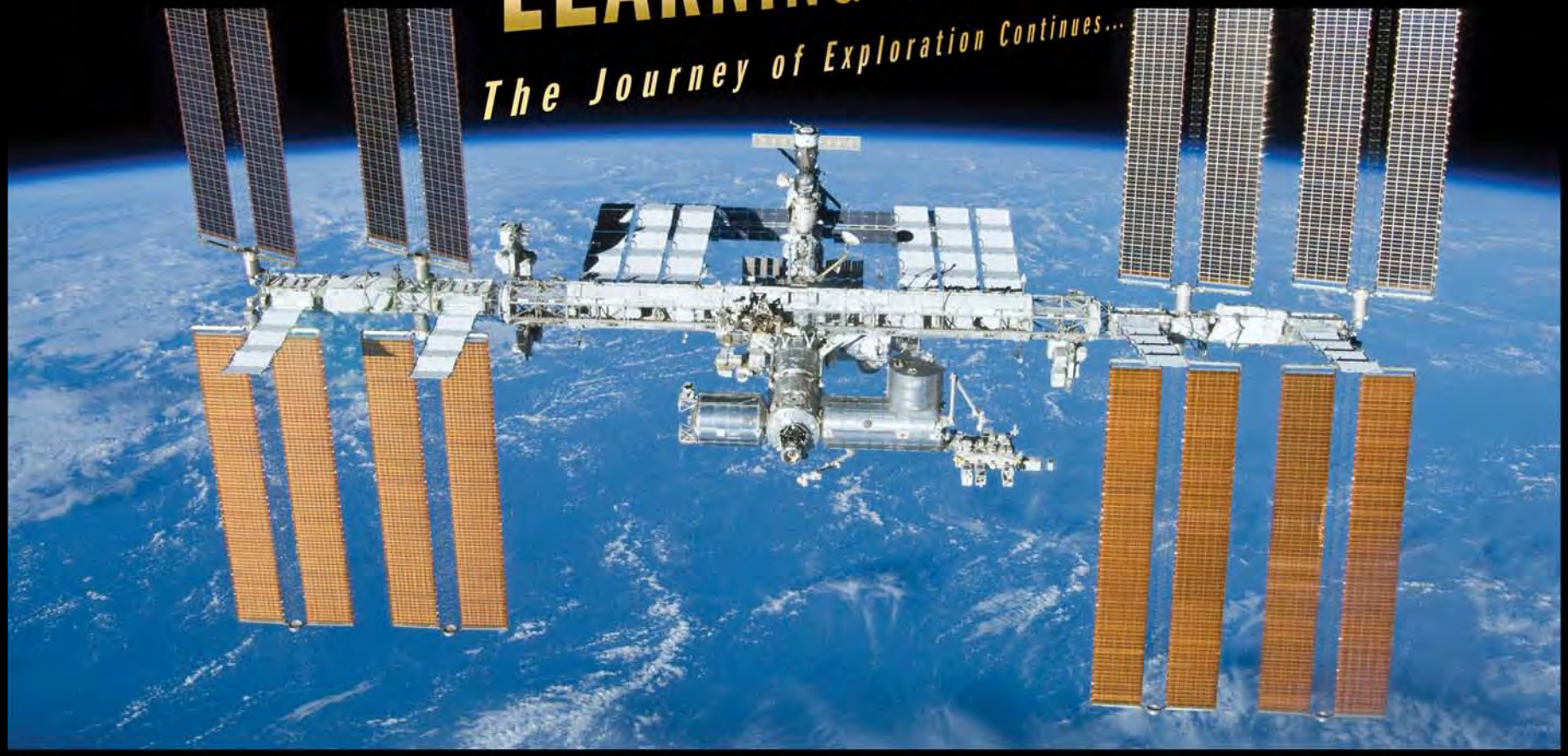
National Aeronautics and Space Administration

