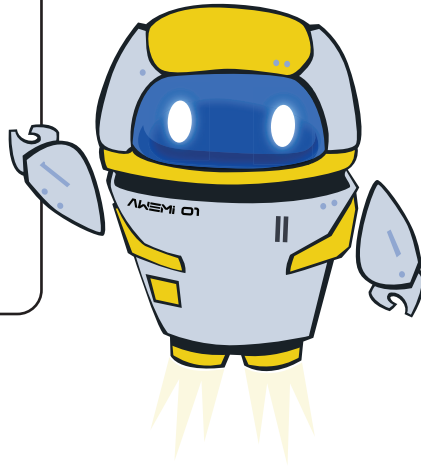


AWE

JUNIOR MISSION SPECIALIST WORKBOOK

AGES 5-12

Hello, Recruit! My name is AWEMI-01, short for Atmospheric Waves Experiment Mission Instructor One. Mission Control reported that you want to join the AWE mission team. Welcome to training!



REQUIREMENTS

All recruits must complete the following requirements:

1. Read the AWE Mission Brief
2. Complete all the workbook activities:
 - Mysterious Atmospheric Gravity Waves
 - Wacky Space Weather
 - Our Amazing Atmosphere
 - AWE's Powerful Payload
 - Illuminating Infrared Data
 - AWE's Tenacious Mission Team
3. Receive a readiness "go" or "no-go" check from your parent, teacher, or guardian to become a certified Junior AWE Mission Specialist

Listen up, Recruit! News from AWE Mission Control has now been released.

AWE MISSION BRIEF

To: Junior AWE Mission Specialist Recruits

Subject: AWE Mission Brief

The Atmospheric Waves Experiment, AWE for short, will unravel scientific mysteries of how atmospheric gravity waves (AGWs) affect space weather.

Atmospheric gravity waves are invisible to us, but scientists have been studying them from Earth using infrared light technology. Infrared is red light in the longest wavelength that we sense as heat. Put on your imaginary infrared glasses, Recruit. Envision waves moving in all directions and transporting heat and momentum up, UP, UP into space and influencing space weather.

Mission engineers designed and built an infrared instrument called the Advanced Mesospheric Temperature Mapper, or AMTM, to observe AGWs as they pass through the mesosphere layer of Earth's atmosphere.

Mission scientists will collect and study the image data at the Science Operations Center. They hope to better understand characteristics of AGWs, like their energy (speed) and amplitude (distance and direction), so they can better predict how Earth's weather affects space weather.

MYSTERIOUS ATMOSPHERIC GRAVITY WAVES

AGWs are invisible pulses of air that form in the troposphere, or the layer of Earth's atmosphere between the ground and where airplanes fly. AGWs can form during weather events, like thunderstorms, hurricanes, or cyclones. They also form when wind rushes over tall mountains.

How do we know AGWs exist if they are invisible?

We can feel the impact of AGWs as breath-catching, bumpy turbulence during an airplane flight, and we can see their wave-like influence in clouds. Scientists believe that AGWs impact Earth weather and space weather.

What does that impact look like?

Just like ocean waves build up energy, travel, and crash onto the beach, AGWs build up energy and momentum and propagate, or travel in all directions, depositing their energy and momentum into Earth's upper atmosphere. Scientists predict that AGWs affect space-based communication systems, and navigation and tracking, because their energy and momentum disrupts charged particles, or ions, in space.

REQUIREMENTS:

1. Draw a picture of an AGW and complete one of the following activities.

a] Watch the skies and capture a picture of AGWs influencing the clouds.

b] Get crazy with duct-tape and candy to make a Candy Wave Model.

