# USU 4-H Space Tote

**BIG IDEA:**
Space provides opportunity to challenge human intellect.

**UNDERSTANDINGS:**
Identify and understand celestial objects and their connection to life on Earth.
Technology and science enables humans to explore space beyond their normal capacity.

**ESSENTIAL QUESSTIONS:**
Why is it important to learn more about objects in space?
What challenges does space exploration present to humans?

**THREE DIMENSIONS, UTAH SCIENCE STANDARDS, AND INTENDED LEARNING OUTCOMES:**
See pg. 14-16

## Supplies

- Paper*
- Pencils*

**Get to Know Your Planets** p. 2
- Inflatable Solar System
- Electric or Manual Air Pump
- Poster Board and Markers*

**Orbiting the Sun** p. 7
- Sun Measuring Tape
- Inflatable Solar System

**Design a Rocket** p.9
- Plastic Drinking Straw*
- Tape Measure*
- Ruler*
- Tape*
- Scissors*
- Cardstock*

**Make a Comet** p. 11
- Dry Ice*
- Garbage Bags*
- Hammer*
- Gloves*
- Popsicle sticks*
- Sand or Dirt*
- Ammonia*
- Corn Syrup*

### Activity 1: Getting to Know Your Planets

Time: 20-30 min

Grade Level: 2-6

Materials:

- Inflatable Solar System
- Electric or Manual Air Pump
- Poster Board and Markers (optional)

**To Do:**

1. Inflate the Inflatable Solar System using the electric or Manual Air Pump.
2. Distribute the planets and sun with their information cards (on following pages) to individuals, partners, or groups (depending on the size of your class).
3. Have each person/group learn about their planet (or sun). If desired, provide poster board and markers to for students to later present what they learn.
4. Read the Get to Know Your Planets Paper (on following page) and have students guess which planet you are reading about. No guessing your own planet! (For younger classes you may want share one interesting fact about each planet rather than have students guess).
5. As each planet is guessed correctly, have that group introduce their planet more thoroughly.

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**REFLECT:**

- What new things did you learn about the planets? What new questions do you have?
- Why do you think the planets are made out of different materials?
- What makes our planet especially different from the others? What if the earth was closer or further from the sun? What would it be like to live on the other planets?

**APPLY:**

Our solar system is made up of the sun and everything that travels around it, including the eight planets and their moons. All the planets are different from each other. They vary in size, composition, color, and of course, distance from the sun. The four planets closest to the sun are called the terrestrial planets because they are made up of rock and have solid surfaces. Jupiter and Saturn are called gas giants and Uranus and Neptune are called ice giants. The distance a planet is from the sun plays a large role in what temperature the planet is. Earth's distance from the sun and its atmosphere make it just the right temperature for us to live.

## GET TO KNOW YOUR PLANET

I am the biggest planet of all.  I am a big, big ball of gas.  I am bigger than all the other planets put together.  I have a giant red spot that is made up of gases that are turning very fast.

-Jupiter

I have the most rings around me.  Some of them are very thin and some are very wide.  My rings can appear to be many different colors.

-Saturn

I have rings to but they appear to go from top to bottom because I lie on my side.  I am light blue but my rings are dark.

-Uranus

I am the furthest ringed planet from the Sun.  I look like a big blue ball.  Some people say Uranus and I look like twins.

-Neptune

I am the smallest planet.  I am also the closest to the sun.  I move very fast around the sun and I get hit a lot by rocks from space, so I am lumpy.  I am brownish grey.

-Mercury

I am about the same size as earth.  I am always covered with thick, yellow clouds, so you cannot see me very well.  My clouds hold in the sun's heat so I am extremely hot.

-Venus

I have lots of iron mixed in my dirt.  That iron makes me have a red color.  I have two moons and people call me the red planet.  My moons are kind of bumpy and look like potatoes.

-Mars

I have water and land on me.  In fact, I am mostly covered in water.   My air and temperatures make it possible for plants and animals to live on me.  From outer space, I mostly look blue.

-Earth

## PLANET INFORMATION CARDS

Information found on http://solarsystem.nasa.gov.

**The Sun:**

The sun is a star. A star does not have a solid surface, but is a ball of gas made of hydrogen (92.1%) and helium (7.8%) held together by its own gravity. The sun is the center of our solar system and makes up 99.8% of the mass of the entire solar system. The sun is orbited by eight planets, at least five dwarf planets, tens of thousands of asteroids, and hundreds of thousands to three trillion comets and icy bodies. The solar atmosphere is where we see features such as sunspots and solar flares on the sun. The sun's outer atmosphere -- the corona -- extends beyond the orbit of dwarf-planet Pluto. The temperature at the sun's core is about 15 million degrees Celsius (27 million degrees Fahrenheit). Without the sun's intense energy there would be no life on Earth. If the sun were as tall as a typical front door, Earth would be about the size of a nickel.

