Astraviator

SPACE WORKBOOK

UNIT 8 OF 8

Astronaut Life

Training · Spacewalks · Space food · Living in orbit

Puzzles · Experiments · Role cards · Mission patch

Ages 9–14 · three levels · answer key included

★ Explorer ★★ Navigator ★★★ Commander



Print at 100% · black & white pages, color cover · Imagery rendered from NASA / USGS data and Solar System Scope textures (CC BY 4.0)

FREE SIMULATOR

Scan to fly to the Moon

SOLAR SYSTEM EXPLORER

astraviator.com/explore

Assemble the rocket, launch, cross to the Moon and explore real space data. Play the free simulator in your browser, on a phone, tablet or computer: no install, no account.

SAFETY FIRST Children should do the experiments with an adult, using ordinary household materials and eye protection when asked. Never look directly at the Sun, never cap a bottle that fizzes, and do not point anything at people or pets. Adults are responsible for supervision and for deciding whether an activity is suitable for the child.

Point your phone’s camera at the code and tap the link.

Mission Briefing: Becoming an Astronaut ★ EXPLORER

Astronauts are scientists, engineers, pilots and doctors. They train for years to live and work where there is no air, no up and no down.

Training

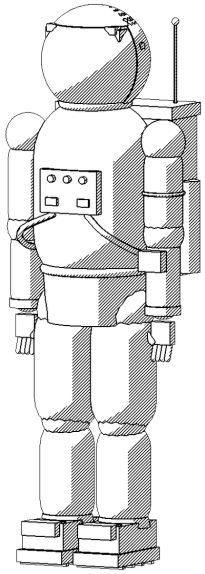
Trainees practice underwater in a giant pool to feel weightless, ride jets that fly in arcs, learn to speak Russian (for the ISS) and rehearse every emergency in simulators.

Living in microgravity

In orbit, astronauts float because they are in **free fall** around Earth. Sleeping bags are fixed to walls, food is eaten from pouches, and water forms floating balls. Without gravity, bones and muscles weaken, so astronauts exercise about 2 hours every day.

Spacewalks

A spacewalk, or **EVA** (extravehicular activity), lasts about 6 or 7 hours. The suit gives air, water, pressure and protection from heat and cold.

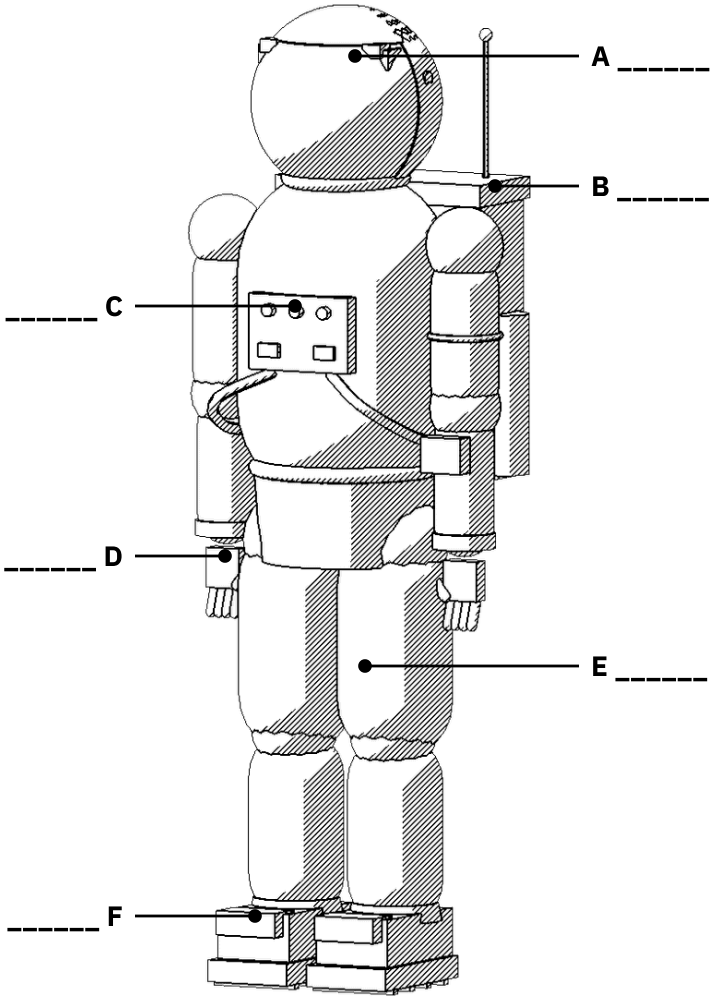


An astronaut in a spacesuit

Fact	Number
Sunrises per day on the ISS	16
Suit weight on Earth	~300 lb
Longest single spaceflight	437 days
Exercise per day	2 hours

