National Aeronautics and Space Administration

www.nasa.gov

Space Communications and Navigation Program

The Space Communications and Navigation (SCaN) Program provides communications and navigation services that are essential to the operation of NASA's space flight missions.

SCaN manages the ground-based facilities and services provided by the Deep Space Network (DSN), Near Earth Network (NEN), and Space Network (SN).

Entering the Decade of Light

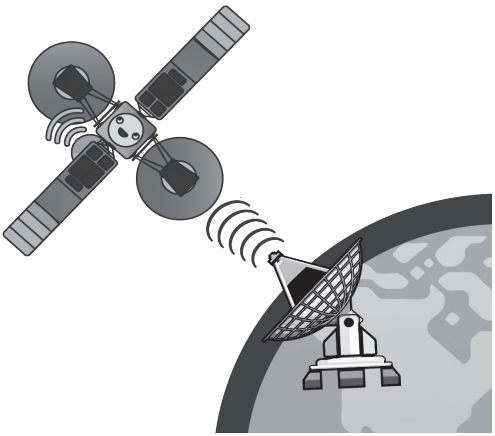
http://www.nasa.gov/scan

SCAN WORD SEARCH

Circle the hidden words from the list below.

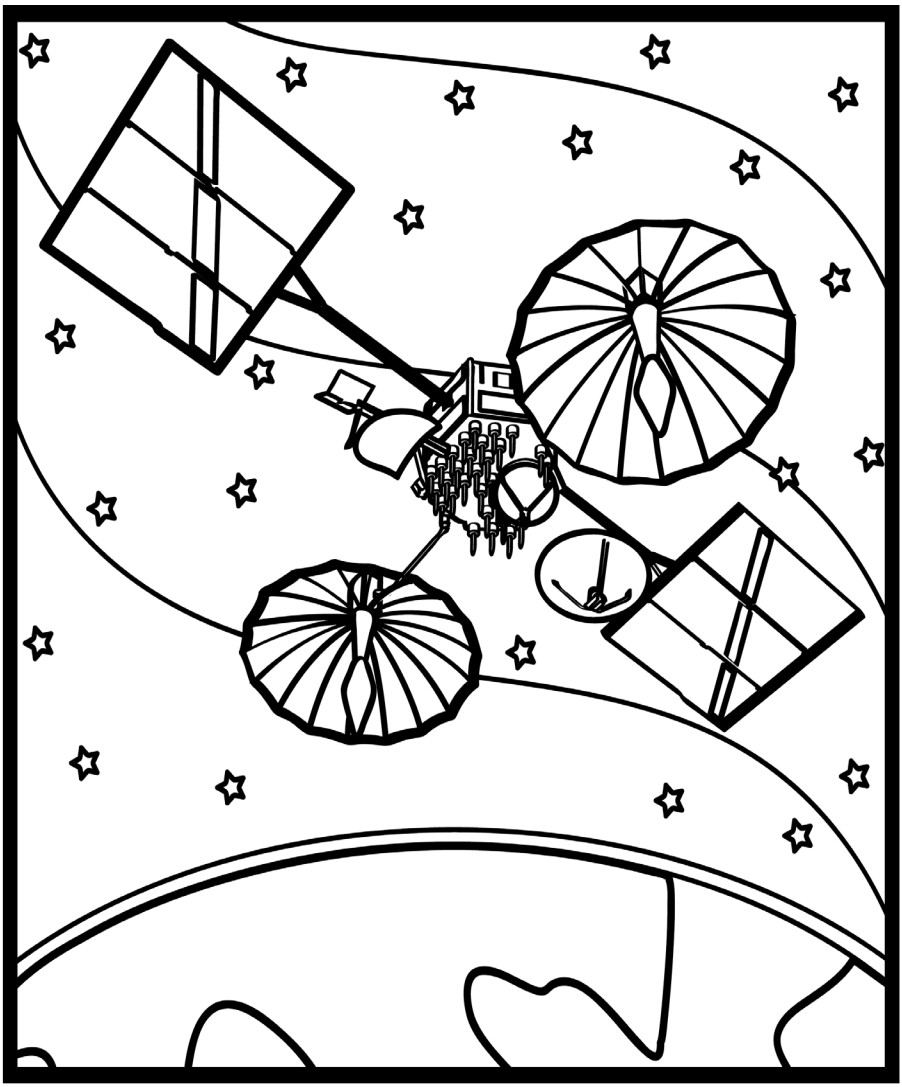
```
                C I M
              P S D U O F A I H
            H Q L J L H I E X O N Q C
          T D R R A D A R P O S K V P Q H U
        W C F P D N L F D N R O J Q H N H C E
      D Q I Q L O E V T C Y F X X M L C I O O G
      S D J F D N T O N W T T K N Z N Q S M R F
    L P P C O P Z R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

Antenna
TDRS
Satellite
Planet
Network
Space
Orbit
Radar
Communication
Navigation
Earth
Mars
Exploration
Launch
Spacecraft
Station
Moon
Rocket
Asteroid
Mission
Astronaut
Stars



COLOR ME

TDRS Satellite—First Generation

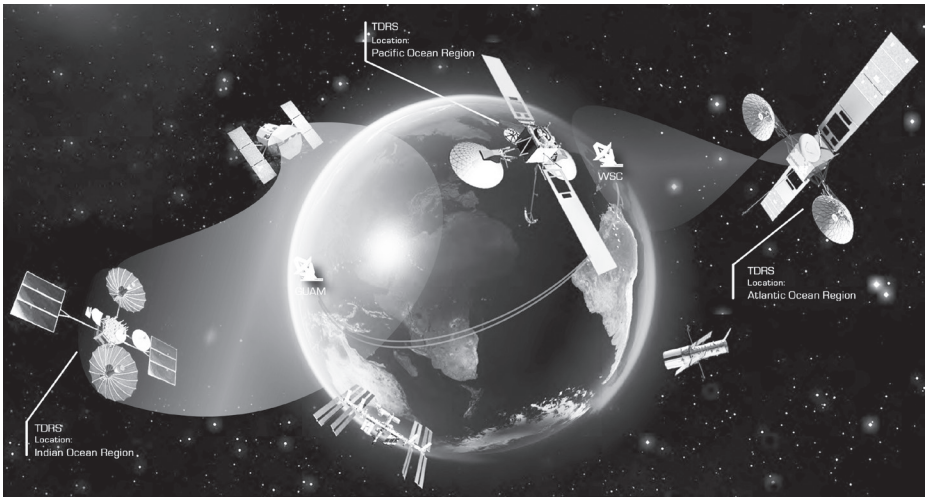


DID YOU KNOW?

Started in the early 1970's the Tracking and Data Relay Satellite (TDRS) is part of the Space Network. The Tracking and Data Relay Satellite system consists of in-orbit satellites to provide near continuous information to and from missions the Hubble Space Telescope (HST) and the Space Station.

SATELLITE FACTS

Tracking and Data Relay Satellite



WHAT IS A RELAY SATELLITE?

Like in a relay race, where runners pass the baton to the next runner to run the next leg of the race, the Tracking and Data Relay Satellite (TDRS) works similarly with satellite's information to transfer data between the ground and space.

Satellites in orbit cannot pass along their information to the ground stations on Earth if the satellite does not have a clear view of the ground station. Therefore, TDRS serves as a way to pass along the satellite's information. Nine TDRS sit about 35,400 kilometers (22,000 miles) above the Earth and are able to forward information from a satellite until it reaches the appropriate ground station in view, to that TDRS at either White Sands, New Mexico or Guam Island. TDRS can also send information from the ground to the satellite to tell the satellite what to do (take a picture, turn a sensor or off, send stored data back or change its orbit). TDRS allows NASA to have global coverage of all the satellites–24 hours a day–without having to build extra ground stations on Earth.

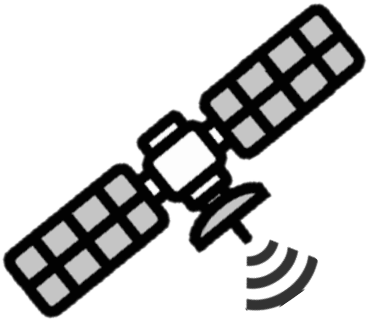
Operating SCaN Network: Space Network

NAVIGATE TO ORBIT

Navigate the string routes to find the path that takes TDRS to orbit.
(The strings cross over and under each other, so crossing other string routes is okay to stay on your route!)

DID YOU KNOW? • NAVIGATION Mission users in orbit can determine their position and time using communications channel tracking via the Space Communications and Navigation (SCaN) Deep Space Network (DSN), Near Earth Network (NEN), Space Network (SN), or by on-board means of processing one-way radionavigation signals from Global Navigation Satellite Systems (GNSS) such as the U.S. Global Positioning System (GPS). The DSN is also capable of supporting tracking from Low Earth Orbit (LEO) through interplanetary transfer domains. GPS is transforming operations in space–from guidance systems for the Space Station's return vehicle to the control of communication satellites to entirely new forms of Earth remote sensing to collect and analyse data from faraway places!

