

Your Guide To the Space Kit!

It's easy to travel light years and keep social distance in outer space! Launch yourself into outer space with a Film Canister Rocket, then enjoy your space dessert first with Astronaut Ice Cream. Leave your mark in the cosmos by "discovering" a new constellation; write a myth about your constellation and make a diagram of it with Glow-in-the-Dark Stickers. Feel awed by the universe with images from the Hubble telescope.

Activities in this Kit include:

- ★ Film Canister Rocket (Rocket body template on a separate sheet)
- ★ Astronaut Ice Cream Sandwich
- ★ Make Your Own Constellation
- ★ Images from Hubble Telescope

We'd love it if you'd tag
@SteamExchange
in any pictures you post on Facebook or Instagram :)

Have fun playing and making!

About Steam Exchange:

Our mission is to facilitate passion-driven learning experiences where individuals explore the arts, the world, and themselves through creative play and production. We also use the arts as an innovative platform for young people to engage with concepts in science, technology, engineering, and mathematics (STEAM).

Our Community Art Center &
Community/Commercial Screen Printing Shop
are in the Smoketown Neighborhood.



STEAM EXCHANGE
COMMUNITY ARTS CENTER

Rocket Film Canister

Safety: CHOKING HAZARD. Contains small parts. Keep out of reach children under age 3.

This project involves pressurized gases and minor explosions. Please wear protective eyewear and back 6ft away from the rocket immediately.

Tips:

- Do this activity outside! It is messy and your rocket will have more space to fly.
- Save the leftover pieces of Alka-Seltzer tablet to reuse.
- Save 1 tablet to use once you have made fins, a nose cone and rocket body (see the **Explore** section).

Your mission:

- ★ Break your Alka-Seltzer tablet in half.
- ★ Pour 1 teaspoon of water (does not have to be exact) into the canister.
- ★ Drop the half tablet into the canister, quickly replace the lid, and set the canister on the ground, lid side down.
- ★ **Immediately back 6ft away from the canister!** (If you have safety glasses, wear those. If not, wear some sunglasses to protect your eyes.)
- ★ See how high your rocket canister flies!

How it works:¹

Newton's Third Law: For every action, there is an equal and opposite reaction.

When you add the Alka-Seltzer tablet, the water starts to dissolve it. This creates the gas **carbon dioxide**. As the carbon dioxide is being released, it creates pressure inside the film canister. The more gas that is made, the more pressure builds up until the cap is blasted down and the rocket is blasted up - Newton's Third Law!

This system of thrust is how a real rocket works whether it is in outer space or here in the earth's atmosphere. Of course, real rockets use rocket fuel.

Explore:

- Reuse the leftover pieces of tablet with fresh water. Make sure you move 6ft back extra fast!! The rocket will launch faster with the multiple smaller pieces than when you used the half tablet. Why do you think that is?
- Try using really cold water and then really hot water. Does the water temperature make a difference in how fast the rocket launches or how high it goes?
- Try using $\frac{1}{4}$ of a tablet. What happens to your rocket launch speed and height?
- Does changing the canister's aerodynamics affect its flight? Use the enclosed **Film Canister Rocket Template** and **Film Canister Rocket Body** to find out by adding fins, a nose cone and a rocket body to your canister. First, use markers, colored pencils or crayons to decorate your rocket parts! Once your rocket parts are looking slick, curl the Rocket Body paper into a cylinder around your canister and tape

¹ Adapted from <https://sciencebob.com/build-a-film-canister-rocket/>

it in place. Then tape the fins to the canister, with the base of the triangles lid side down. Last, tape the nose cone to the top of the rocket body. Make sure no paper or tape are inside the canister or in the way of the cap. (Otherwise, your cap will not seal and your canister won't be able to build up the pressure necessary for launch. Play around with your rocket design to see what design elements enable optimum flight!

Astronaut Ice Cream Sandwich

No, this will not melt. Yes, this is real ice cream! It's hard, dry and crumbly until you take a bite and it begins to dissolve in your mouth. Suddenly, there's the smooth, sweet flavor of ice cream.

How it Works:²

In physics, **sublimation** is the transition of matter from ice to gas, without becoming liquid between the two. To do this it needs to be exposed to a **vacuum** (all the air has been removed). In a vacuum, liquid water will boil at any temperature. We're told that, when people are briefly exposed to vacuum conditions, their saliva boils away. Put a block of ice in a vacuum, and it will never form a puddle. As soon as any molecules get the energy to break away from the ice, they'll zoom away as a gas.