**Mercury:**

Mercury is the smallest planet in our solar system. It is only slightly larger than our moon. Like our moon, it has a rocky, cratered surface. It is the closest planet to the sun. Standing on Mercury's surface at its closest point to the sun, the sun would appear more than three times larger than it does on Earth. Daytime temperatures can reach 800 degrees Fahrenheit (430 degrees Celsius) and drop to -290 degrees Fahrenheit (-180 degrees Celsius) at night. Mercury's thin atmosphere, or *exosphere,* is composed mostly of oxygen ($O_2$), sodium (Na), hydrogen ($H_2$), helium (He), and potassium (K). One day on Mercury takes 59 Earth days. Mercury makes a complete orbit around the sun in just 88 Earth days.

**Venus:**

Venus is the second closest planet to the sun and is only a little smaller than Earth. One day on Venus lasts as long as 243 Earth days. Venus makes a complete orbit around the sun in 225 Earth days. Venus' thick and toxic atmosphere is made up mostly of carbon dioxide ($CO_2$) and nitrogen ($N_2$), with clouds of sulfuric acid ($H_2SO_4$) droplets. Venus' thick atmosphere traps the heat of the sun causing extreme high temperatures of almost 900 degrees Fahrenheit (480 degrees Celsius). Venus spins backwards (retrograde rotation) when compared to the other planets. This means that the sun rises in the west and sets in the east on Venus.

**Earth:**
The third planet from the sun, Earth is a rocky planet, also known as a terrestrial planet, with a solid and dynamic surface of mountains, valleys, canyons, plains and so much more. What makes Earth different from the other terrestrial planets is that it is also an ocean planet: 70 percent of the Earth's surface is covered in oceans. The Earth's atmosphere is made up of 78 percent nitrogen ($N_2$), 21 percent oxygen ($O_2$) and 1 percent other ingredients -- the perfect balance for us to breathe and live. Many planets have atmospheres, but only Earth's is breathable. Earth has one moon and many orbiting spacecraft that study the Earth. One day on Earth takes 24 hours. Earth makes a complete orbit around the sun (a year in Earth time) in about 365 days.

**Mars:**
Mars is the fourth planet from the sun at a distance of about 228 million km (142 million miles) or 1.52 times further from the sun than Earth. One day on Mars takes just a little over 24 hours. Mars makes a complete orbit around the sun in 687 Earth days. Mars' solid surface has been altered by volcanoes, impacts, crustal movement, and atmospheric effects such as dust storms. Mars has a thin atmosphere made up mostly of carbon dioxide ($CO_2$), nitrogen ($N_2$) and argon (Ar). Mars has two moons and is half the diameter of Earth. Mars is known as the Red Planet because iron minerals in the Martian soil oxidize, or rust, causing the soil -- and the dusty atmosphere -- to look red.

**Jupiter:**
Jupiter is the fifth planet from the sun at a distance of about 484 million miles (778 million km) or 5.2 times as far away from the sun as Earth. If the sun were as tall as a typical front door Jupiter would be about as big as a basketball. Jupiter is a gas-giant planet and therefore does not have a solid surface. However, it is predicted that Jupiter has an inner, solid core about the size of the Earth. One day on Jupiter takes about 10 hours. Jupiter makes a complete orbit around the sun in about 12 Earth years (4,333 Earth days). Jupiter's atmosphere is made up mostly of hydrogen ($H_2$) and helium (He). Jupiter has 50 known moons, with an additional 17 moons awaiting confirmation of their discovery -- that is a total of 67 moons. Jupiter has a faint ring system that was discovered in 1979 by the Voyager 2 mission. Jupiter cannot support life as we know it. However, some of Jupiter's moons have oceans underneath their crusts that might support life. Jupiter's Great Red Spot is a gigantic storm (about the size of two to three Earths) that has been raging for hundreds of years.

**Saturn:**
Saturn is the sixth planet from the sun at a distance of about 1.4 billion km (886 million miles) or 9.5 times as far from the sun as Earth. If the sun were as tall as a typical front door Saturn would be about as big as a basketball. One day on Saturn takes 10.7 hours. Saturn makes a complete orbit around the sun in 29 Earth years. Saturn is a gas-giant planet and does not have a solid surface. Saturn's atmosphere is made up mostly of hydrogen ($H_2$) and helium (He). Saturn has 53 known moons with an additional 9 moons awaiting confirmation of their discovery. Saturn has the most spectacular ring system of all our solar system's planets. It is made up of seven rings with several gaps and divisions between them. Five missions have been sent to Saturn. Since 2004, Cassini has been exploring Saturn, its moons and rings. Saturn cannot support life as we know it. However, some of Saturn's moons have conditions that might support life.