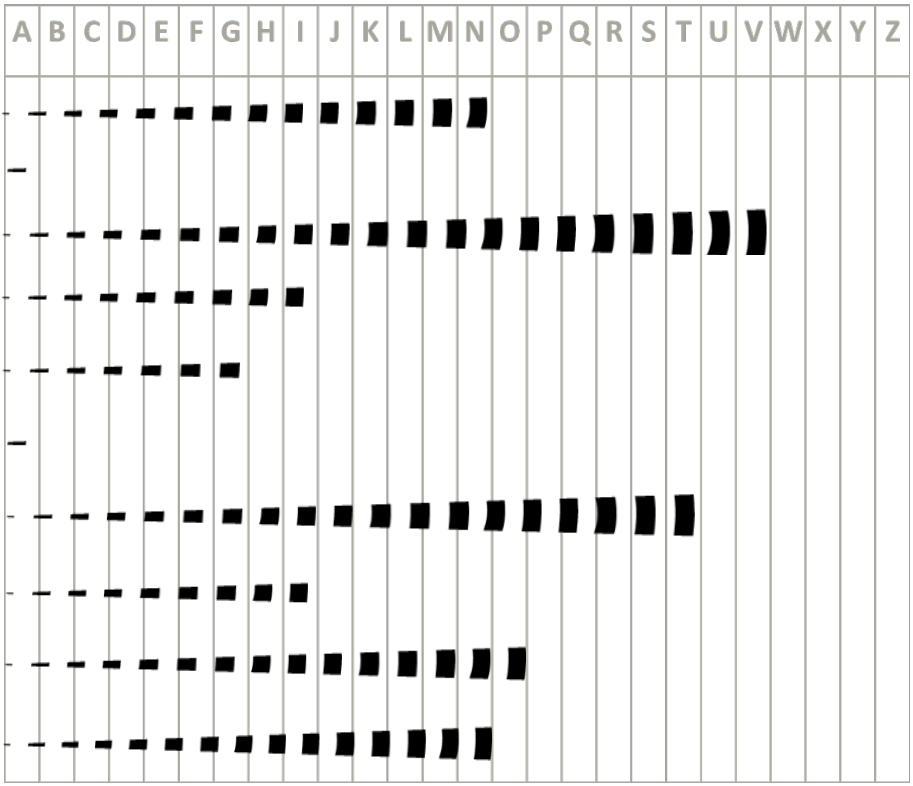
DECODE THE SIGNAL!



INSTRUCTIONS

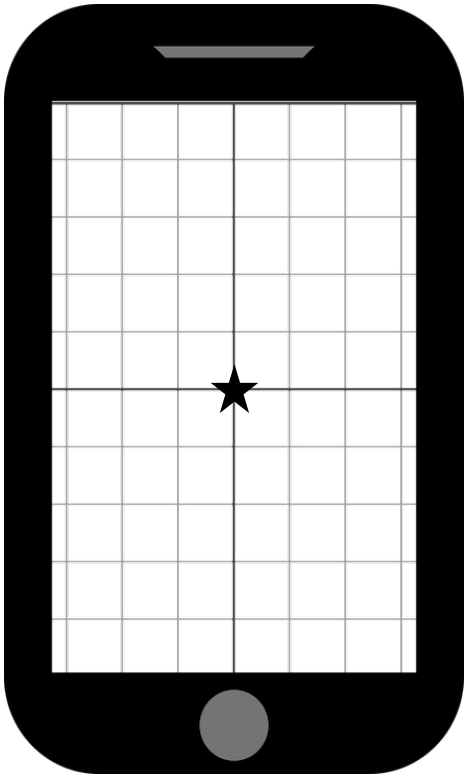
The radio signals are sending a message! Figure out what it says by going row by row to see what letter the radio wave lands on!

MESSAGE: _ _ _ _ _ _ _ _ _ _ _ _



WHERE AM I?

Your phone needs to figure out where you are!
Start at the center star and follow
the instructions to find out!



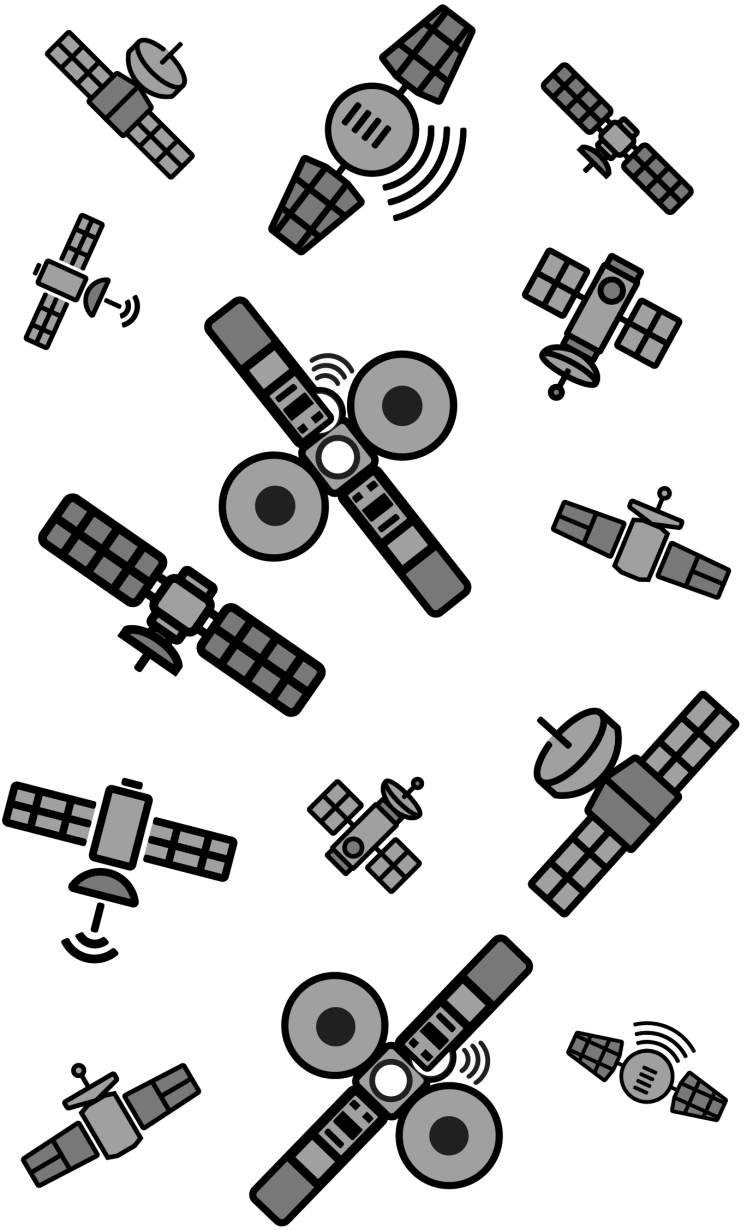
1. Satellite A tells you to go up four squares
2. Satellite B tells you to go left two squares
3. Satellite C tells you to go down three squares
4. Satellite D tells you to go right four squares

Label where you are!

DID YOU KNOW? One GPS satellite isn't enough to tell you where you are. You need at least four GPS signals to figure out your position! When people use their phone for GPS, the phone has to figure out what the signals are saying.

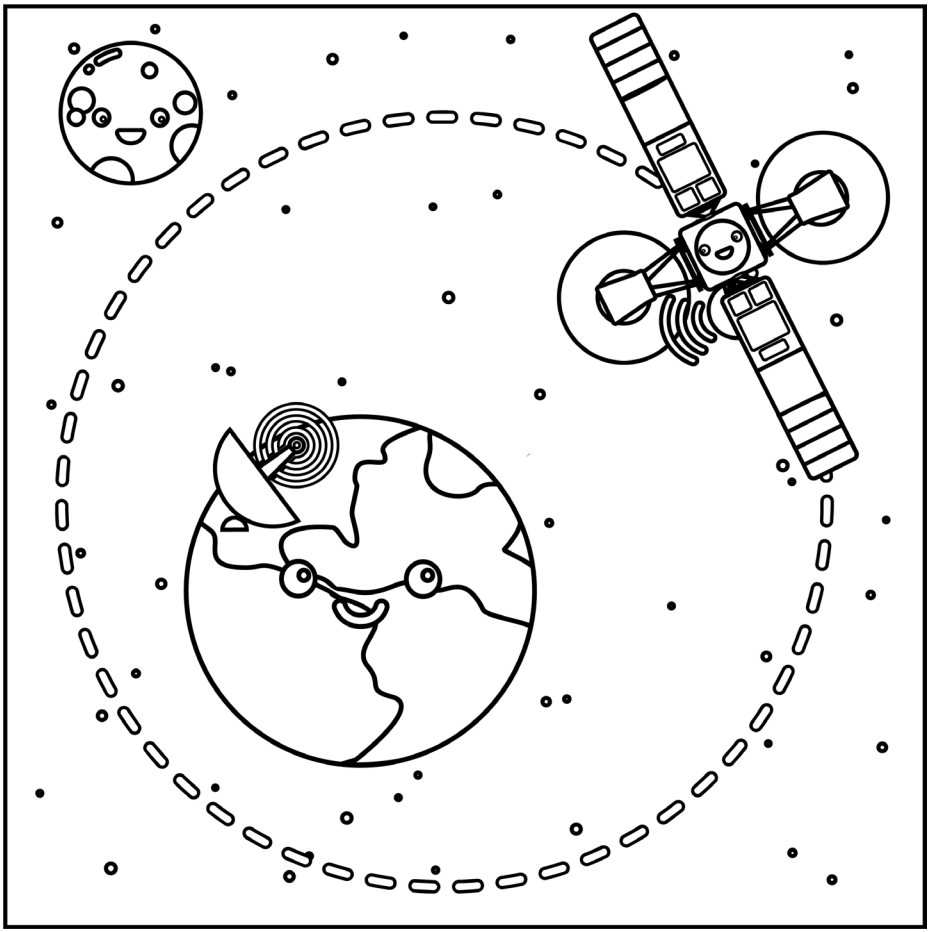
MATCH THE SATELLITES

Draw lines to connect all the matching satellites.