<https://www.awemission.org/get-involved/>

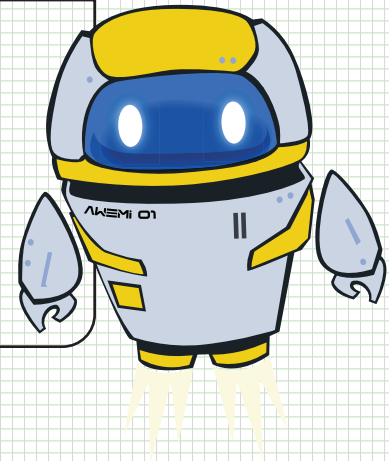
c] Learn how waves are formed and see the difference between short and long waves by making your own Bottle Wave Experiment.

https://www.youtube.com/watch?v=HUzcfqVld_Q

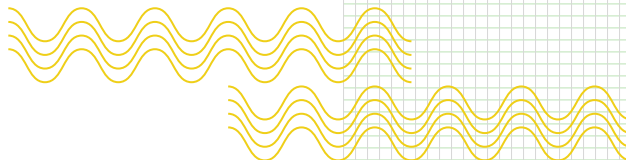
Do you like mysteries?
I do! I present to you...

[drumroll please]...

Mysterious atmospheric
gravity waves (AGWs)!

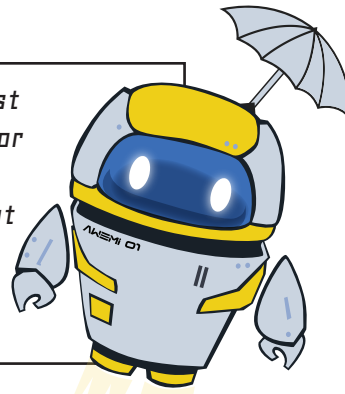


DRAWING - AGW



WACKY SPACE WEATHER

Look out your nearest window, go outside, or check the weather forecast online. What weather do you see or feel happening near you today?



Earth's weather is called *terrestrial weather*. Terrestrial weather can be sunny, windy, rainy, stormy, cloudy, or a combination of these at the same time! Knowing terrestrial weather helps us prepare to drive during certain road conditions, decide what clothes to wear, and plan for work or activities.

Weather also occurs in space.

Heliophysics (He-li-oh-fisiks) is the study of the Sun and how it influences Earth, space, and planets in our Solar System. Like terrestrial weather, space weather results from a complex system driven by the Sun and its solar cycle, solar winds, and magnetic waves. The Sun affects space weather, and space weather can affect how space- and ground-based technological systems function, which can affect you!

REQUIREMENTS:

How do you think space weather might affect your daily life? Use the workspace to the right to answer the question creatively by writing a poem or song lyrics, drawing a picture, or making up a short story.



AWE explores the global distribution of AGWs in the upper atmosphere and how they travel upward and vary with the seasons. AWE will investigate how AGWs contribute to space weather, which affects space-based and ground-based communications, navigation, and tracking systems. By increasing our understanding of AGWs, we will also better understand our atmosphere, weather, and climate.

OUR AMAZING ATMOSPHERE

Earth's atmosphere has six different layers that act as a jacket of protection for us and the planet. Each layer of the atmosphere is different and important for a variety of reasons.

AWE surveys atmospheric gravity waves in the mesosphere, which is in Earth's upper atmospheric region. Earth's magnificent mesosphere acts like a window to space weather. Everything that impacts space weather from below passes through this window.