INTERNATIONAL SPACE STATION

LEARNING IN SPACE

The Journey of Exploration Continues...



www.nasa.gov

National Aeronautics and Space Administration

Mass vs. Weight
International Space Station Partners

MASS VS WEIGHT

Objective

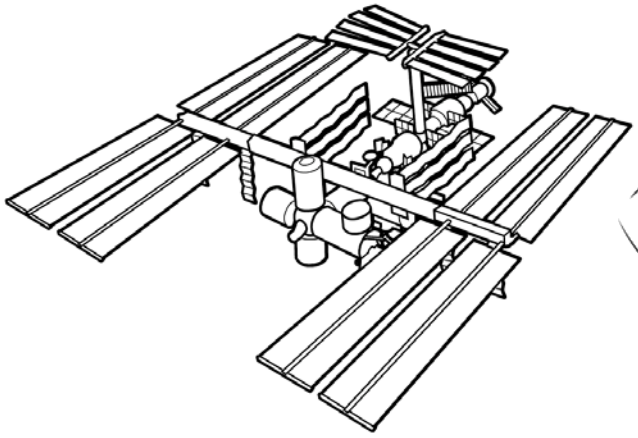
To identify the international partnerships involved in the development and operation of the International Space Station (ISS).

Description

Students use geography research skills to help them learn about the sixteen partner countries that support the International Space Station. They first identify and color the flags of the partner nations then locate those countries on a political map. Additionally, students use lines of latitude to determine which of these countries the ISS flies over as it orbits Earth and why doing so may be important to each nation.

Materials

- **World map or atlas (including political boundaries)**
- **Fine tip color markers or color pencils**
- **World globe**
- **Copies of Student Data Sheets**



Background

The ISS travels from west to east as it orbits Earth. Its orbit is tilted or inclined to the equator, enabling it to pass over a large portion of Earth's surface while Earth rotates beneath it. This allows for better communications and Earth surface observations. As a result, the ISS eventually passes directly over all Earth's surface between 51.6 degrees north latitude and 51.6 degrees south latitude during its successive orbits.

Procedure

1. Have students read the *International Space Station* information sheet to learn about the ISS, its international partners, construction, components and mission. The students will use the *Student Data Sheet 1* to record their answers for this activity.
2. The *Student Data Sheet 2* has black and white representations of the flags of the sixteen ISS partner nations. Have the students research these flags using an atlas or the Internet then color the flags their proper colors using fine tip markers or colored pencils.
   Note: A suggested U.S. government web site that is safe for the students to use for this research is: https://www.cia.gov/library/publications/the-world-factbook/index.html
3. Have the students use a world map with political boundaries to locate the sixteen ISS partner nations on the *World Map* page. Students will label the countries on the world map on page 6 using the corresponding numbers for the flags on page 5. Because some of the European countries will be too small to locate on this map, students should use the *Europe Map* to assist them in identifying those countries.
4. Have the students estimate the location of 51.6 degrees *north* latitude on the *World Map* page, and draw a dark east-west line along this latitude. They should repeat this procedure for 51.6 degrees *south* latitude. The students should then identify each partner country the ISS flies over as it orbits Earth by circling the name of each country in the provided list on the Student Data Sheet. Have them discuss why they think it is important for the ISS to fly over each of the partnering nations and record their answer on the Student Data Sheet question 9.

Assessment

Review the Student Data sheets and discuss the results with the students.

Extensions

1. Have the students cut out one set of colored flags and pin or tape them on the correct countries on a political wall map of the world. Students can make flagpoles for each flag using toothpicks.
2. Have the students discuss why there are sixteen partner nations involved with the ISS. Should there be less or more countries involved? They should be able to support their answers.
3. Show how the ISS orbits Earth by having one student hold up a world globe and another hold up a Hula Hoop. Place the hoop around the globe and tilt it at an approximate 52-degree angle. Point out how the orbit is angled to Earth's equator. Next, have the globe student spin the globe slowly. Use a finger to trace the shape of the hoop. Each time the finger crosses the equator, it will do so at a different geographic location.