Label the Spacesuit

★ EXPLORER ★★ NAVIGATOR



Helmet with a gold sun visor · Life-support backpack · Chest control panel · Gloves with fingertip heaters · Layers · Boots

Jobs

1. Keep fingers warm while gripping tools → _____
2. Protects the head and blocks glare → _____
3. Protect the feet and grip handrails → _____
4. Lets the astronaut control the suit's systems → _____
5. Gives oxygen, water and power for 8 hours → _____
6. Keep the astronaut at a safe pressure and temperature → _____

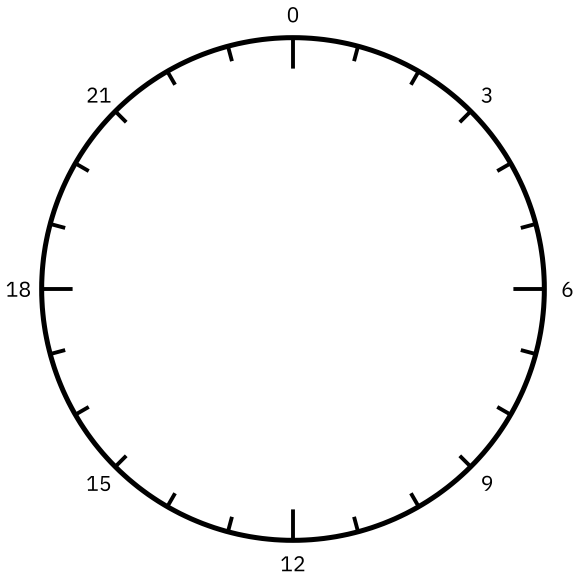
1. Write the name of each part (A–F) on its line, using the bank.
2. Write the letter of the part that does each job. Which part would you want to work best?

_____

A Day on the Space Station ★★ NAVIGATOR

The ISS runs on Greenwich time. Here is a typical day for an astronaut. Use the table to color a wedge for each activity on the 24-hour clock, starting at 0 (top) and going clockwise.

Activity	Hours	°
Sleep	8	_____
Exercise	2	_____
Meals & hygiene	3	_____
Science & work	7	_____
Station repairs	2	_____
Free time	2	_____
Total	_____	



1. Add the hours and write the total in the table. _____ Each hour is 360° ÷ 24 = _____ °. Fill in the degrees column (hours × 15).

2. What percent of the day is spent sleeping? 8 ÷ 24 = _____ %. And working on science? _____ %

3. The ISS circles Earth every 90 minutes. How many sunrises does an astronaut see during the 8 hours of sleep? _____

4. If you could change one activity, which would you change and why?

_____

_____

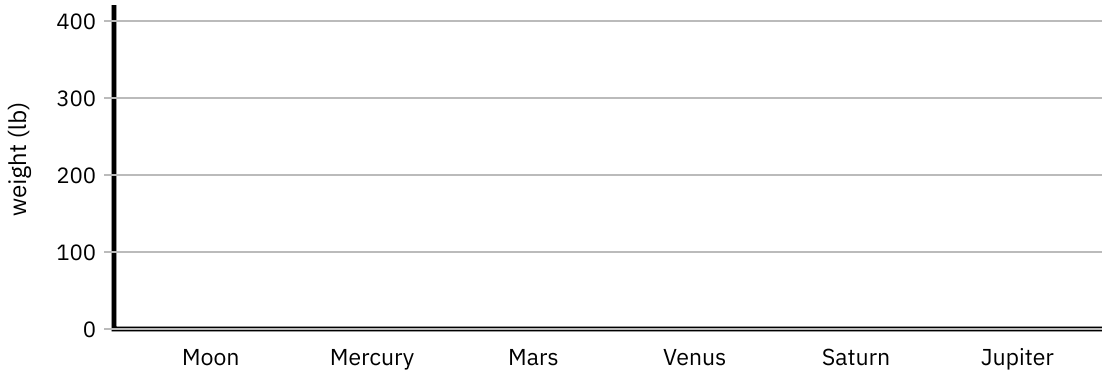
Math Lab · Your Weight on Other Worlds

★★ NAVIGATOR ★★★ COMMANDER

Mass is how much matter you are made of. It never changes. **Weight** is how hard gravity pulls on you, so it changes from world to world. In orbit you feel **weightless**, but you still have the same mass!