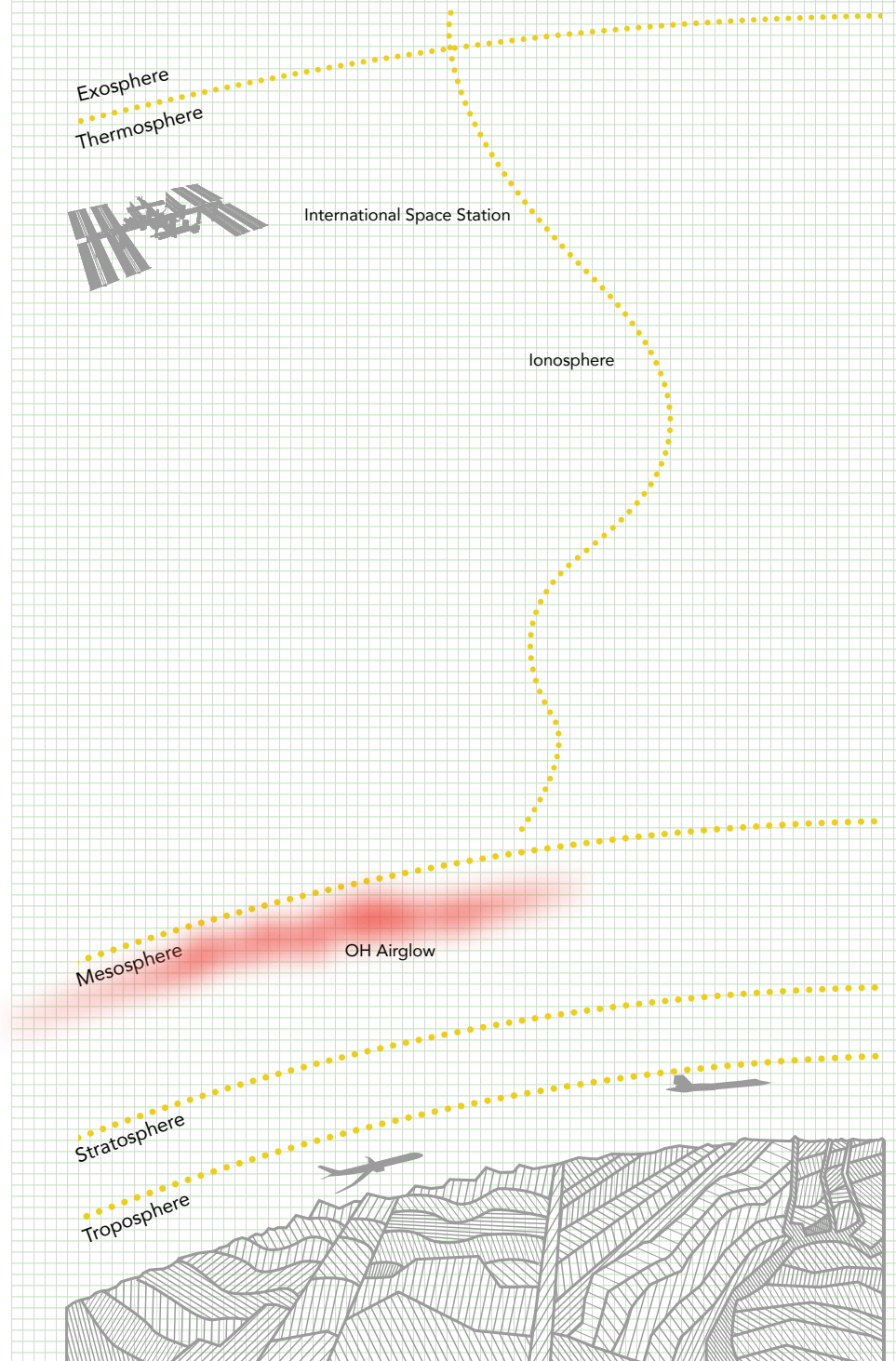
Scientists hope that by observing atmospheric gravity waves in Earth's airglow layer of the mesosphere, we will better understand the connections between weather in our atmosphere and space.

REQUIREMENTS:

1. Why do you think the atmosphere is important to Earth and humankind?

2. Study the map or visit <https://spaceplace.nasa.gov/atmosphere/> to learn more about the layers in Earth's atmosphere. Draw a line to match each layer of the atmosphere to its fun fact.

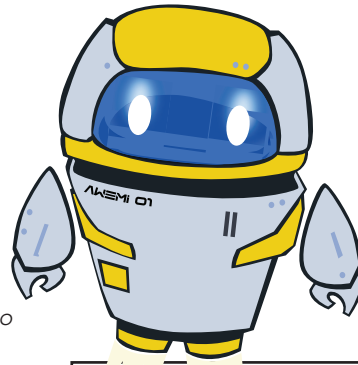
Troposphere	The low Earth orbit layer where satellites and the International Space Station orbit the Earth.
Exosphere	An active layer that shrinks and grows depending on the energy it absorbs from the Sun.
Stratosphere	The layer closest to Earth that holds the air we breathe.
Mesosphere	The "middle" layer where Earth's airglow layer exists and gasses cause friction, create heat, and burn up meteorites.
Ionosphere	The area where the ozone layer protects us from the Sun's ultraviolet (UV) radiation.
Thermosphere	The coldest, thickest, and highest layer of Earth's atmosphere that is closest to space.