(Tip: There is more than one match.)



COLOR ME

Add your own colors to the image below!

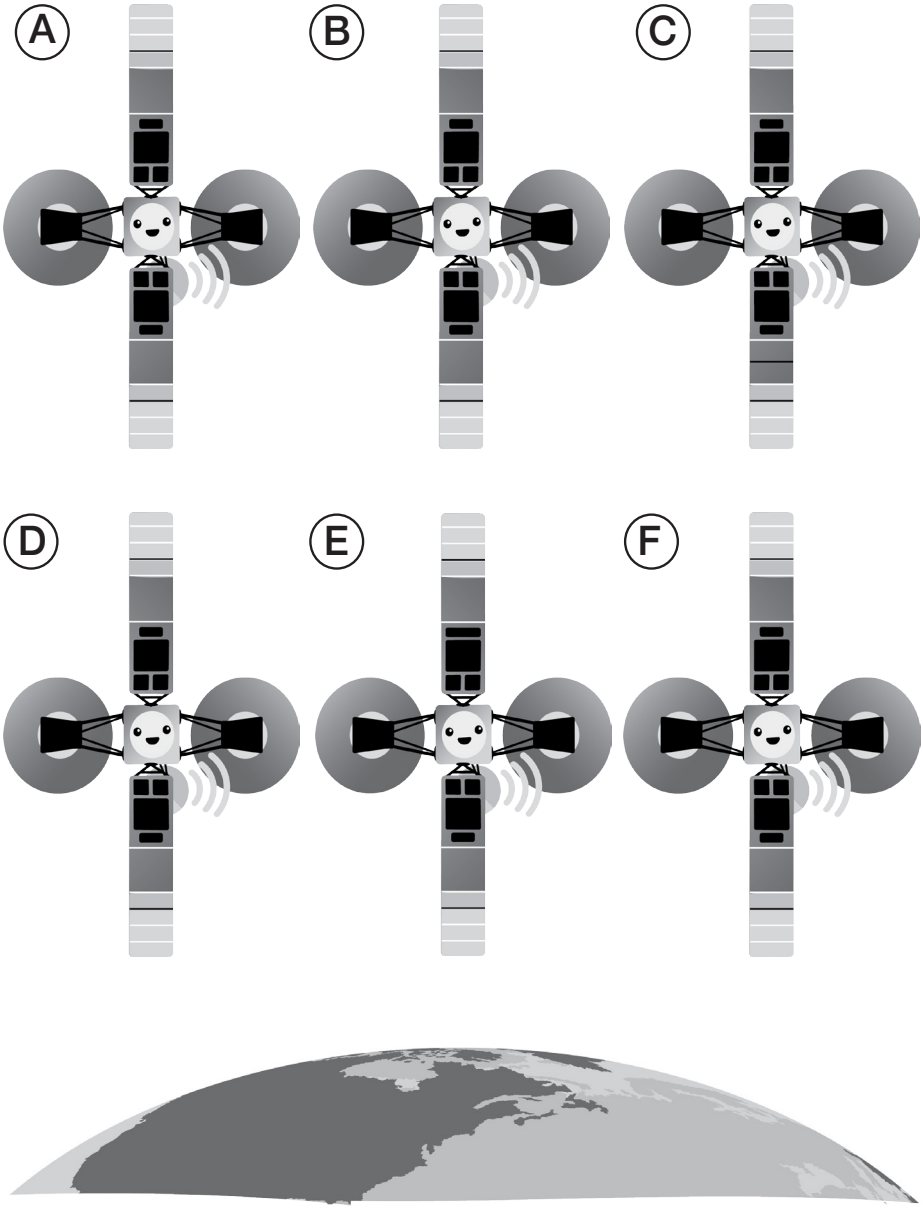


DID YOU KNOW?

When satellites reach their orbit, their name changes from a letter to a number: TDRS-A → TDRS-1

SATELLITE ODD ONE OUT

Two of the satellites are different from the others.
Can you find them?



SPACE JOURNEY STORY

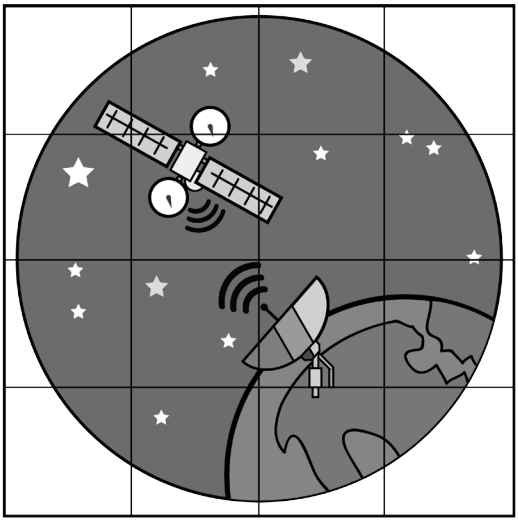
Instructions:
- Choose a word for each part of speech specified.
- Read the story on the page out loud, filling your words in the blanks.
- Laugh and ask your family and friends to see what words they choose – a new story every time.

NASA is starting a mission in which they will be sending a select group of _____ to _____ in a _____. They have asked you to join in this _____ mission! _____ is leading your team on this _____ journey in which you will _____. The Space Communications and Navigation (SCaN) Deep Space Network will be managing the communication with you, your _____, and the mission control center. The satellites will transmit and receive the messages with the _____ ground station. You and your team will live for _____ years in a _____ and work on _____ experiments to benefit science and _____. The experiment data will be sent to scientists at _____ to evaluate. The food you will be eating is _____ and _____. The team will be wearing _____ spacesuits and exploring the planet in a _____. Your scientific experiments will help people on Earth with their _____!

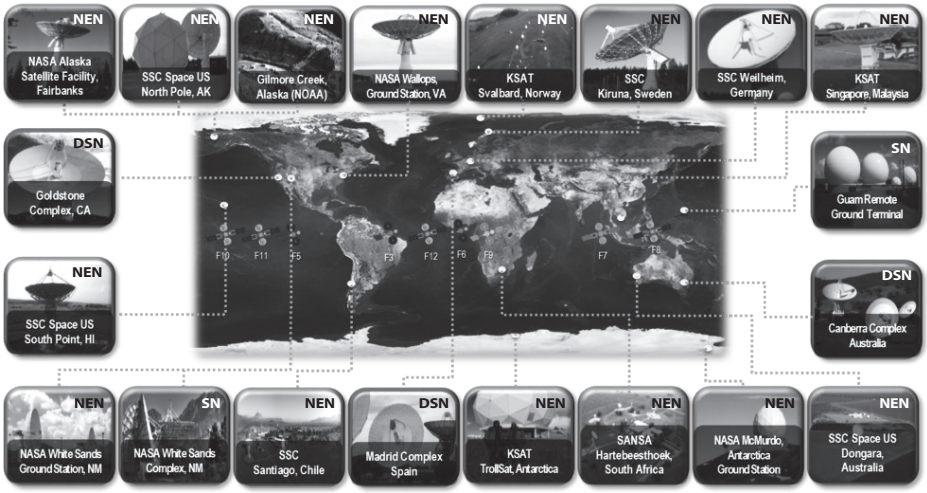
plural noun *planet* *noun* *constellation* *person* *adjective* *verb* *plural noun* *place* *number* *noun* *adjective* *plural noun* *place* *food* *beverage* *color* *vehicle* *plural noun*

DRAW ME

Use the grids on this page to copy the satellite and network antenna picture, then add some color to your drawing!



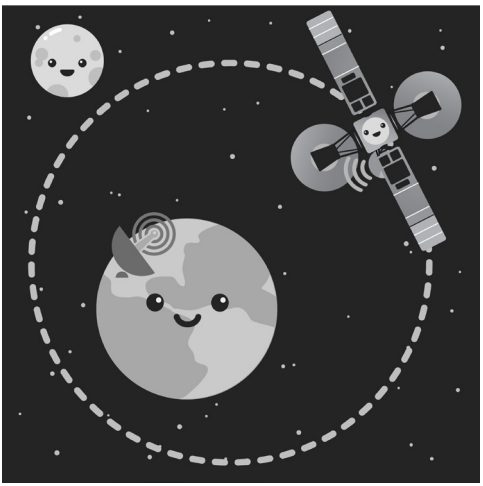
SCAN NETWORKS



WHAT ARE THE SCAN NETWORKS?

SCaN provides three networks, offering support to customers for global telecommunication services between customer mission platforms and operations centers.

NEAR EARTH NETWORK (NEN): provides telemetry, commanding, ground-based tracking, data and communications services. The NEN provides these services to customers with satellites in low Earth orbit, geosynchronous orbit, highly elliptical orbit, lunar orbit and missions with multiple frequency bands.



SPACE NETWORK (SN): consists of a constellation of geosynchronous satellites named the Tracking and Data Relay Satellite and ground systems that schedule, command and control the relay system of satellites.

DEEP SPACE NETWORK (DSN): supports NASA and non-NASA missions that explore the furthest points of our solar system. The DSN has three ground stations located approximately 120 degrees apart on Earth.