An astronaut weighs **160 lb** on Earth. Multiply by each world's gravity (Earth = 1).

World	Gravity	Weight (lb)
Moon	×0.165	_____
Mercury	×0.38	_____
Mars	×0.38	_____
Venus	×0.91	_____
Saturn	×1.07	_____
Jupiter	×2.53	_____
ISS (orbit)	≈ 0 (free fall)	



Draw a bar for each world.

1. On which world would the astronaut weigh the least? _____ The most? _____

2. The suit and backpack weigh 300 lb on Earth. How much do they weigh on the Moon? 300 × 0.165 = _____ lb

3. **Your weight.** Write your own weight: _____ lb. On the Moon you would weigh _____ lb. On Mars _____ lb.

4. Mass stays the same everywhere. Why can an astronaut still not lift a heavy satellite easily in orbit?

_____

_____

Pack the Food Box ★★ NAVIGATOR ★★★ COMMANDER

Every pound that goes to space is very expensive, so astronauts' food must be light and full of energy. You must pack one day of meals for one astronaut: **at most 18 ounces** and **at least 2,000 calories**. Choose from the list. Check the boxes of the items you pack.

	Food	Weight (oz)	Calories
☐	Oatmeal pouch	2.0	280
☐	Scrambled eggs	1.8	190
☐	Tortilla	1.0	90
☐	Peanut butter packet	1.2	200
☐	Trail mix	2.0	310
☐	Dried apricots	1.5	100
☐	Beef jerky	1.0	80
☐	Chicken & rice	4.0	350
☐	Mac & cheese	3.5	380
☐	Chocolate pudding	3.0	250
☐	Granola bar	1.5	190
☐	Drink powder	1.0	60

1. Total weight of your box: _____ oz. Is it at most 18? _____

2. Total calories: _____ . Is it at least 2,000? _____

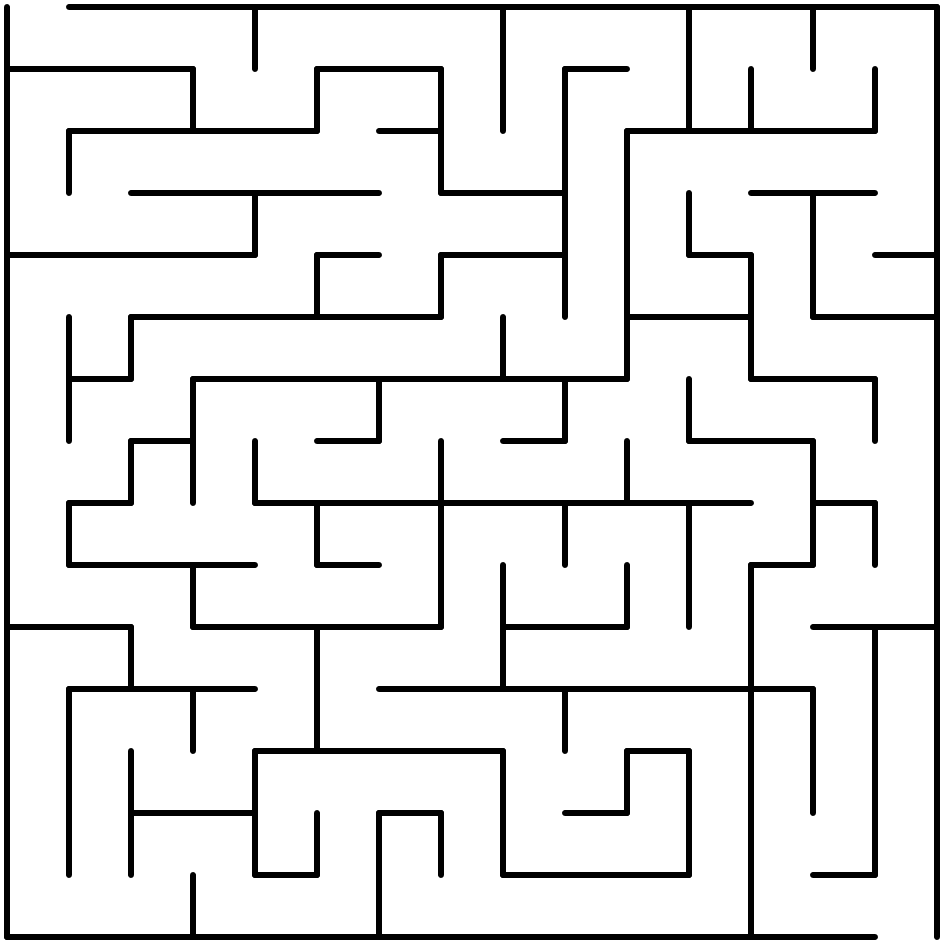
3. **Calories per ounce** shows which foods give the most energy for the least weight. Find the best food: calories ÷ weight = _____ . Which is it? _____