THE ATMOSPHERE

Not to scale

AWE'S POWERFUL PAYLOAD



AWE's Advanced Mesospheric Temperature Mapper, or AMTM payload, launched into space and docked on the International Space Station (ISS). Using a robotic arm on the ISS, ground operators moved the AMTM from its launch vehicle to its location outside the ISS, where it points downward, or nadir, at Earth.

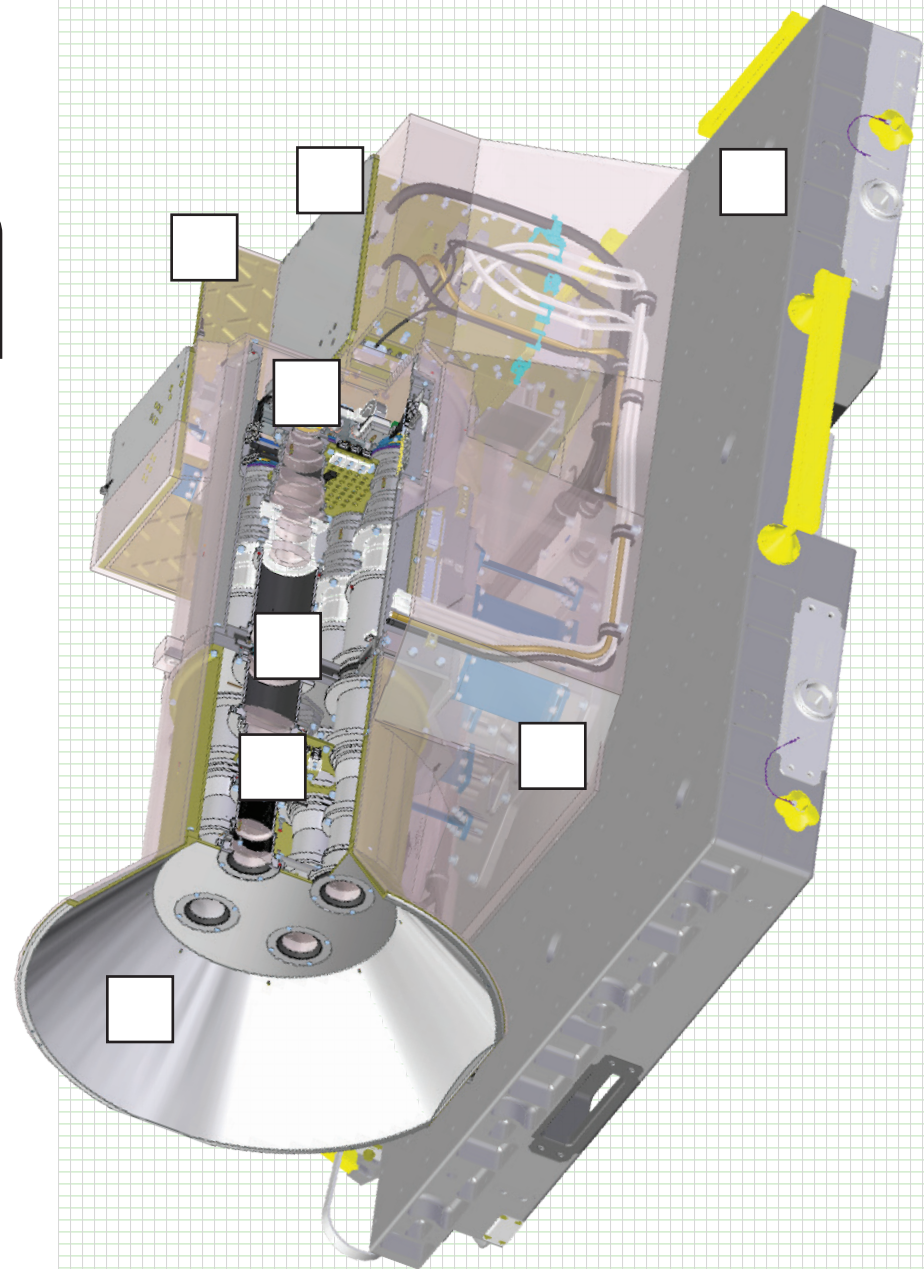
Once every second for two years, the AMTM's four "eyes," or telescopes, scan Earth and gather nighttime infrared temperature image data of AGWs in Earth's airmass layer.