Standards

National Science Education Standards

Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding scientific inquiry

Science in Personal and Social Perspectives

- Science and technology in society

History and Nature of Science

- Science as a human endeavor

National Geography Standards

The World in Spatial Terms

- How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective
- How to use mental maps to organize information about people, places, and environments in a spatial context

The Uses of Geography

- How to apply geography to interpret the present and plan for the future

International Space Station (ISS)

International Space Station Basics

The International Space Station (ISS) is the largest orbiting laboratory ever built. It is an international, technological, and political achievement. The five international partners include the space agencies of the United States, Canada, Russia, Europe, and Japan.

The first parts of the ISS were sent and assembled in orbit in 1998. Since the year 2000, the ISS has had crews living continuously on board. Building the ISS is like living in a house while constructing it at the same time. Building and sustaining the ISS requires 80 launches using several kinds of rockets over a 12-year period. The assembly of the ISS will continue through 2010, when the Space Shuttle is retired from service.

When fully complete, the ISS will weigh about 420,000 kilograms (925,000 pounds). This is equivalent to more than 330 automobiles. It will measure 74 meters (243 feet) long by 110 meters (361 feet) wide. This is equivalent to a football field, including the end zones. The pressurized volume will be 935 cubic meters (33,023 cubic feet), larger than a five-bedroom house. The solar array surface area will be 2,500 square meters (27,000 square feet), which is an acre of solar panels and enough to power 10 average sized homes with 110 kilowatts of power.

The ISS orbits between 370 and 460 kilometers (230–286 miles) above Earth's surface. The average distance is similar to the distance between Washington, DC, and New York, NY. The ISS orbits at a 51.6-degree inclination around Earth. This angle covers 90 percent of the populated area of Earth.

When fully assembled, the ISS will be the third brightest object in the sky, after the Sun and Moon. Every 3 days, the ISS passes over the same place on Earth. To find out when the ISS will be visible from any given city, visit *http://www.spaceflight.nasa.gov/realdata/sightings/index.html.*

It takes about 90 minutes for the ISS to circle Earth one time. The ISS orbits Earth 16 times per day, so astronauts see 16 sunrises and 16 sunsets each day! During the daylight periods, temperatures reach 200 ºC (392 °F), while temperatures during the night periods drop to -200 ºC (-328 °F). The view of Earth from the ISS reveals part of the planet, not the whole planet. In fact, astronauts can see much of the North American continent when they pass over the United States. To see pictures of Earth from the ISS, visit *http://eol.jsc.nasa.gov/sseop/clickmap/.*

Components of the ISS

The components of the ISS include shapes like canisters, spheres, triangles, beams, and wide, flat panels. The modules are shaped like canisters and spheres. These are areas where the astronauts live and work. On Earth, carbonated drinks come packaged in small canisters to hold the pressurized liquids efficiently. Similarly, the U.S. Laboratory, Destiny, holds a pressurized atmosphere. Russian modules like Zvezda (which means "star") and Zarya (which means "sunrise") consist of a combination of spheres and canisters.

Triangular structures and beams are used for strength and support in structures like bridges, roofs, and elevated structures. The truss that forms the backbone of the Station is made up of triangular structures and beams.

Panels are wide, flat surfaces used to cover large areas. On the ISS, the solar panels are used to collect sunlight and convert this radiant energy into electricity. Radiators are waffle-shaped panels used to eliminate extra heat that builds up in the Station.

The ISS also has a robotic arm, known as the Remote Manipulator System (RMS). It is used for construction and manipulation on the ISS. The RMS grapples and moves modules into place and also moves astronauts into position to work on the ISS. The robotic arm was built by Canada and is called Canadarm 2. The first Canadarm is on the Space Shuttle and is used to retrieve cargo from the Shuttle bay and move astronauts during extra vehicular activities (EVA).