4. Why are most space foods dried, and how are they prepared before eating?

_____

Spacewalk Maze ★ EXPLORER ★★ NAVIGATOR

An astronaut must climb along the handrails from the airlock (top-left) to the broken antenna (bottom-right) without crossing the walls of the station. Draw the safe route!



1 The astronaut moves 1 foot every 2 seconds. If the route has 119 blocks of 4 feet each, how many seconds does the walk take? _____

Word Scramble ★ EXPLORER

The letters of each word are mixed up. Unscramble them with the clues. Then copy the letters from the shaded boxes (the first letter of each answer) to find the hidden word!

1	**OTARASUNT**	A person trained to travel in space	
2	**GVTYAIR**	The force that pulls things down	
3	**TLMHEE**	Protects an astronaut's head	
4	**TTRHEE**	A cord that keeps you from floating away	
5	**CSUEPLA**	Where the crew rides in the rocket	
6	**SHETLSGEWI**	How you feel in orbit	
7	**CRSEEIXE**	Astronauts do it 2 hours a day	
8	**OSTIANT**	The ISS is a space ____	
9	**MSIONSI**	A trip with a goal	
10	**RNNTGIIA**	Years of it come before launch	

1. Hidden word (first letters, in order): _____

2. Use three of the words in a sentence about a space mission:

_____

_____

Logic Lab: Crew Sudoku ★ EXPLORER ★★★ COMMANDER

A · Suit sudoku ★

Each row, column and 2×2 box must have **H** (helmet), **G** (gloves), **B** (boots) and **P** (backpack) once.

	H	B	G
G			
		P	H
			B

B · Crew sudoku ★★★

Fill the 6×6 grid with the six crew roles once per row, column and 2×3 box: **Co** commander, **Pi** pilot, **En** engineer, **Dr** doctor, **Sc** scientist, **Ge** geologist.

		En	Dr		Ge
Ge		Dr	Pi	Sc	
			Ge		
Dr		Co	Sc	En	
En					Dr
Co		Pi	En	Ge	Sc

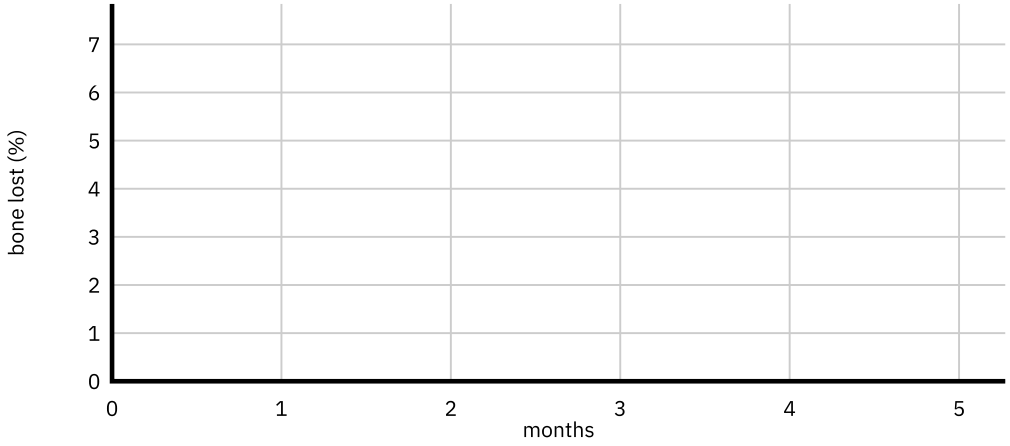
Graph Lab: Bones in Space ★★ NAVIGATOR ★★★ COMMANDER

Without gravity pulling on them, bones lose density. Doctors estimate that astronauts lose about **1 percent** of bone density in the legs and hips each month on long missions (about 1.2% in this model). Exercise helps, but does not stop it completely.