That is a lot of image data for scientists to surf through!

REQUIREMENTS:

1. The AMTM has separate parts and functions to capture the best scientific data. Read each part description and write the AMTM part number in the square on the model where you think each part is located.

- A01** The EXPRESS Payload Adapter (ExPA) is the large panel on the instrument that the ISS's robotic arm will use to remove the AMTM from the launch rocket and install it on the ISS.
- A02** The Instrument Electronics Box (IEB) provides power to the AMTM, communication with the ISS, and control of detector temperatures.
- A03** The radiators reject heat into space or absorb heat from the Sun to help the AMTM maintain optimal temperature.
- A04** The four identical detectors are highly sensitive to short-wave infrared wavelengths.
- A05** The titanium flexures are mounted between the ExPA and the Opto-Mechanical Assembly (OMA) to provide vibration protection during launch.
- A06** The filter wheel is for resiliency, or backup, only. If everything works correctly, it will not be used. But it could be used if a dark image is needed or if one telescope or detector fails.
- A07** The OMA houses the 4 telescopes, with 16 lenses each, that will capture wide field of view images over a range of temperatures.
- A08** The aperture baffle keeps direct sunlight off the lenses and shades them so the instrument can capture quality images.



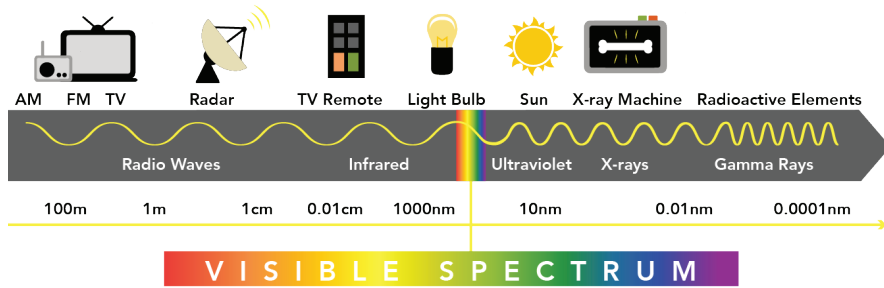
AWE'S POWERFUL PAYLOAD



ILLUMINATING INFRARED DATA

Have you ever gotten an x-ray to see your bones? What about a sunburn from the Sun's ultraviolet light? X-ray and ultraviolet light are forms of energy on the electromagnetic spectrum.

Electromagnetic Spectrum



Like x-ray and ultraviolet light, infrared light is also on the electromagnetic spectrum. Infrared is invisible to the human eye. Instead, we sense infrared light as heat.

AWE's Advanced Mesospheric Temperature Mapper (AMTM) instrument uses infrared telescopes to capture temperature image data about atmospheric gravity waves (AGWs) in the mesosphere and how they influence space weather.

REQUIREMENTS:

- Find and circle the list of words in the word search. Words may appear vertical and horizontal.
- After you have found all the words, illuminate the hidden infrared message by inputting unused letters into the blanks below. Begin your search at the top left of the word search puzzle and go through each line left to right. (Hint: You may not use all the rows of letters.)

