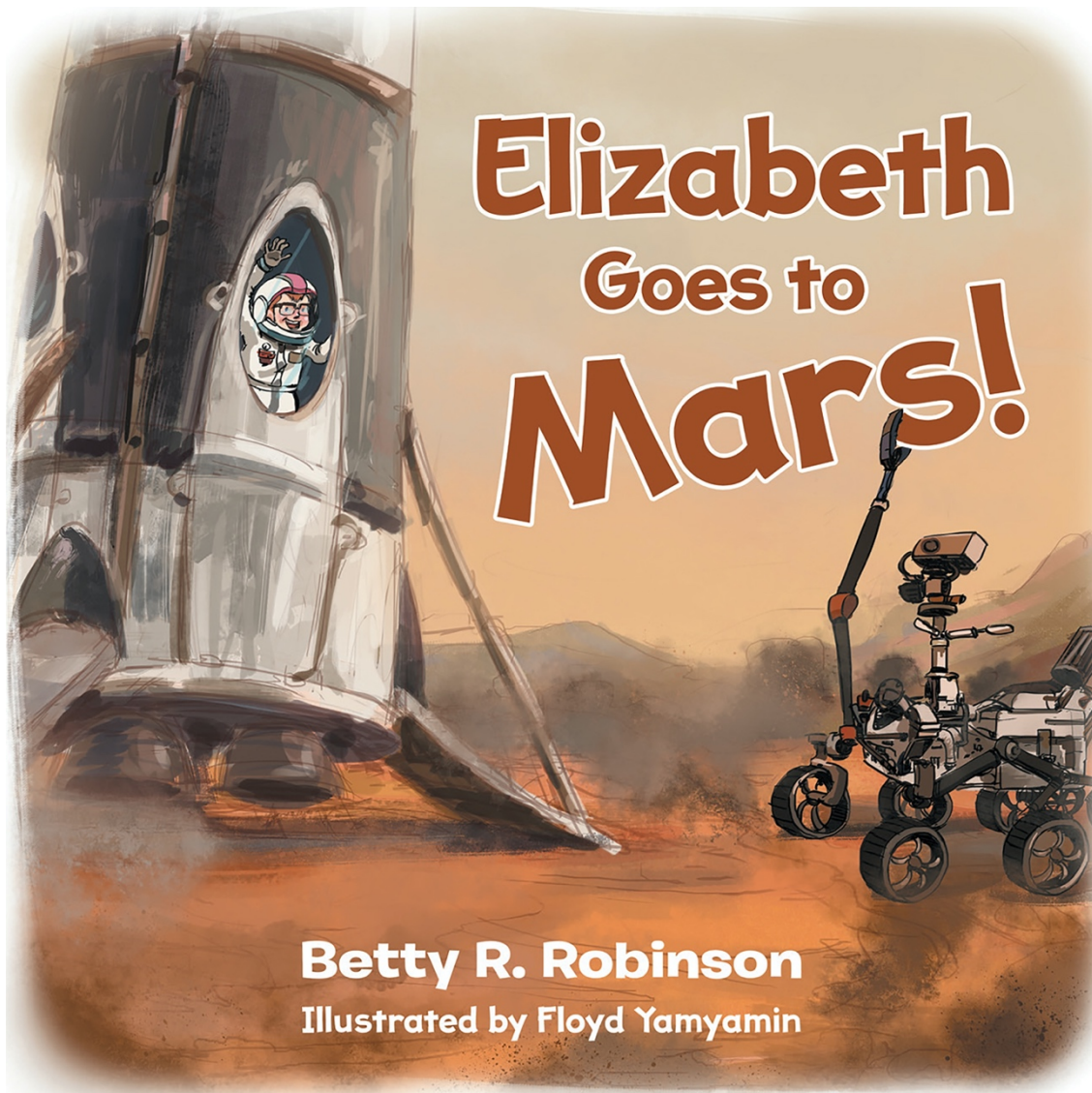


Elizabeth Goes to Mars!
Worksheet and Sample Answers



***Elizabeth Goes to Mars!* Worksheet**



1. What are some dangers of travelling in a spacecraft to Mars?

2. What does free fall mean?

3. Is there gravity in space? Explain your answer.

4. What are some things to think about to take care of our bodies when we spend a long time in space?

5. How could dust storms on Mars be a problem?

6. In a table or graphic organizer, show how Earth and Mars are similar and how they are different.

--

7. Is there life on Mars?

8. List five facts that have you learned about Mars.

9. Use what you know about Mars to imagine a Martian. Draw your Martian.



10. (a) Why do we need energy on Mars to help us live?
(b) Where will we get energy?