Name: _____

International Space Station Partners Activity
Student Data Sheet

1. Read the International Space Station (ISS) information sheet to learn about the ISS and international partners, construction, components and mission.

2. The International Space Station is an international partnership of sixteen countries. *The International Space Station Partner Nations Flags* on page 5 has black and white drawings of the flags of the sixteen ISS partner nations. Research these flags and color them the proper colors using fine tip markers or colored pencils.

3. Label the sixteen ISS partner nations on the *World Map* page. Use a world map with political boundaries as reference to identify each country. The *Map of Europe* on page 7 will assist you in locating the smaller European countries. Label the *World Map and Europe Map* countries on pages 6 and 7 by writing the corresponding number for each country, listed below, on the correct country.

1. Belgium	**5. England**	**9. Japan**	**13. Germany**
2. Brazil	**6. France**	**10. Netherlands**	**14. Sweden**
3. Canada	**7. Germany**	**11. Norway**	**15. Switzerland**
4. Denmark	**8. Italy**	**12. Russia**	**16. United States**

4. Estimate the location of 51.6 degrees ***north*** latitude on the *World Map* page and draw a dark line along this latitude. Repeat this procedure for 51.6 degrees ***south*** latitude. The area of Earth between these lines of latitude is where the ISS will pass over as it orbits. Locate each partner country the ISS flies over on the map. As you find each country, keep track by circling its name in the list above, using a red pencil or marker.

5. Which of the ISS Partner countries does the ISS orbit directly over? Which countries does it miss? Draw an X on the countries in #3 the ISS does not fly directly over, using a black pencil or marker.

6. How did you determine which countries it misses? (use back of page if needed)

_____

_____

8. If you were building your own space station, which countries would you invite as partners and why? (use back of page if needed)