WORD SEARCH

A W W A V E L E N G T H E I L L U M I N A T E S A
 T E M O S P H E R I C G R A V I T Y W A V E S L I
 D A W N S P A C E U S I N A V I G A T I O N N E G
 E R I I N F R T I T A N I U M F L E X U R E S N A
 T T N A P E R T U R E B A F F L E R E D L I G S H
 E H D T J P E W L W V I S I B L E Z D M T Y V E A
 C A T M O S P H E R I C G R A V I T Y W A V E S M
 T T R O P O S P H E R E W J M H U R R I C A N E T
 O J J T R A C K I N G O P E U U P U G R F B O A M
 R J Z H I N F R A R E D E U U S P E C I A L I S T
 S Z Y N K Q O E V W N P A Y L O A D O L I G H T G
 M O U N T A I N T O P G Q G S W M R Q D I A R E P
 E L E C T R O M A G N E T I C S P E C T R U M X T
 K W Q W E A T H E R R G N Q B T E Y E S D O Z P E
 P A S E G O V B T H U N D E R S T O R M M C I A L
 S K A W C X W V R O C K E T B A B R N D A W K F E
 E J E U M I S S I O N I W M E S O S P H E R E R S
 N N Z F I L T E R W H E E L Q A J R O F B M S A C
 S C O M M U N I C A T I O N H I Y T C H X O P D O
 E E N Q E T E M P E R A T U R E A Y C B C G A I P
 A I R G L O W V M Y S U L T R A V I O L E T C A E
 Q O D Z A L S J Y Z U H Y V H E A T J X M W E T R
 N G R I X R A Y G H F D D Q W S C I E N C E W O J
 I N V I S I B L E R C I Z R H M Y J N E B T X R Y
 N U W Z J M Q J V U F N H Y M U G M P F C L B S N

- | | | |
|---------------------------|-------------|-------------------|
| Airglow | Infrared | Specialist |
| AMTM | Invisible | Telescope |
| Aperture baffle | Lenses | Temperature |
| Atmospheric gravity waves | Light | Thunderstorm |
| AWE | Mesosphere | Titanium flexures |
| Communication | Mission | Tracking |
| Detectors | Mountaintop | Troposphere |
| Earth | Navigation | Ultraviolet |
| Electromagnetic spectrum | Payload | Visible |
| ExPA | Radiators | Wavelengths |
| Eyes | Rocket | Weather |
| Filter wheel | Science | Wind |
| Heat | Sense | Xray |
| Hurricane | Space | |

HIDDEN MESSAGE

AWE'S TENACIOUS MISSION TEAM

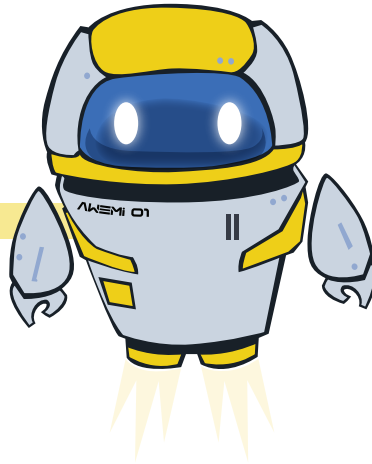
AWE mission team members work together to create a successful mission. Each team has specific roles and responsibilities. Team members contribute their unique talents, skills, and knowledge.

REQUIREMENTS:

1. What AWE mission team do you see yourself joining?

- a) What would be your AWE mission role?
- b) What important skills, talents, and knowledge do you have or want to learn for this role?

