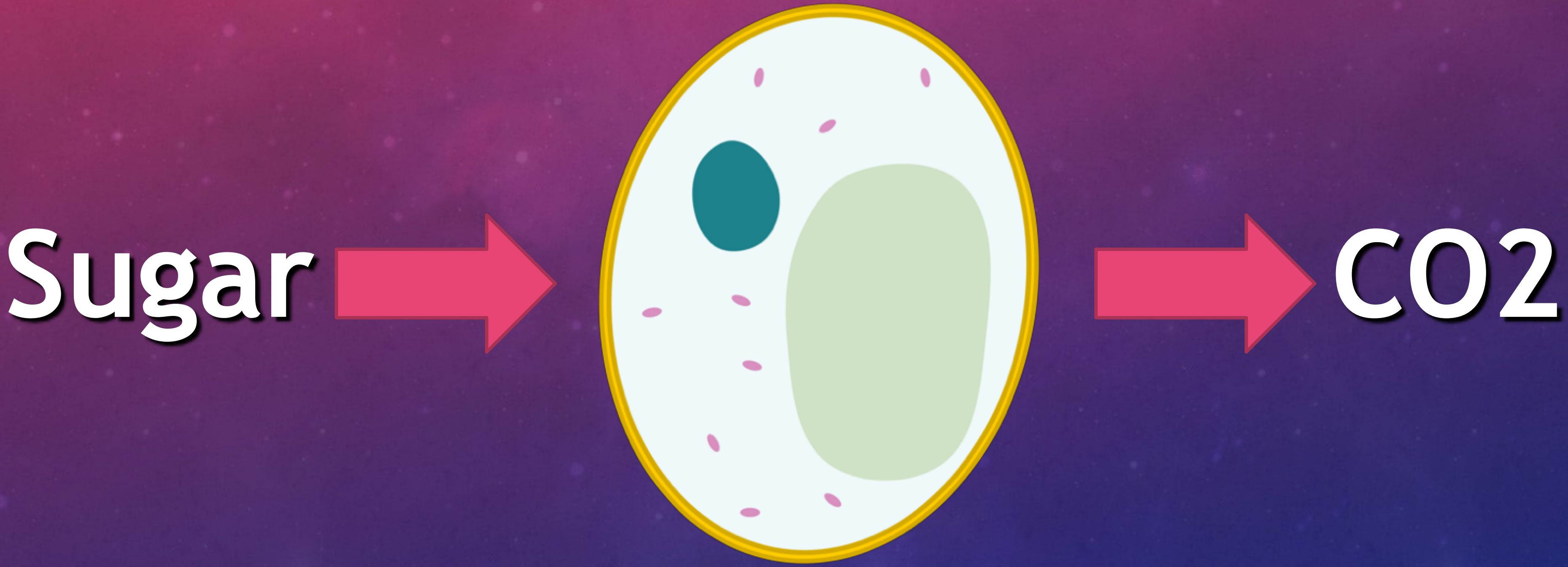
NEXT, WE NEED TO KNOW WHERE TO LAND

We want to avoid landing our probe in areas that could damage it or non-navigational. This includes:

- Areas with lots of boulders
- Sand dunes
- High elevations
- Crevices that are hard to get out of

View the Martian surface at http://www.google.com/mars/. More info can also be found at http://mars.nasa.gov/msl/mission/timeline/prelaunch/landingsiteselection/. Another good source is https://trek.nasa.gov/mars/

FINALLY, HOW CAN WE LOOK FOR LIFE ON MARS?



MICROBIAL LIFE VS. CHEMICAL REACTION

- The rate of CO2 production differs between microbial reactions and chemical reactions.
- We can therefore, distinguish between the two.