11. If we bring wood with us on a spacecraft, can we just make a campfire on Mars to keep us warm? Explain.

12. Why are sunsets on Mars bluish?

13. Why do you have to wear spacesuits and space helmets on Mars?

14. Describe Mars's moons.

15. How can Phobos cast a shadow?

16. Why don't stars twinkle in the Mars night sky?

17. Does Mars have a north star, like Polaris?

18. Has Polaris always been Earth's north star?

19. Describe some problems with growing plants on Mars.

20. Describe one way that we may be able to get fresh water on Mars.

21. Because our own Moon and the Sun look like they're about the same size in the sky, we can see total solar eclipses. (They aren't the same size; they just look like that from Earth.) Do you think that a total solar eclipse from Mars—as Phobos moves in front of the Sun—would look the same as a total solar eclipse from Earth? Why or why not?

22. On Earth, greenhouses are mostly glass to let in as much light as possible. In *Elizabeth Goes to Mars!* the plant houses are not shown as Earth-like greenhouses. Why do you think they should be different on Mars?

23. Use the information in the table to answer the questions.

Planet Data					
Planet	Mass (10^{24} kg)	Mass (number of Earth masses)	Escape speed (km/s)	Density (g/cm ³)	Tilt of axis (degrees)
Mercury	0.330	0.06	4.2	5.429	0.0
Venus	4.87	0.8	10.4	5.243	2.6
Earth	5.97	1	11.2	5.514	23.5
Mars	0.642	0.1	5.0	3.934	25.2
Jupiter	1,898	318	59.5	1.326	3.1
Saturn	568	95	35.5	0.687	26.7
Uranus	86.8	15	21.3	1.270	82.2
Neptune	102	17	23.5	1.638	28.3

(a) Do you think that Mercury and Saturn have seasons? How do you know?

(b) Density tells us how compact something is. For example, a material with a lot of mass per cubic centimetre is dense; it is compact and heavy. Compare the densities of the planets. What pattern do you see?

(c) If something has a density that is less than 1, it floats. Can any of the planets float?

(d) The table shows mass as number of kilograms times 10^{24} and how massive a planet is compared to Earth. For example, Saturn is 95 times more massive than Earth. The table also shows escape speed. Escape speed is how fast you need to go to be able to leave a planet. Compare the masses of the planets to their escape speeds. Use the mass column you find easiest. What trend do you notice? Explain.

(e) Sometimes people say that Venus is Earth's twin. Yet Mars is probably the first planet we will visit. Why do you think people say that?

Sample Answers

1. Mars is so far away that it takes several months to get there. During a long ride in a spacecraft, you have to bring everything you need: food, water, medicine, protection from radiation from the Sun for that length of time, exercise equipment, something to help pass away the time (books, music, games on tablets, for example). There could be problems on the spacecraft that can't be fixed. There could be a problem with communication with Earth.
2. Free fall is like having no weight. You float around in a spacecraft when you are in free fall around Earth or the Sun.
3. Yes, there is gravity in space. Everything that has mass has gravity. In a spacecraft going to Mars, the spacecraft is really in free fall around the Sun, until close enough to Mars to fall into Mars gravity, so everybody on the spacecraft floats.
4. We need to make sure we give our bodies enough food and water. We need to think about our bones. During a long time in space our bones will lose bone strength. So we have to exercise all the time to keep them healthy and strong. And we have to think about our waste and what to do with it.
5. Dust from Mars could clog up the solar panels. When they are clogged, they can't convert solar energy into electrical energy efficiently.

6.

Earth	Similarities	Mars
<ul style="list-style-type: none"> • gravity more than Mars • has one moon • over 70% water • supports life • Earth year is 365 days • orbit is close to a circle • seasons roughly the same number of days • blue sky during the day • reddish sunsets • thick atmosphere; mainly nitrogen and oxygen • atmospheric pressure is heavy (compared to Mars) • global magnetic field 	<ul style="list-style-type: none"> • rocky planets • orbit the Sun • have seasons • length of days: one Earth day is 24 hours; one day is 24 1/2 Earth hours • have wind • tilt of Earth's axis: 23.5°; tilt of Mars's axis: 25.2° 	<ul style="list-style-type: none"> • gravity less than Earth • has two moons • no liquid water • does not support life • Mars year is 687 Earth days • orbit is slightly more oval • seasons are longer than Earth seasons and not roughly the same length • reddish sky during the day • bluish sunsets • thin atmosphere; mainly carbon dioxide • atmospheric pressure is about 1% of Earth's atmospheric pressure • no global magnetic field