_____

_____

9. Why is it beneficial for the ISS to orbit over so much of Earth's surface? (use back of page if needed)

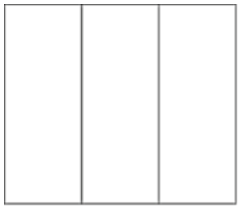
_____

_____

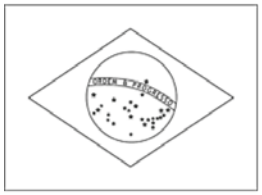
Name: _____

MASS VS WEIGHT

International Space Station Partner Nations Flags

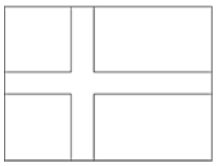


1. Belgium

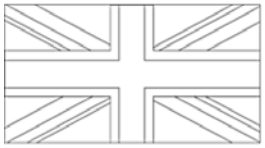


2. Brazil

3. Canada



4. Denmark

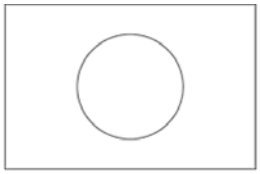


5. England

6. France

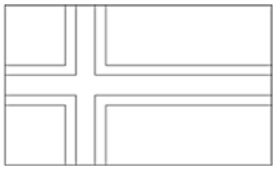
7. Germany

8. Italy



9. Japan

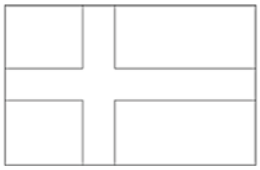
10. Netherlands



11. Norway

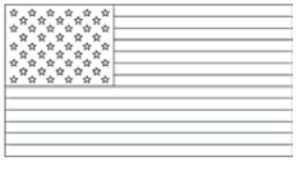
12. Russia

13. Spain



14. Sweden

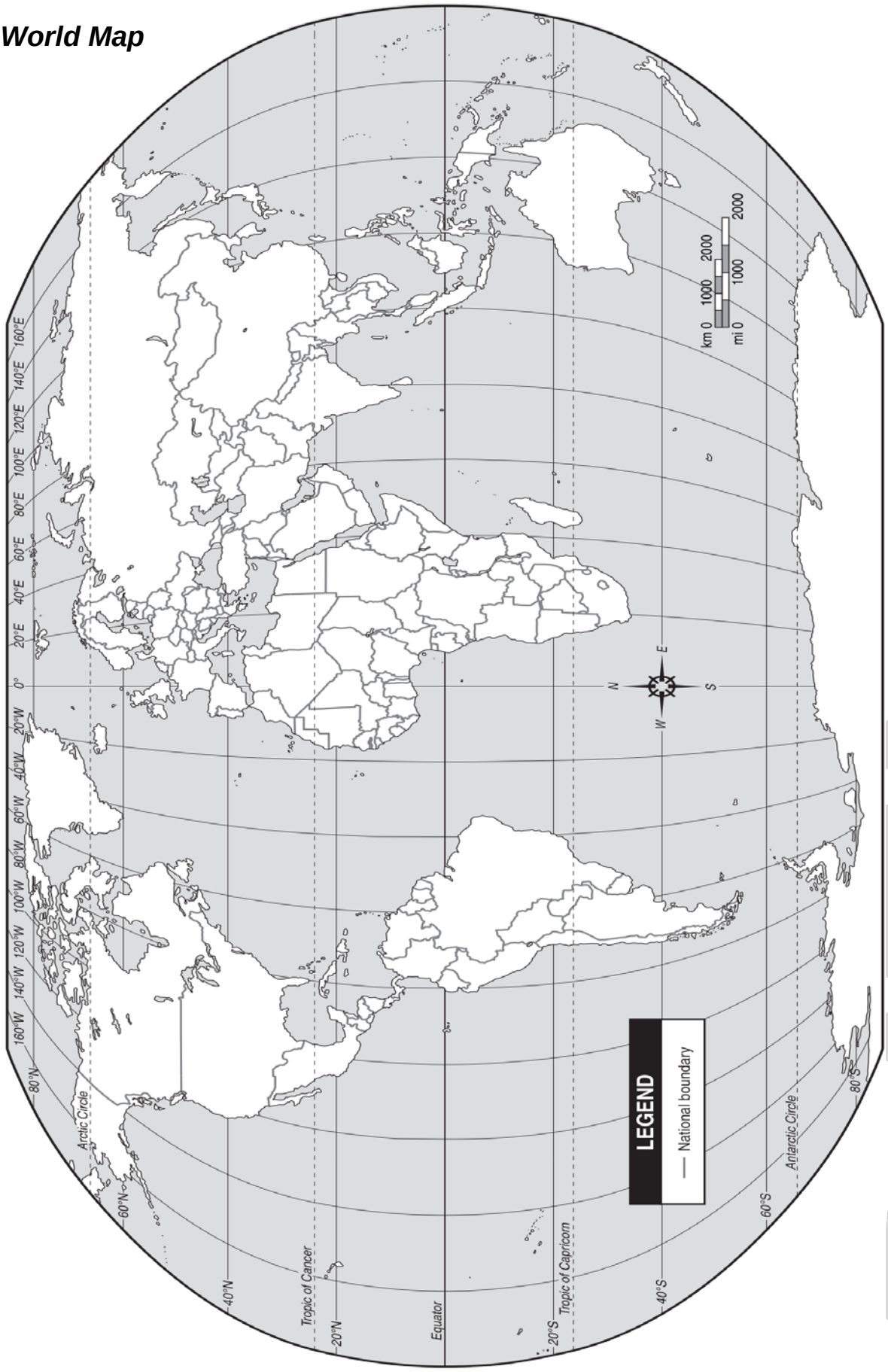
15. Switzerland



16. United States

Name: _____

World Map



DATA

Name: _____

Europe