*Remember, Recruit,
teamwork makes the
mission plan work!*



MISSION TEAM

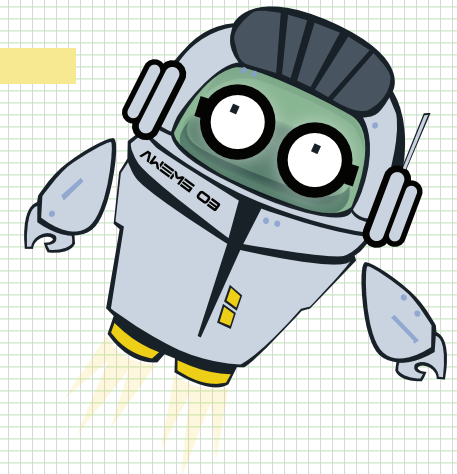
- Roles:**
- Project Manager
 - Systems Engineer
 - Safety and Mission Assurance Manager
 - Mission Operations Manager
 - Hardware Engineers
 - Software Engineers
 - Machinist
 - Contracts Specialist

Responsibilities:
Responsible for achieving science goals and objectives, ensuring instrument performance, and providing mission operations and management.

SCIENCE TEAM

- Roles:**
- Director of Science Operations
 - Scientist
 - Researcher

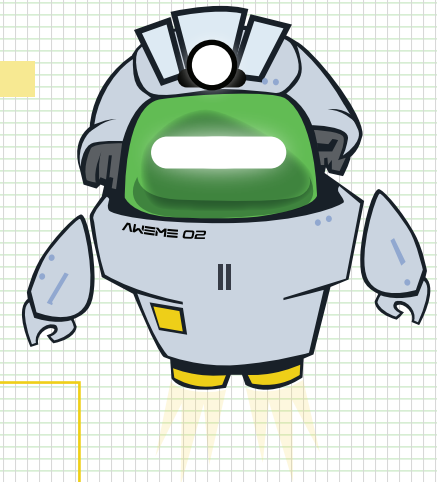
Responsibilities:
Responsible for achieving the science goals and objectives.



RESEARCH TEAM

- Roles:**
- Director of Science Operations
 - Scientist
 - Researcher

Responsibility:
Provides support to the science team.



Team Name: _____

Role: _____

Responsibilities:

- _____
- _____
- _____

JUNIOR AWE MISSION SPECIALIST REQUIREMENTS CHECKLIST

As a Junior AWE Mission Specialist recruit, I have completed all requirements as directed by AMEMI-01.

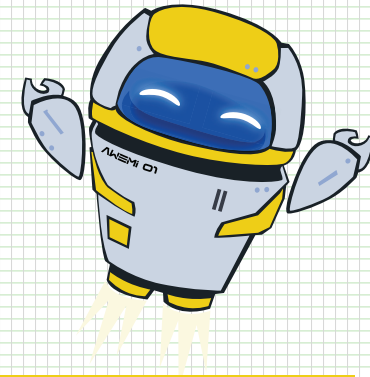
- Read the AWE Mission Brief
- Completed all the workbook activities:
 - Mysterious Atmospheric Gravity Waves
 - Wacky Space Weather
 - Our Amazing Atmosphere
 - AWE's Powerful Payload
 - Illuminating Infrared Data
 - AWE's Tenacious Mission Team
- Received a readiness "go" or "no-go" check from my parent, teacher, or guardian to become a certified Junior AWE Mission Specialist.

GO

NO - GO

JUNIOR AWE MISSION SPECIALIST PLEDGE

I pledge to discover more about space and science and to share with others what I have learned about the AWE mission. I promise to gain more skills in science, technology, engineering, art, and math so I can support future space missions.

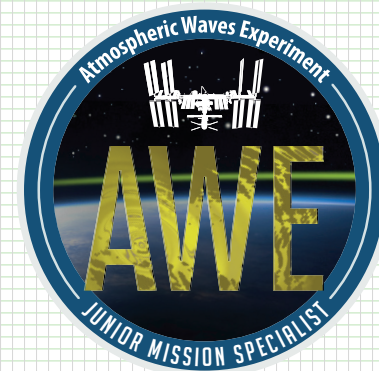


JUNIOR AWE MISSION SPECIALIST CERTIFICATE

This is to certify that _____ has completed the requirements and received a "Go" recommendation to advance from Recruit to Junior AWE Mission Specialist.