SPACE WORDS

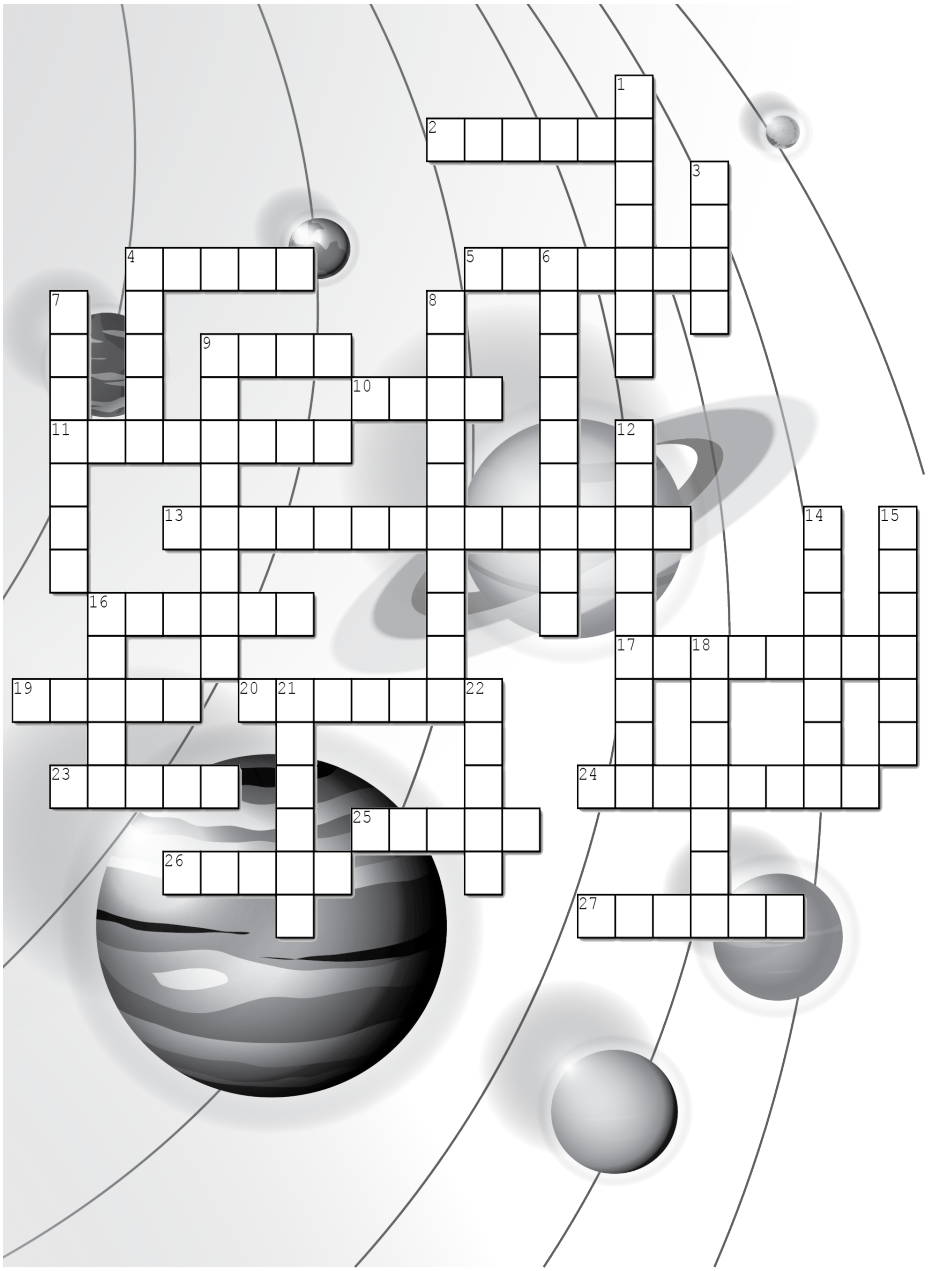
The Space Communications and Navigation (SCaN) Program provides communications and navigation to NASA's missions. Our main goal is providing accurate and reliable space communications for our customers. Entering the Decade of Light!

How many words can you make using all the letters in the phrase in the box below? Write them below.

Space Communication

GALACTIC CROSSWORD

Read the clues on the facing page and fill in the correct answers from the Word Key in the puzzle below.



GALACTIC CROSSWORD

WORD KEY:

Solar Star Networks Radar Link Mission Rocket Gravity Satellite Planets Radar Apogee Payload Antenna Perigee Lunar Orbit NASA Space Communications Latitude Launch Galaxy Receiver Tracking Spacecraft Longitude Robot Rover Meteor

ACROSS:

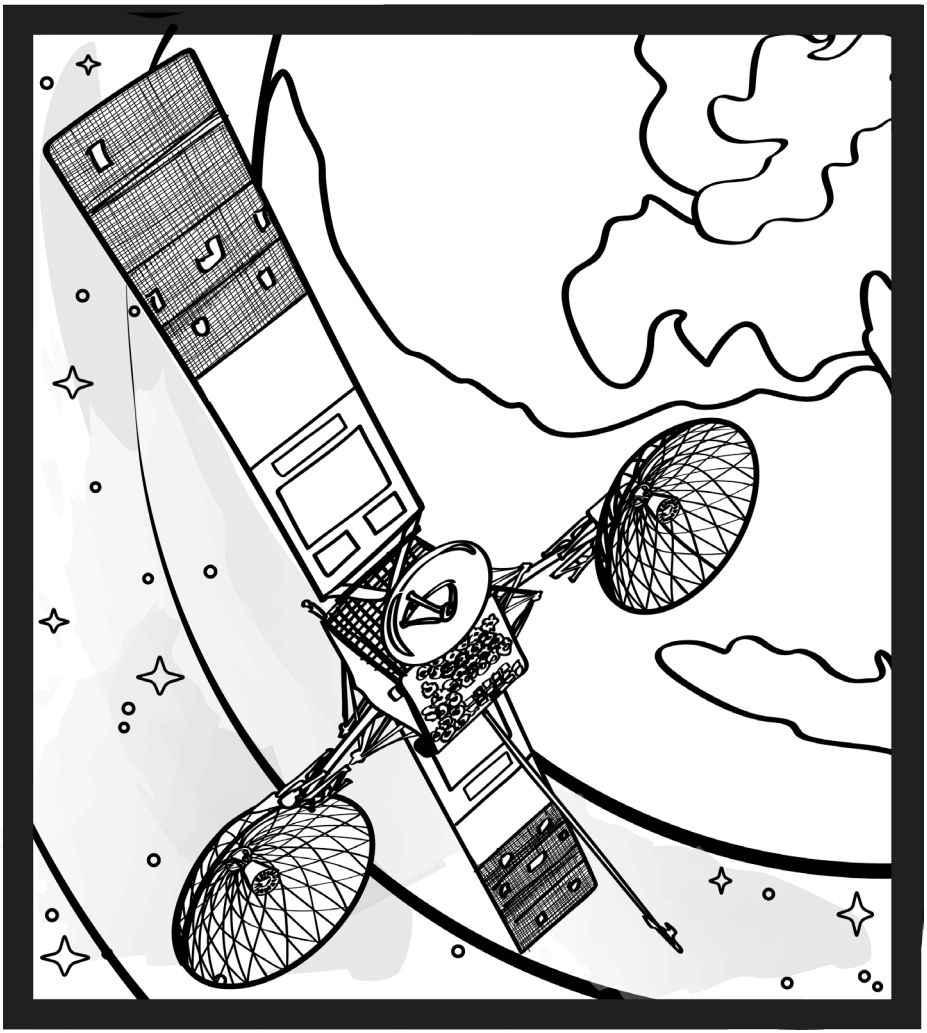
2. A space rock that becomes so hot it glows when it passes into Earth's atmosphere.
4. A vehicle for exploring the surface of a planet or moon.
5. A flight to a destination in space.
9. National Aeronautics and Space Administration
10. A huge ball of very hot, glowing gas that gives off both heat and light.
11. A measurement of distance, given in degrees north or south from the equator.
13. A means of transmitting and receiving information.
16. A vehicle used to launch people and objects into space.
17. Locking on and following a selected signal.
19. A device that sends out radio waves and picks them up again after the waves strike another object and bounce back.
20. Large round objects that revolve around a star.
23. The path followed by a moon, planet or artificial satellite as it travels around another body in space.
24. A device that captures and processes a desired signal.
25. Having to do with the Moon.
26. The region beyond Earth's atmosphere.
27. One of the very large groups of stars and other matter that are found throughout the universe.

DOWN:

1. The force by which a planet or other body draws objects toward its center.
3. The connection between a sender and receiver.
4. A machine that is built to do a certain job again and again, or to do work that might be dangerous for humans.
6. A natural moon or man-made object that orbits a planet or other object.
7. Equipment and samples from a mission that must be returned to Earth for analysis.
8. Vehicle capable of traveling in outer space.
9. Collection of systems that provide communication and navigation services to missions.
12. A measurement of distance, given in degrees east or west of the prime meridian.
14. A point in the satellite's orbit where it is closest to the Earth–opposite of apogee.
15. A point in the Earth satellite's orbit where the satellite is furthest from Earth–opposite of perigee.
16. Device that transmits a radio signal and receives the reflectors from selected object to determine the characteristics of that object.