**Uranus:**
Uranus is the seventh planet from the sun at a distance of about 2.9 billion km (1.8 billion miles) or 19.19 times further from the sun than Earth is. If the sun were as tall as a typical front door Uranus would be about as big as a baseball. One day on Uranus takes about 17 hours. Uranus makes a complete orbit around the sun in about 84 Earth years. Uranus is an ice giant. Most (80 percent or more) of the planet's mass is made up of a hot dense fluid of "icy" materials – water ($H_2O$), methane ($CH_4$) and ammonia ($NH_3$) – above a small rocky core. Uranus has an atmosphere which is mostly made up of hydrogen ($H_2$) and helium (He), with a small amount of methane ($CH_4$). Uranus has 27 moons and has faint rings. The inner rings are narrow and dark and the outer rings are brightly colored. Like Venus, Uranus has a retrograde rotation (east to west). Unlike any of the other planets, Uranus rotates on its side, which means it spins horizontally.

**Neptune:**
Neptune is the eighth planet from the sun at a distance of about 4.5 billion km (2.8 billion miles) or 30.07 times further from the sun than the Earth. One day on Neptune takes about 16 hours. Neptune makes a complete orbit around the sun in about 165 Earth years (60,190 Earth days). Neptune is a sister ice giant to Uranus. Neptune is mostly made of a very thick, very hot combination of water ($H_2O$), ammonia ($NH_3$), and methane ($CH_4$) over a possible heavier, approximately Earth-sized, solid core. Neptune's atmosphere is made up mostly of hydrogen ($H_2$), helium (He) and methane ($CH_4$). Neptune has 13 confirmed moons (and 1 more awaiting official confirmation of discovery), and has six rings.

## Activity 2: Orbiting the Sun

Time: 20 min

Grade Level: 4-6

Materials:

- Paper and Pencil
- Inflatable Solar System
- Sun Measuring Tape
- At least 61 feet of space

### To Do:

1. Ask students what the largest item in our solar system is (the sun).
2. Have students draw the sun on one side of their paper.
3. Ask the class what the planets in our solar system are in order from the sun. (Mercury, Venus, Earth, Mars, (Asteroid Belt), Jupiter, Saturn, Uranus, Neptune.) Have them draw them on their paper.
4. Hand out the Inflatable Solar System to your students. Assign two measuring tape holders to each sun measuring tape you choose to use. Assign the rest of your students to a planet. Students can also be assigned to be part of the asteroid belt or even moons. There are three measuring tapes so you can have as many as three different sets of planets, asteroid belts, and moons
5. Have students sort their planets into the correct order. If you have assigned students to be part of the asteroid belt be sure they find their correct spot as well.
6. Check and correct their order. Alternatively, have students correct it themselves in the next step.
7. Have the measuring tape helpers pull out the measuring tapes. Ask students to find their planets' correct spot on the measuring tape.
8. Talk with the students about what they learned about our solar system.
9. Have students redraw their solar system based on what they have learned.

### REFLECT:

- How were most of your planets initially spaced? How did you redraw it to make your planets look more realistic?
- Could you remember the order of the planets? What helps you remember?
- A year is the amount of time is takes the Earth to go around the sun. How do you think other planets' years are different than ours? Why?

- What is the furthest you traveled? How long do you think it would take you to travel to different parts of our solar system?

**APPLY:**

Often, people initially think of the planets being even spaced apart. In reality, the closest four planets are relatively close together and the outer four are quite spaced out. Mercury, Venus, Earth and Mars are known as the terrestrial planets because they are solid and made up of rock. Jupiter and Saturn are made up of mainly gas and are called gas giants. Uranus and Neptune are called ice giants.

Each planet's year is different than an Earth year. Mercury's year is only 88 Earth days and Neptune's year is 165 Earth years! You can get a feel for why Neptune takes so much longer to go around the sun by using the Sun measuring tape. Time someone walking around the sun at the end of the measuring tape. Then time them walking while holding on to the Mercury spot. When at the Mercury spot it will take less than ten seconds to walk around the sun. Contrastingly, it will take about a minute and a half to walk around the sun when standing at the Neptune spot. Neptune has a lot of distance to travel.