Months in space	0	1	2	3	4	5
Bone lost (%)	0	1.2				

1 Complete the table: each month the loss grows by 1.2%. Fill in months 2 to 5. (Month 2: 1.2 + 1.2 = _____)

2 Make a line graph of the table below. Mark one point per month and join them.



3 A mission to Mars could last about 30 months. How much bone could be lost? 30 × 1.2 = _____ %

4 Name two ways to keep bones and muscles strong in space.

_____

_____

What Would You Do? Scenario Cards ★ EXPLORER cut-out

Cut out the cards. Take turns reading one aloud: the other players choose A, B or C. The answers are in the answer key.

SCENARIO 4

Radio contact with Mission Control is lost.

A. Panic and shout.

B. Follow the checklist and try the backup radio.

C. Turn off the station.

SCENARIO 6

It is bedtime and nothing holds you down.

A. Float in the middle of the module.

B. Zip into a sleeping bag fixed to the wall.

C. Sleep inside the airlock.

SCENARIO 3

You feel dizzy in your first days in orbit.

A. Move slowly, rest and tell the flight doctor.

B. Do flips to get used to it.

C. Stop drinking water.

SCENARIO 7

You skipped exercise for three days.

A. It is fine, space is easy.

B. Bones and muscles weaken: return to your 2 hours a day.

C. Only exercise your arms.

SCENARIO 8

After splashdown, your body feels very heavy.

A. Run around to celebrate.

B. Sit and let the recovery team help you: gravity is back!

C. Jump out of the capsule alone.

SCENARIO 5

A drifting ball of water escapes from your drink pouch.

A. Swat it with your hand.

B. Catch it with a towel or sip it with a straw.

C. Ignore it.

SCENARIO 1

A smoke alarm rings on the station.

A. Ignore it and keep working.

B. Put on masks, tell Mission Control and look for the source.

C. Open a hatch to let the smoke out.

SCENARIO 2

A tool floats away during a spacewalk.

A. Chase it without your tether.

B. Stay tethered and tell your crewmate and Mission Control.

C. Throw another tool after it.

Lab · Falling Water (Microgravity at Home) ★★ NAVIGATOR

SAFETY An adult makes the hole with the thumbtack or nail and handles it carefully. Do this outdoors or over a sink, and do not drop the bottle on anyone's feet.

Astronauts float because they are in **free fall**. You can see how free fall changes things with a bottle of water. Do this experiment over a sink, tub or outdoors!

You need

- A plastic bottle (16 oz) filled with water
- A thumbtack or nail (an adult makes the hole)
- A sink, bathtub or outdoor space
- A friend to watch

Steps

1. An adult pokes one small hole near the bottom of the bottle.
2. Fill it with water and cover the hole with your thumb.
3. Hold the bottle high over the sink. Remove your thumb: water squirts out.
4. Drop the bottle while the water squirts. Watch the stream as it falls!

My prediction:

	Water squirts while held still?	Water squirts while falling?
Trial 1		
Trial 2		
Trial 3		

1. What happened to the stream of water while the bottle was falling?

2. In free fall, both the bottle and the water fall at the same rate, so the water does not push on the hole. How is this like an astronaut in orbit?

3. Draw what the water stream looked like before and during the fall:

Reading: A Spacewalk Day ★★ NAVIGATOR

Maya floats through the hatch of the airlock. For the past two hours she has breathed pure oxygen to get nitrogen out of her blood, and now she is wearing a suit that weighs 300 pounds on Earth but feels like nothing in orbit. Her partner Leo helps her check the seals twice. Then the hatch opens and the Earth appears beneath her boots: a bright blue ball slipping by at 17,500 miles per hour.

Maya clips her tether to a handrail before she moves an inch. “Always one hand on the station,” says Leo. Her job is to replace a broken antenna cable. She works slowly with big gloves, tools tied to her suit so they cannot float away. After six and a half hours, she and Leo return, tired but happy. Tonight she will sleep strapped to the wall and dream of the blue Earth.