18. A metallic structure or conductor that captures and/or transmits radio electromagnetic waves.
21. To send something on its way, such as when a rocket's engines are ignited to send it from Earth into space.
22. Having to do with the sun.

COLOR ME

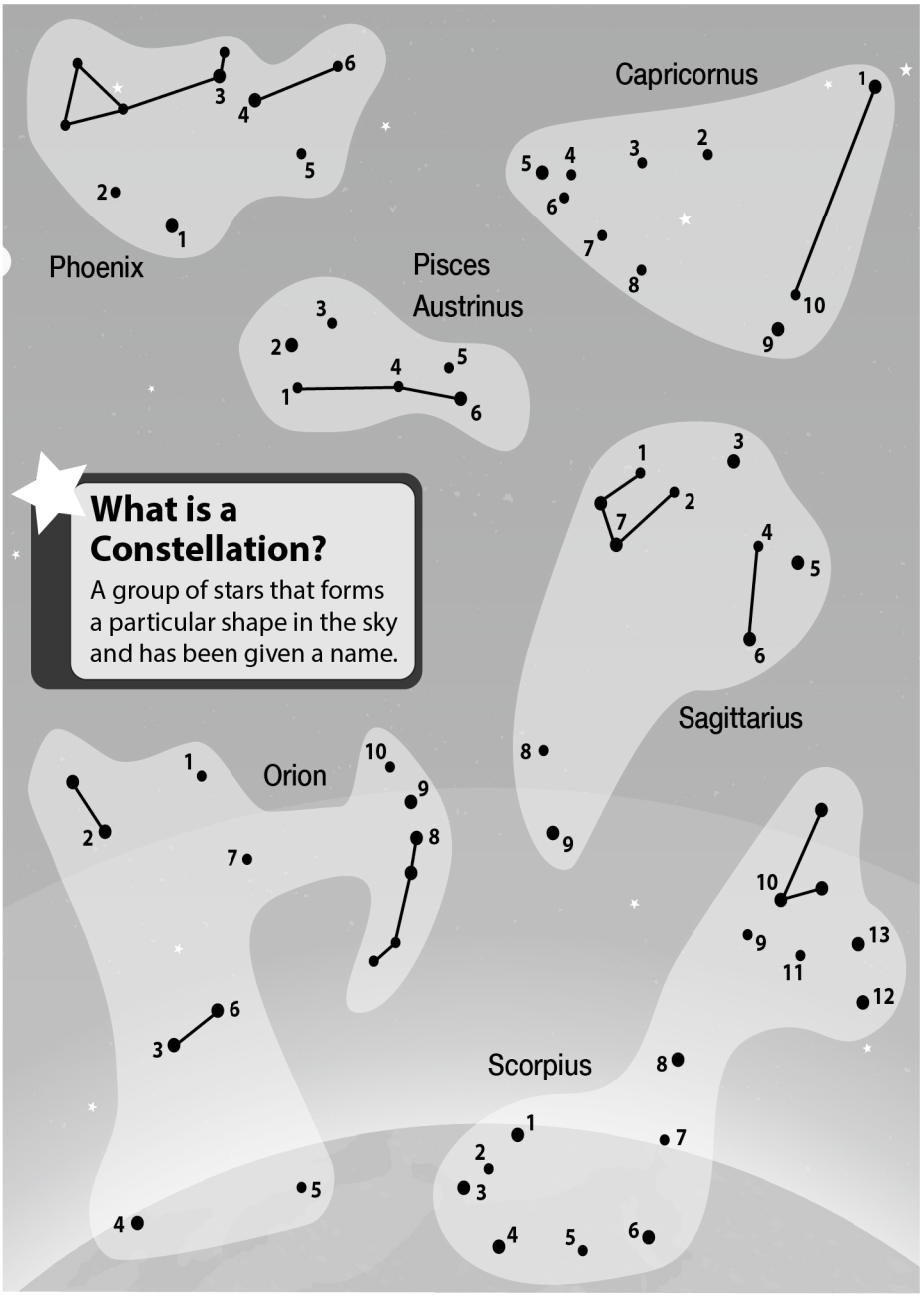
TDRS M Satellite—Third Generation



DID YOU KNOW? TDRS-M, now named TDRS-13 after reaching geosynchronous orbit, is the latest communications satellite to join the TDRS fleet and will support space communications for an additional 15 years.

CONNECT THE DOTS

Connect the dots to complete the constellations.



SPACE WORD SCRAMBLE

Unscramble the letters below to make space words.

ETASORID _____

AENLTP _____

EOCTKR _____

RATEH _____

MNOO _____

RSMA _____

ILSLATEET _____

TBROI _____

LXAYGA _____

STURTOANA _____

ROTMEE _____

ATSR _____

ERRVO _____

IIMSNSO _____

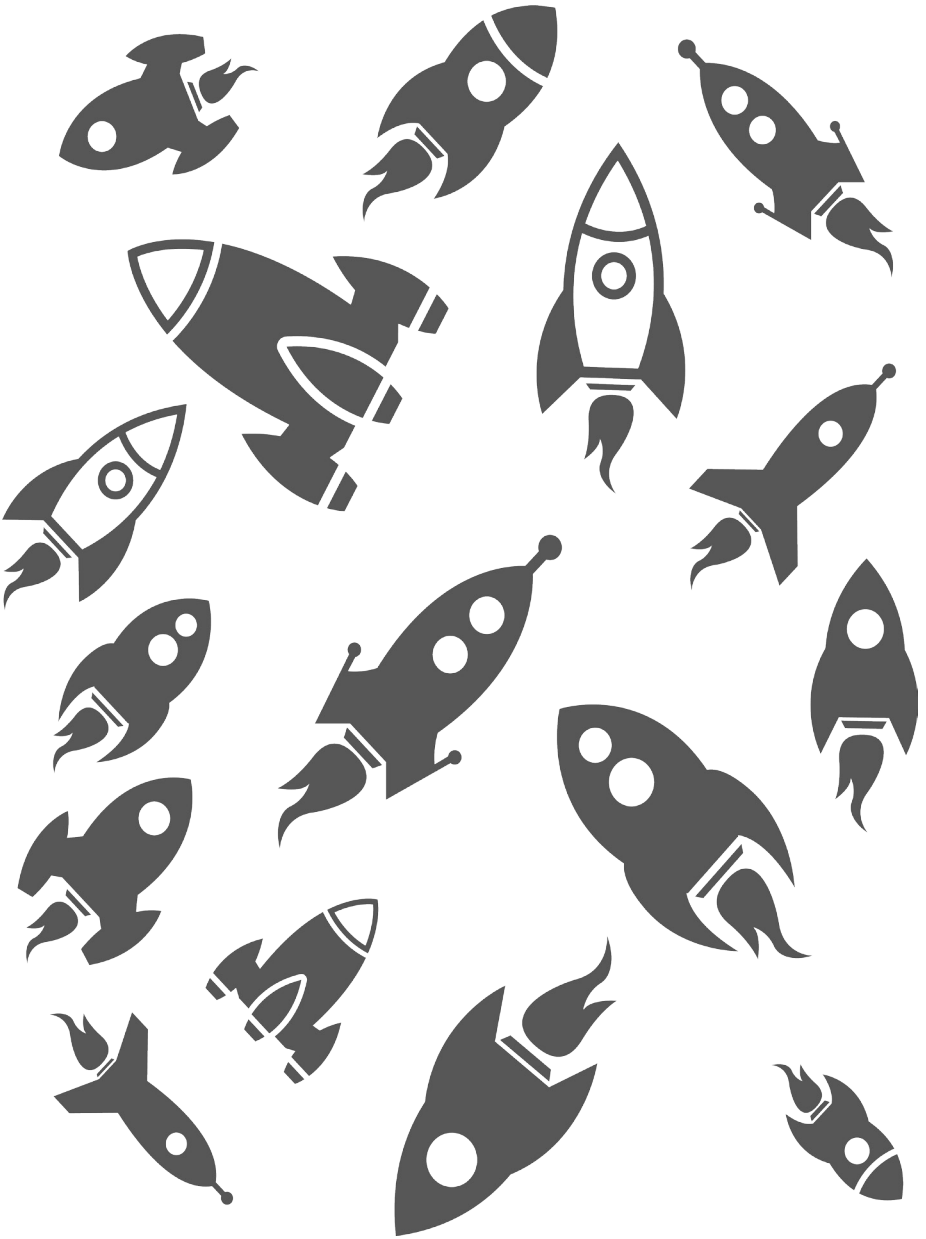
CPAES _____

ROCKET LAUNCHES

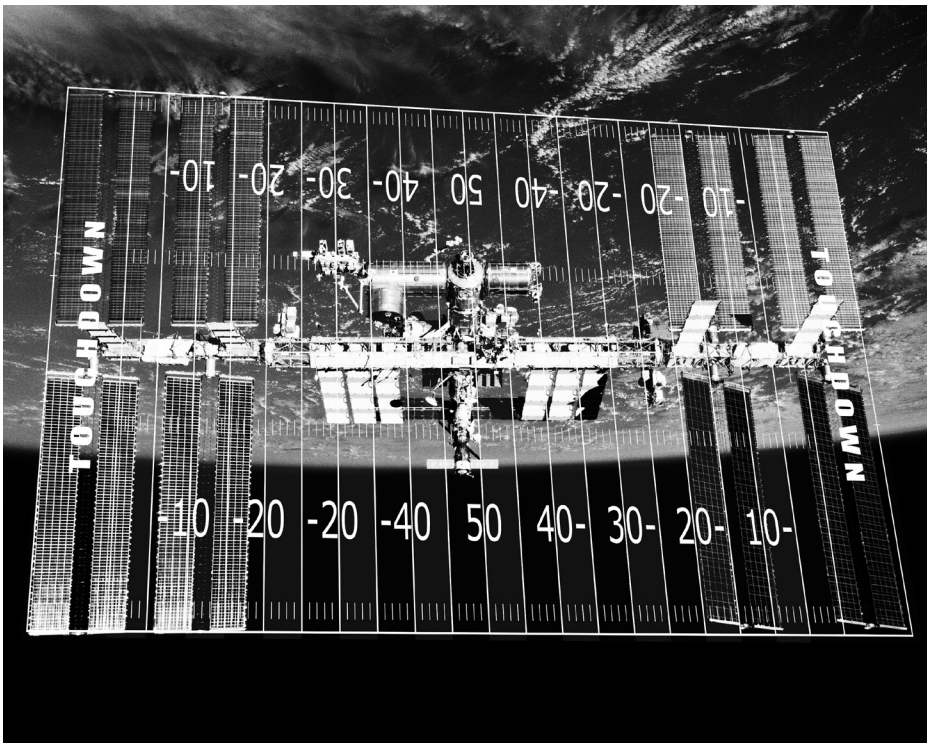
Rockets such as the Atlas V rocket are used by the Space Communications and Navigation Program at NASA to launch spacecraft from the Cape Canaveral Air Force Station Space Launch Complex.