Measuring space in inches or even miles gets messy because the numbers are so huge. The measuring tape uses the unit AU to mark out distances. AU stands for Astronomical Unit which is the distance between the Earth and the Sun. Even then it is hard to get a feel for how huge the distances in space are. One way to think of it is, if you were to travel as fast as our rockets that orbit the earth and begin at the sun it would take you 2.7 months to get to Mercury, 7 months to get to Earth and 18 years to get to Neptune. If you were to travel to the nearest star, Alpha Centauri, it would take you 157,000 years. If Alpha Centauri were on our sun measuring tape, our tape would be 101 miles long!

**Activity 3: Design a Rocket**

Time: 30 min-1 hr

Grade Level: 5-8

Materials:

Rocket:

- Paper and Pencil
- Plastic Drinking Straw
- Tape Measure
- Ruler
- Tape
- Scissors
- Cardstock

**To Do:**

1. Begin by telling students that they are going to build a rocket. Ask them what is important to consider when building a rocket. Emphasize engineering and design, materials, and safety.
2. Let students know what materials they will be using to build their rocket. Have students sketch/write out design plans, particularly fin size, number, shape and placement and nozzle shape and size. You may want to have students focus on only different fins or nozzles.

   *These rockets are built by wrapping paper around a pencil and taping the new paper tube together. Finish by closing the top off and placing the rocket over a straw to blow the rocket off. (For younger students, you may want to make the bodies of the rockets ahead of time.)
3. Build a control rocket. If you are testing fins, make one without fins. If you are testing nozzles, just close off the tip without adding a nozzle.
4. Have students build the rockets following their design plans.
5. Test and record the results of each rocket model. Record size, position, and shape of designed parts. Record height, distance, and accuracy of rocket launch. Students can also design tools to ensure more consistent launch force and angles.

   Variation: Have students design their plans for someone else to execute. Have students trade rocket plans. Have the builder test the rocket and record the data and observations to give to the designer to redesign. Costs could be assigned to parts and students could be given a specific goal and budget.

**REFLECT:**

- How high did your rocket launch? Did you follow your design plans? How would or did you revise your plans? Did the revisions work?
- What was particularly successful?
- What was the trickiest part of making and launching your rocket? Could you engineer something that would make that part work easier?
- How do you think it is different to work by yourself verses with a partner or a team? How does it change things if you are working with someone that can only read your instructions and communicate in writing rather than talking and working with you directly?
- It takes force to send rockets into space. What were our rockets powered by? (Air pressure from blowing in the straw.) What other ways can you think of to launch a rocket?

**APPLY:**

Taking exact measurements and working carefully is very important. Engineers make very exact design plans. If the plans are not exact, the product likely will not come out as imagined. Often someone that was not part of the design process is the one building the rocket. Another reason it is important for engineers to make thorough and accurate plans is because the materials they use are very expensive and cannot be wasted. Plans get revised before anything is built and even after the object is built there are still usually problems to be solved and things to improve. There are many different types of engineers, mechanical engineers, chemical engineers, electrical engineers, and civil engineers, that all work together to complete specific projects.

There are lots of different ways to launch things into the air. The strength and cost of each method varies. Scientists use many different areas of science from physics to chemistry to electricity and other areas to design the most effective design and fuels.

**Activity 4: Make a Comet**

Time: 30+ min

Grade Level: 5-8

Materials:

- Dry Ice (2 cups)*
- Garbage Bags*
- Hammer*
- Thick Gloves*
- Goggles*
- Popsicle sticks*
- Water (2 cups)*
- Sand or Dirt (2 large tablespoons)*
- Ammonia (1 teaspoon)*
- Corn Syrup (1 teaspoon)*

**To Do:**

1. Because you will be working with dry ice, have students protect their hands and eyes by wearing gloves and goggles.
2. Line a mixing bowl with plastic.
3. For a 6 inch comet add 2 cups of water, 2 heaping tablespoons of sand/dirt, and 1 teaspoon each of ammonia and corn syrup. Stir together.
4. Put 2 cups of dry ice inside three bags and crush the ice using a hammer.
5. Add the dry ice to the ingredients in the bowl and stir until the mixture is nearly completely frozen.
6. Shape your frozen mess into a ball by lifting the plastic liner out of the bowl and shaping the mixture. Unwrap it when it is frozen enough to hold its shape.
7. Have students learn about and simulate comet behavior. Talk about the gravitational force of the sun as students holding their comet with gloves begin far away from what has been designated as the sun and then walk towards the sun, increasing their speed as they come closer to the sun.
8. Have students examine their comets using popsicle sticks as the comets begin to melt. Have students write about what they observe as the comet continues to melt over time.
9. Discuss how their comets are like real comets.