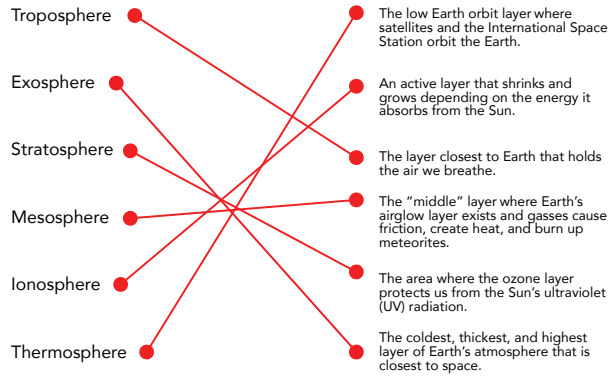
Junior AWE Mission Specialist Signature

Celebrate your success by telling friends and family about the AWE mission.



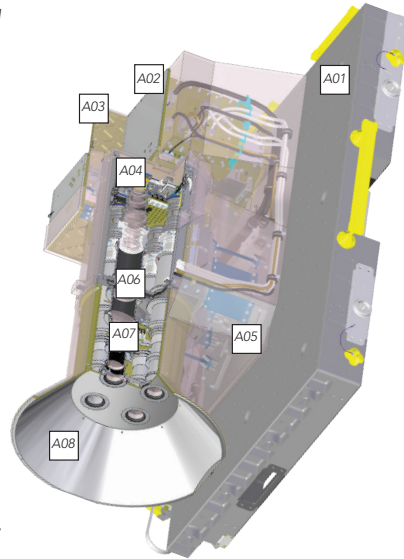
ANSWER KEY

OUR AMAZING ATMOSPHERE

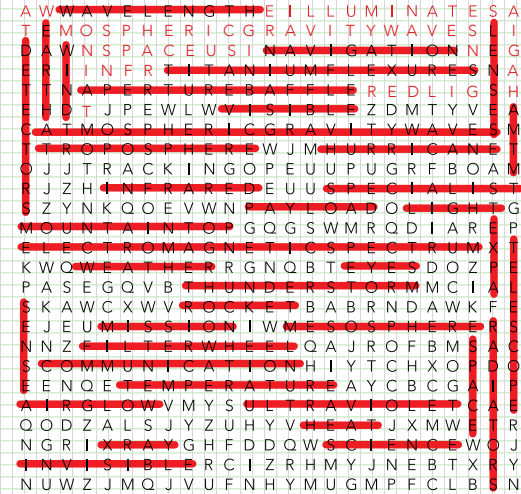


AWE'S POWERFUL PAYLOAD

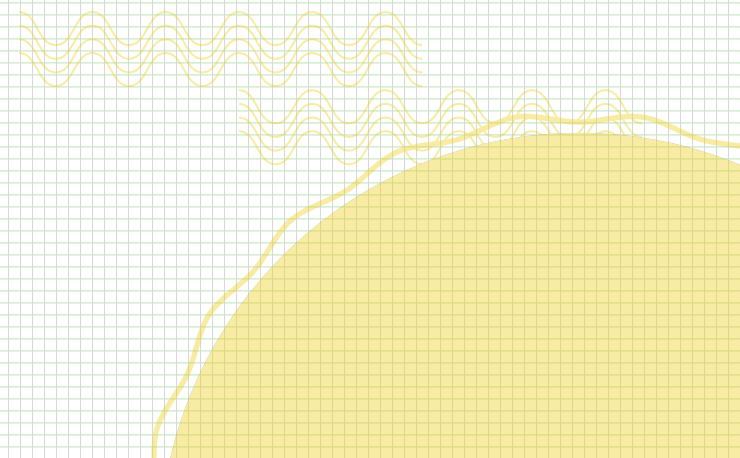
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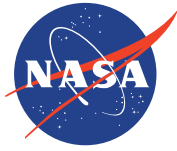


ILLUMINATING INFRARED DATA



AWE ILLUMINATES ATMOSPHERIC GRAVITY WAVES IN SPACE USING INFRARED LIGHT





Developed by Space Dynamics Laboratory

<https://www.awemission.org/>