MATCH THE ROCKETS

Draw lines to connect all the matching rockets.
(There is more than one match.)



SPACE STATION FACTS



WHAT IS THE SPACE STATION?

The Space Station is a habitable vehicle in a low Earth orbit that serves as a microgravity and space environment research laboratory. An international collaboration, the Space Station began assembly in December 1998 and has been continually occupied since November 2000. Since then, more than 200 people from 15 countries have spent time aboard. The Space Station is approximately the size of a football field and is the second brightest object in the night sky, after the moon.

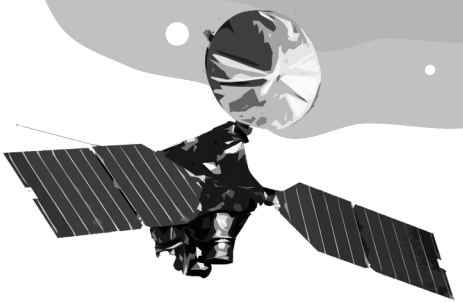
I SPY ONBOARD SPACE STATION

Find these items hidden onboard the Space Station:

Astronaut	Chess Pieces	Earth
Guitar	Robot	Rocket
Satellite		
Shoe	Tomato	

FIND THE MARS ROVER

Start your mission here to navigate to the Mars Rover at the center of the maze!

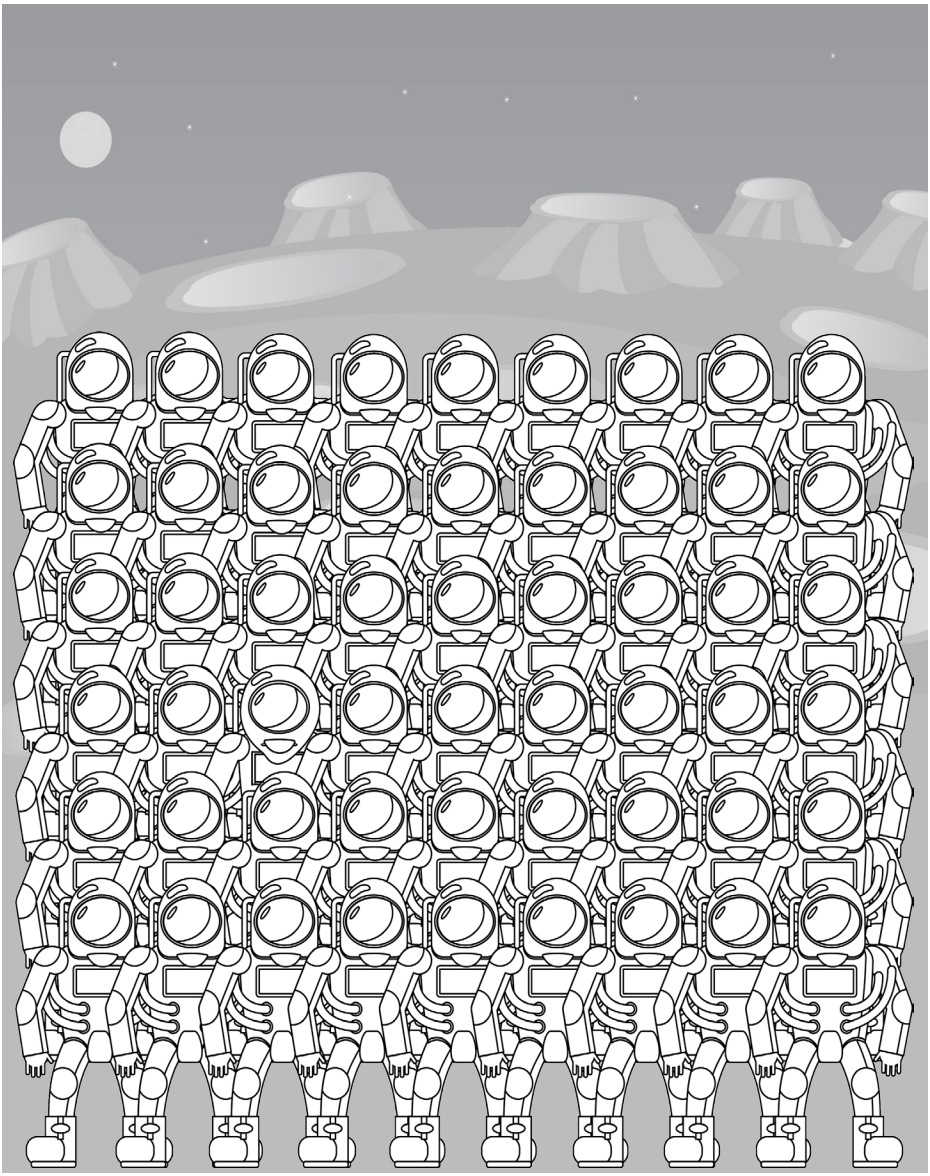


DID YOU KNOW?

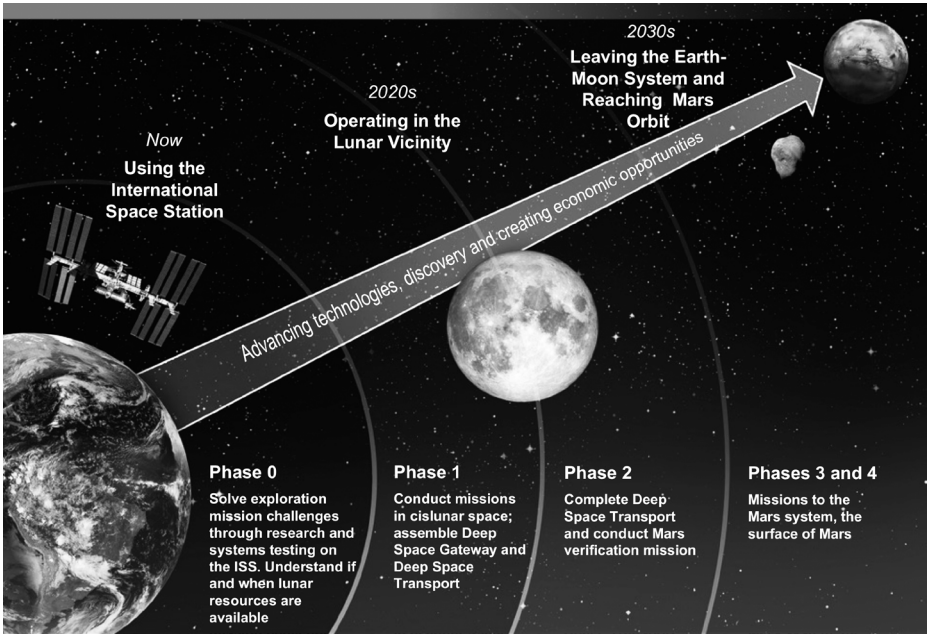
The Mars Reconnaissance Orbiter provides relay support to the Mars Exploration Rovers: Spirit and Opportunity.

FIND ME

Find the martian in the picture below.

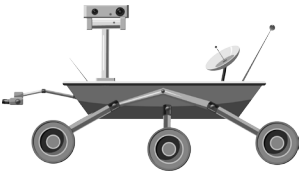


FUTURE SPACE EXPLORATION



OUR GOAL

The nation's goal for space exploration is to lead an effort that expands human presence deeper into the solar system through a sustainable human and robotic spaceflight program.