1. Why did Maya breathe pure oxygen for two hours before the walk?

_____

2. What is the purpose of the tether?

_____

3. How many minutes did the spacewalk last? (6.5 hours × 60) _____

4. How many miles does the station travel during the walk? 17,500 × 6.5 = _____

5. **True or false?** a) Maya’s suit feels heavy in orbit. T / F b) Tools are tied to the suit. T / F c) Maya works alone, with no partner. T / F

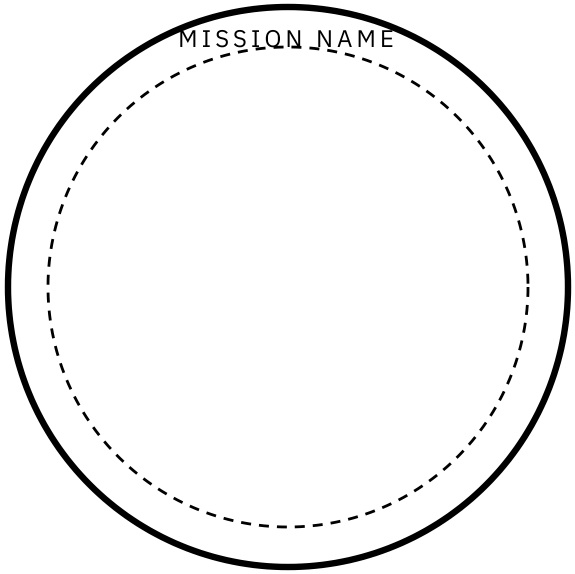
6. Write a title for the story and a sentence about how Maya feels.

_____

_____

Create · Mission Patch & Letter Home ★ EXPLORER ★★ NAVIGATOR

Every mission has a **patch**: a badge that shows its goal, its crew and its spirit. Design yours in the circle, then write a letter from space to someone at home.



- Pick a symbol for your goal (planet, rocket, star…)
- Write the crew names around the edge
- Choose a motto in Latin or your language: *Ad astra* = “to the stars”
- Add a year

1 Mission name: _____

2 Destination: _____

Letter from space

Tell what you see out the window, what you eat, how you sleep and what you miss.

Unit Review · Mission Check

★ EXPLORER ★★ NAVIGATOR ★★★ COMMANDER

1. **Match**: EVA ___ microgravity ___ tether ___ airlock ___

   A. a cord that stops you floating away · B. the chamber used to enter and leave the station · C. a spacewalk · D. the feeling of weightlessness in orbit

2. **Why** do astronauts float in the ISS even though gravity there is almost as strong as on Earth?

3. **Calculate.** An astronaut who weighs 120 lb on Earth would weigh _____ lb on Mars (×0.38).

4. **Explain** why astronauts exercise 2 hours every day.

5. **Order** the steps before a spacewalk: open the hatch · check the seals · breathe pure oxygen · put on the suit:

6. **Choose** the best action: a smoke alarm rings. ☐ Ignore it. ☐ Put on masks and tell Mission Control. ☐ Open a hatch.

7. **Compare** eating on Earth and eating in orbit.

8. **Decide.** Which crew role would you like to have, and what would your first task be?

Mission Log ★ EXPLORER

Check the boxes when you can do each one. Color a star for each section you enjoyed.

☐ I can explain why astronauts float.

☐ I can name the parts of a spacesuit.

☐ I can plan a day in orbit.

☐ I can calculate weight on other worlds.

☐ I can pack food for space.

☐ I can read a graph about bones in space.

☐ I can solve a maze and sudoku puzzles.

☐ I can design a mission patch.

My favorite activity was

Something new I learned

A question I still have about space

UNIT 8
ASTRONAUT LIFE
★ ★ ★
MISSION COMPLETE

Signed: _____
Date: _____

The Space Workbook series

You have **Mission 8**. There are **8 missions** in all: each one is a complete set of puzzles, math labs, games and experiments, and each works on its own.

1	**Earth, Moon & Sun** Phases, time zones, seasons, eclipses, tides	☐
2	**Rocky Planets** Mercury, Venus, Earth and Mars	☐
3	**Giant Planets** Jupiter, Saturn, Uranus and Neptune	☐
4	**Moons, Dwarf Planets & Small Bodies** Pluto, Ceres, comets, asteroids and icy moons	☐
5	**Rockets, Orbits & Missions** SLS, orbits, Morse code, spacecraft	☐
6	**Stars, Constellations & Galaxies** Light-years, star maps, galaxies, black holes	☐
7	**Life Beyond Earth** Habitable zones, extremophiles, exoplanets	☐
8	**Astronaut Life** Training, spacewalks, food, living in orbit	**★ YOU ARE HERE**
+	**Field Guide** The 29 destinations of the Solar System Explorer	in the Complete Workbook

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Play the free simulator. Fly to the Moon and explore real space data in your browser: **astraviator.com/explore**