**REFLECT:**

- How does the gravitational pull of the sun affect how comets travel?
- How big are real comets?
- Did the comets change from solid to water or solid to gas? (They should have change directly to gas.)
- Did you notice any jets of gas coming from your rocket?
- What happened as your comet melted? How did it change from when it was first melting towards the end of it melting?
- What was left after your comet finished melting?

**APPLY:**

As comets get closer to the sun, the gravitational force between the comet and the sun becomes stronger and stronger. Comets are made up of rock and ice and are a similar size to a small town. The ice sublimates, which means it turns directly from solid to gas, as it warms up and creates an atmosphere around the comet called a coma. The dust and gas that flies off the comet create a huge tail away from the sun that can even be seen on earth. Like real comets, as the homemade comets melted and sublimated jets of gas may have been visible. Craters form on the comet as it melts. Like the homemade comet, comets do eventually break apart.

# Other Activities

## Other Activities

- Play the Stargo Game
- Play the Space Card Game
- Learn about the constellations
- Calculate your weight on the other planets
- Research about an astronaut

# Contents of Space Tote

## Contents of Space Tote

- Constellation Posters (10 different ones)
- Star Bingo
- Electric Pump
- Manual Pump
- Inflatable Solar System
    - Sun and nine planets
- Sun to Planet measuring tape 3
- Extra Inflatables: Sun, Saturn, and 7 others
- Inflatable Solar System Info Book and Cardboard

# Three Dimensions, Utah Science Standards, and Intended Learning Outcomes

**Note:** These applications of National and State Science Standards are not comprehensive. They are meant to serve as suggestions. While only standards for K-6 have been listed, standards for more advanced grade levels can also be applied. Additionally, this tote is an excellent tool to facilitate inquiry for any age group.

## THREE DIMENSIONS

**1-ESS1-1. Space Systems: Patterns and Cycles** (Activity 1: Get to Know Your Planets, Activity 2: Orbiting the Sun)

**Use observations of the sun, moon, and stars to describe patterns that can be predicted.**

**Science and Engineering Practices:**

- Use observations (firsthand or from media) to describe patterns in the natural world in order to answer scientific questions.

**Disciplinary Core Ideas:**

- Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.

**Crosscutting Concepts:**

- Patterns in the natural world can be observed, used to describe phenomena, and used as evidence.
- Science assumes natural events happen today as they happened in the past.
- Many events are repeated.

**K-2-ETS1-2. Engineering Design** (Activity 3: Design a Rocket)

**Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.**

**Science and Engineering Practices:**

- Develop a simple model based on evidence to represent a proposed object or tool.

**Disciplinary Core Ideas:**

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

**Crosscutting Concepts:**

- The shape and stability of structures of natural and designed objects are related to their functions.

**K-2-ETS1-3. Engineering Design** (Activity 3: Design a Rocket)

**Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.**

**Science and Engineering Practices:**

- Analyze data from tests of an object or tool to determine if it works as intended.

**Disciplinary Core Ideas:**

- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.

**3-5-ETS1-2 Engineering Design** (Activity 3: Design a Rocket)

**Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.**

**Science and Engineering Practices:**

- Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem.

**Disciplinary Core Ideas:**

- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions
- At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.

**Crosscutting Concepts:**

- Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands.

**3-5-ETS1-3. Engineering Design** (Activity 3: Design a Rocket)

**Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.**

**Science and Engineering Practices:**

- Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.

**Disciplinary Core Ideas:**

- Tests are often designed to identify failure points of difficulties, which suggest the elements of the design that need to be improved
- Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

**UTAH SCIENCE STANDARDS**

**K-Grade 2** (Activity 1: Get to Know Your Planets, Activity 2: Orbiting the Sun, Activity 3: Design a Rocket, Activity 4: Make a Comet)

Standard 1:

The Processes of Science, Communication of Science, and the Nature of Science. Students will be able to apply scientific processes, communicate scientific ideas effectively, and understand the nature of science.

Standard 2:

Earth and Space Science. Students will gain an understanding of Earth and Space Science through the study of earth materials, celestial movement, and weather.

**Grade 6** (Activity 1: Get to Know Your Planets, Activity 2: Orbiting the Sun, Activity 4: Make a Comet)

Standard 3:

Students will understand the relationship and attributes of objects in the solar system.

## INTENDED LEARNING OUTCOMES (ILO'S):

1. Use science process and thinking skills.
2. Manifest science interests and attitudes.
3. Understand important science concepts and principles.
4. Communicate effectively using science language and reasoning.
5. Demonstrate awareness of the social and historical aspects of science.
6. Understand the nature of science.