(a) LONG TERM GOALS – The long-term goals of the human space flight and exploration efforts of NASA shall be:

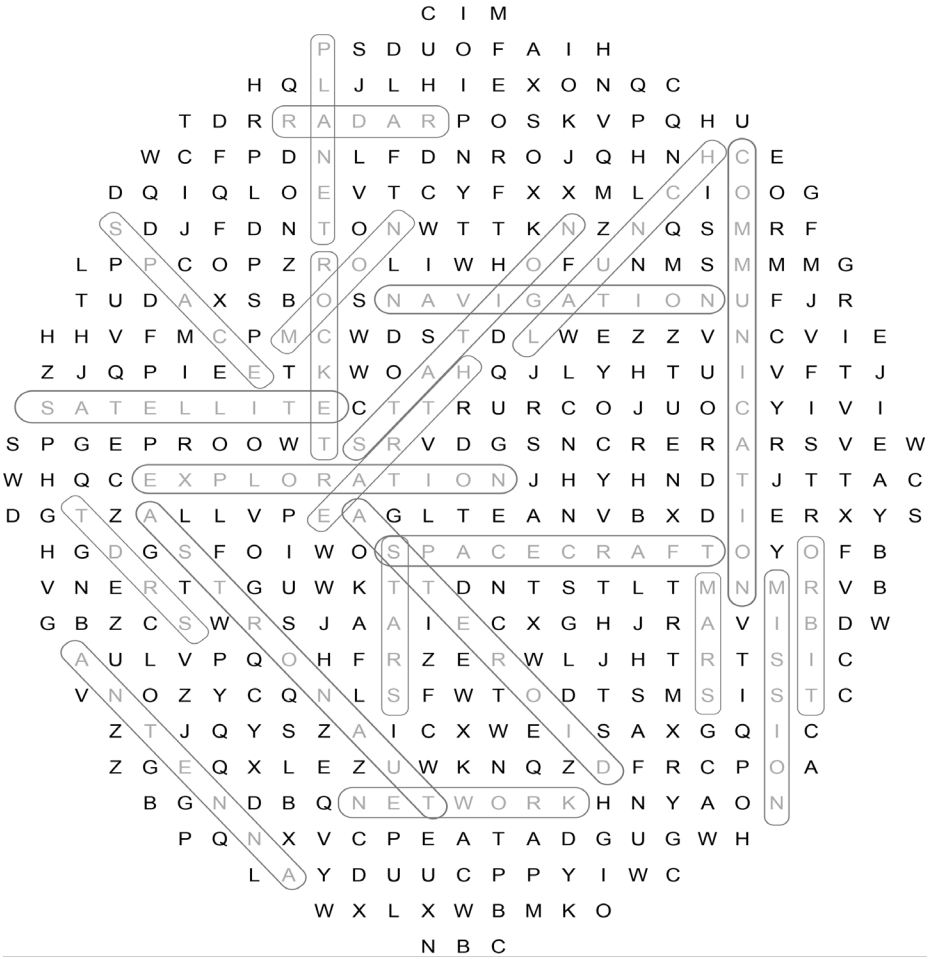
(1) to expand permanent human presence beyond low-Earth orbit and to do so, where practical, in a manner involving international, academic, and industry partners;

(2) crewed missions and progress toward achieving the goal in paragraph (1) to enable the potential for subsequent human exploration and the extension of human presence throughout the solar system; and

(3) to enable a capability to extend human presence, including potential human habitation on another celestial body and a thriving space economy in the 21st century.

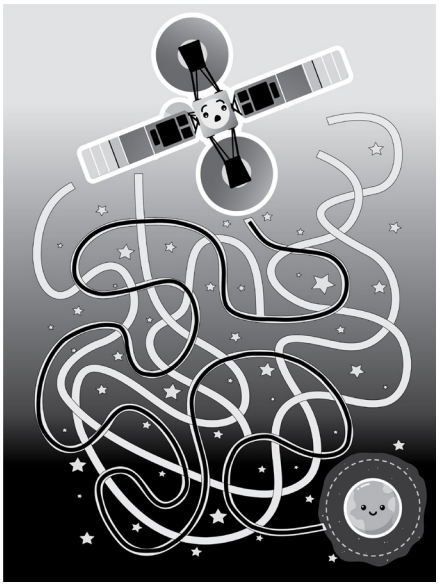
ANSWER KEY

Page 3—SCaN Word Search:



ANSWER KEY

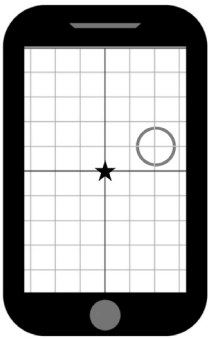
Page 6—Navigate to Orbit:



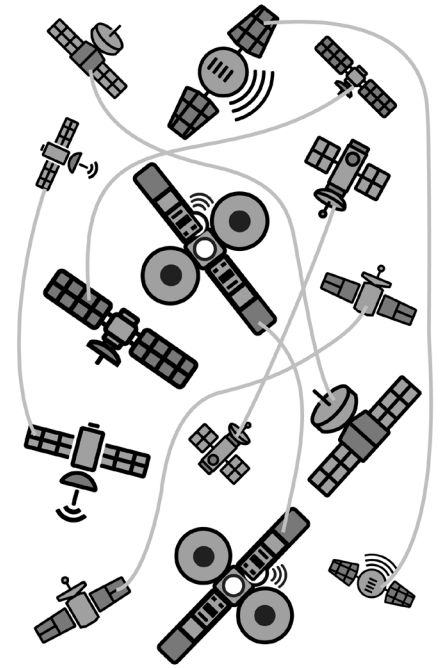
Page 7—Decode the Signal:

Navigation

Page 8—Where Am I?:



Page 9—Match the Satellites:

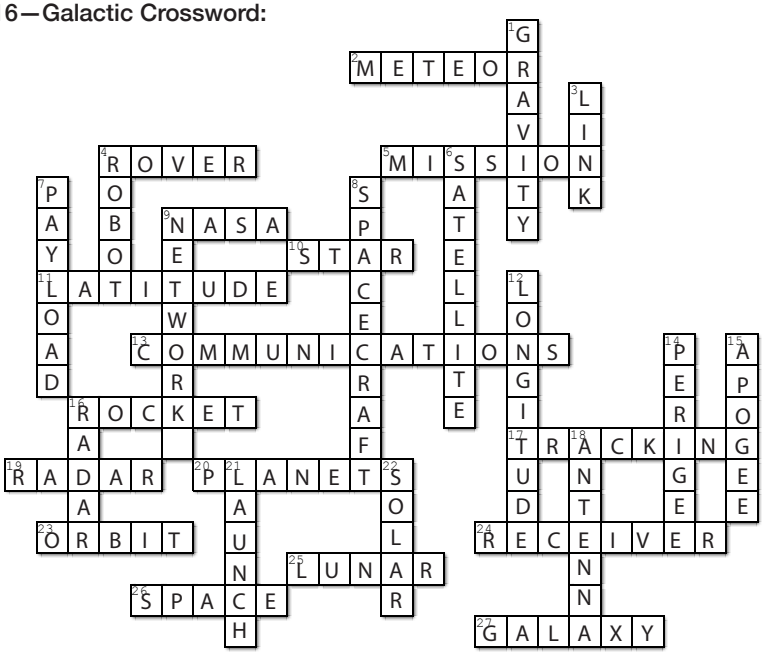


Page 11—Satellite Odd One Out:

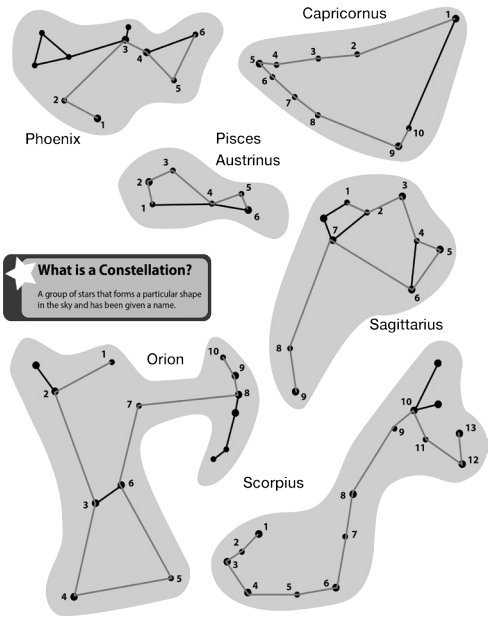
C and E

ANSWER KEY

Page 16—Galactic Crossword:



Page 19—Connect the Dots:

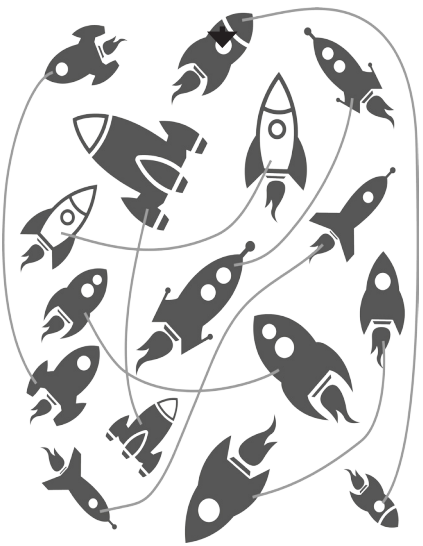


ANSWER KEY

Page 20—Space Word Scramble

ETASORID	ASTEROID
AENLTP	PLANET
EOCTKR	ROCKET
RATEH	EARTH
MNOO	MOON
RSMA	MARS
ILSLATEET	SATELLITE
TBROI	ORBIT
LXAYGA	GALAXY
STURTOANA	ASTRONAUT
ROTMEE	METEOR
ATSR	STAR
ERRVO	ROVER
IIMSNSO	MISSION
CPAES	SPACE

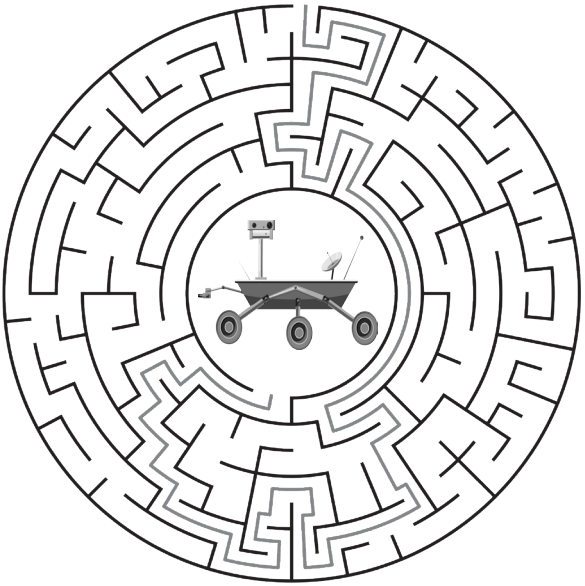
Page 21—Match the Rockets:



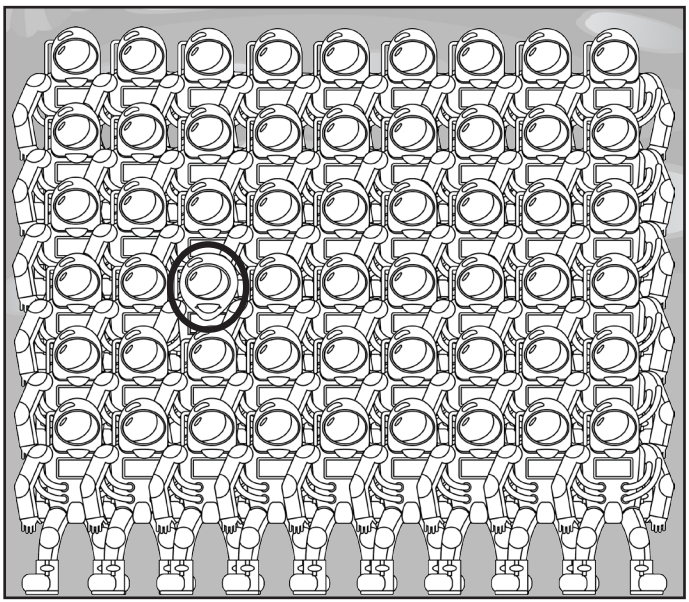
Page 23—I Spy Onboard Space Station:

ANSWER KEY

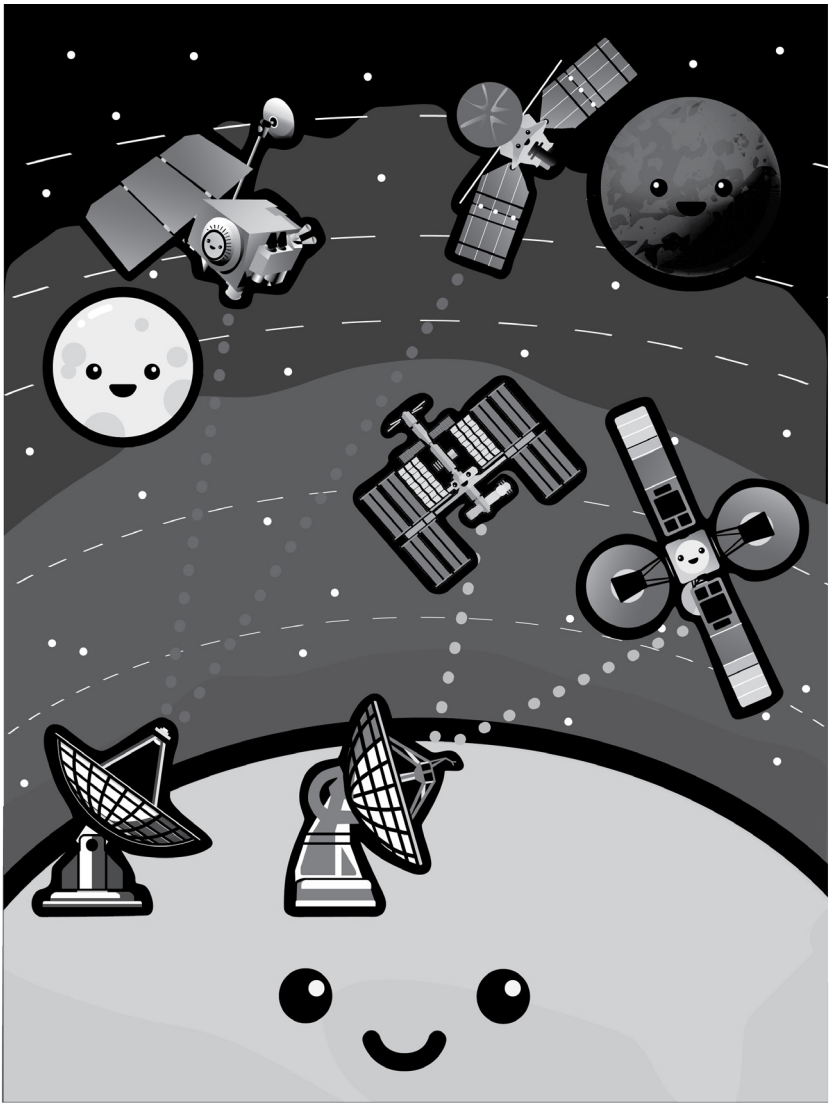
Page 24—Find the Mars Rover:



Page 25—Find Me:



Page 35—Create Your Own Space Communications Networks:

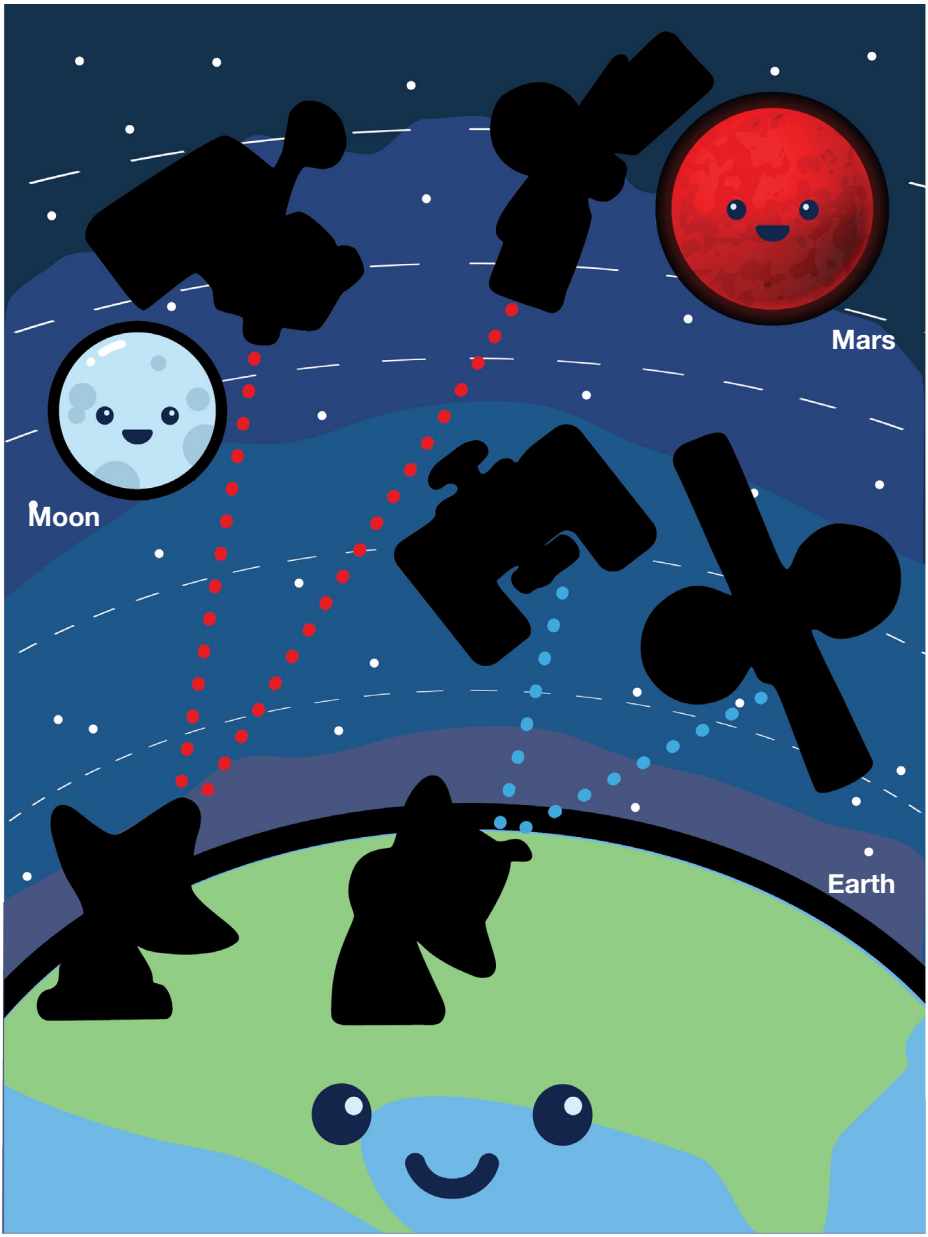


NOTES

NOTES

CREATE YOUR OWN SPACE COMMUNICATIONS NETWORKS

Match the Space Communications and Navigation (SCaN) Fun Stickers to the correct shapes in the picture below to create your own space communications networks!

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