7. No, there isn't any life that anybody or any spacecraft has found. There are no trees or plants or anything.

8. Mars is reddish (because of the iron oxide, or rust, in the soil)!
It's much colder than Earth because it's farther away from the Sun.
There is no known liquid water on Mars. But there is water ice in the soil. There might also be underground saltwater lakes.
Mars gravity is less than Earth's gravity.
The Mars sky is orangey during the day and bluish in spots at sunset.
There is very little atmosphere on Mars, but it can be very windy.
No plants or animals.
No magnetic field to protect us from radiation from the Sun.
9. Anything goes! Just a fun activity for students to imagine life in an environment so different from ours. Maybe some students will have Martian organisms moving with the wind. Maybe a Martian organism has a strong shell to protect it from the radiation. Maybe Martians are below the surface swimming in the salty lakes.
10. (a) We need energy on Mars so that we can get heat to keep us warm, run machines to help build things, run appliances so that we can cook, and have lights on to see and to grow plants.
(b) We will get energy from solar panels. Solar panels can convert light energy from the Sun into electrical energy to help us run systems to keep us warm, run appliances, and use lights. We will need to be able store energy in batteries.
11. No, unfortunately we cannot do this. Campfires need oxygen. There is no oxygen on Mars.
12. Sunlight is made of different wavelengths, like the colours in the rainbow. On Mars, tiny water ice particles in high clouds scatter the blue light in the sunlight, so the sky looks bluish.
13. On Mars, there is no oxygen to breathe. If you didn't have a helmet on, you wouldn't be able to breathe, so you would suffocate. It's also too cold. And the air pressure is very different. With such a light atmosphere on Mars, there is very little air pressure.
14. Phobos and Deimos are small compared to our Moon. They were named after two soldiers in Greek mythology. Phobos is brighter than Deimos because Phobos is a bit bigger. They are thought to be captured asteroids.
15. Like our own Moon, Phobos reflects light from the Sun, so it can make shadows, even if they aren't very dark.
16. Stars don't twinkle because there is very little atmosphere on Mars. On Earth, the light from stars gets distorted when coming through our atmosphere, making the stars twinkle.
17. No, no north star on Mars.

18. No it hasn't. Around 5,000 years ago, Thuban (in the constellation Draco) was Earth's north star. And about 12,000 years ago, Vega (in the constellation Lyra) was the north star.
19. It's going to be difficult to grow plants on Mars. The plants we need to grow are Earth plants. Earth plants need sunlight, air with oxygen, maybe a soil of some kind, and water. On Mars, there's no liquid water and no soil like on Earth. And because Mars is farther away from the Sun than Earth is, the amount of sunlight is less. Also, with such a light atmosphere, there is no protection from the radiation from the Sun. But one big problem is air pressure. Earth plants need air pressure like they're used to. If they don't get it, they can't grow the way we need them to.
20. If we know an area has frozen water ice under the surface, an excavator can dig up the soil. Then we can microwave the soil. By heating the ice in the soil with microwaves, we get water vapour, which condenses into liquid water. Then we collect the liquid water and store it. There will have to be a lot of water recycling on Mars.
21. No, I don't think a total solar eclipse from Mars would look like what we see from Earth. Phobos is really small. And since it's probably a captured asteroid, it isn't round like our Moon.
This video was taken by the *Curiosity* rover in 2019. It shows Phobos eclipsing, or passing in front of, the Sun: <https://photojournal.jpl.nasa.gov/archive/PIA23133.gif>
22. On Earth, the greenhouses are designed to let in lots of light. But on Mars, while there is less light from the Sun, there is no magnetic field. Our magnetic field protects us from the dangerous radiation from the Sun. A greenhouse design would allow too much radiation, which would damage the plants. So the plant houses have to be built differently and use artificial light.
23. (a) No, Mercury doesn't have seasons because it isn't tilted, like Earth and Mars. Yes, Saturn is tilted a little more than Earth is tilted, so Saturn must have seasons. But it's so far away, the seasons must be much longer than seasons on Earth and Mars.
(b) Mercury, Venus, Earth, and Mars have higher densities than Jupiter, Saturn, Uranus, and Neptune. The first four planets are the rocky planets. The rest are the gas planets. Rock is denser than gas.
(c) Yes, the density of Saturn is less than 1! If I could find a bathtub big enough, Saturn would float in it!
(d) The more massive the planet, the higher the escape speed. The more massive planets have higher gravity. So we need a higher speed to escape them.
(e) Venus and Earth are similar in mass, density, and escape speed. (But Mars seems like the best planet to visit because we can bring supplies there and construct buildings to live and work. If we were to go to Venus, we couldn't survive the temperatures, the suffocating atmosphere of carbon dioxide, and the strength of Venus's air pressure; it would crush us.)