Freeze drying is a two-stage process. A freeze dryer works like a regular freezer to freeze food solid. Then a vacuum pump kicks in and lowers the pressure inside the freezer to 0.06 of Earth's atmospheric pressure. Left alone long enough like this, and the water molecules will drift away. (Some people have noticed that their freezers at home can freeze-dry food left exposed long enough even without the vacuum.) But to speed the process along, a tiny bit of heat is added to the chamber. As soon as the water molecules transition out of the ice stage, they immediately become gas, leaving the husk of the food behind with its structure mostly intact. This can be stored, without refrigeration, in a sealed bag for years without decaying or degrading.

Do astronauts really eat Astronaut Ice Cream?

Okay, full disclaimer, calling freeze dried ice cream "astronaut ice cream" is really more of a marketing opportunity. Astronaut ice cream was originally developed by Whirlpool under contract to NASA for the Apollo missions, but probably only ever made it on one space flight.³ Here's the story, according to the **Smithsonian National Air and Space Museum**:

The gift-shop staple, "Astronaut Ice Cream," was the first type of ice cream to make it into space during the Apollo 7 mission in 1968, and it was the only time it was "served" in space. Astronauts Walter M. Schirra, Donn F. Eisele, and R. Walter Cunningham were treated to pouches of Neapolitan on their 11-day mission. Unlike on Earth, the freeze-dried dessert never really took off in space. It was far too crumbly to be practical in a weightless environment (you can't have crumbs floating into all the sensitive equipment), and the astronauts never became enamored with the taste. In 2006, however, the real stuff made its way into orbit. Space Shuttle Atlantis flew a freezer, known as GLACIER, to the International Space Station (ISS). The freezer was meant to store research samples that would eventually be returned to Earth, but why send it up empty? NASA took the opportunity to fill the freezer with ice cream cups from Blue Bell—vanilla with swirls of chocolate sauce. The last time ice cream was enjoyed in zero-g was in 2012. Once again, ISS crew members were treated to Blue Bell ice cream. The tantalizing frozen treat made the trip aboard the SpaceX Dragon resupply capsule.

² Excerpt of Gizmodo article *The Physics of Astronaut Ice Cream* by Esther Inglis-ArkellIn

³ <https://www.cnet.com/news/astronauts-bust-the-myth-of-space-ice-cream/>

Make Your Own Constellation

Safety: CHOKING HAZARD. Keep small parts out of reach of children under age 3.

A **constellation** is a group of stars forming a recognizable pattern that is traditionally named after its apparent form, an animal or identified with a mythological figure.

The constellation Ursa Major, or the Great Bear, is visible throughout the year from most of the northern hemisphere. It is primarily known from the easily recognizable group of its main seven stars, the "Big Dipper". Two of its stars can be used as the navigational pointer towards the place of the north pole star, **Polaris**, in Ursa Minor.



Ursa Major is significant to numerous world cultures in the northern hemisphere, has been called by many names, and has many different myths and legends about its origin. Read the myths below to get some inspiration for the myth you write about your constellation.

Iroquois Legend

Long ago, the Great Bear wandered freely throughout the sky. His massive paws took him far across the unlimited ceiling of the world. He hunted and fished, finding food there in the many rivers of the sky. All throughout the first spring he did this, until his belly was full and he felt happy.

He did not know that three young hunters had discovered him feeding that spring. They sought his pelt and meat to feed their families in the long winter that they knew was coming soon.

Without warning, the hunters ran out after the bear, trying to catch and kill him. The Great Bear ran, trying to escape from the hunters. All through the long summer he ran, always trying to get away. The hunters, however, were very cunning and strong. Eventually they caught up with him. In the first autumn, their arrows pierced the Great Bear and he died.

The blood of the bear spilled out of the sky and tinged all of the leaves with red and orange. The trees then dropped all of their leaves in mourning for their friend, the Great Bear.

The Great Bear was reborn the following spring, as is the way of bears, and the hunters set out after him again. They do this each year. If you look into the sky and watch, you can see the three hunters trailing behind the Great Bear as he runs toward the horizon, only to do it again and again with the coming of each spring.

Korean Mythology

A woman married and in time, had seven young sons. They grew to be creative, smart, and dedicated young men. Sadly, the woman's husband died and she was left to raise her sons alone. Eventually, she met a

widower and the two took great comfort in each other's company. However, in order to visit him every morning, she had to cross a fierce stream. The seven sons soon noticed that and decided to go to the stream each morning and secretly help her mother cross it by forming a bridge with their bodies. The mother, not noticing that the bridge was actually her sons, prayed that the person responsible for building it would become seven stars in the sky. After living long, fulfilling lives, the sons died and were transformed by the power of their mother's blessing, long ago, into some of the brightest stars in the night sky.

Greek Mythology

Callisto was a joyous nymph, who attracted many suitors. Zeus, king of the gods, was well known for being unfaithful to his wife, Hera. Zeus and Callisto had a child together, whom she named Arcas. The birth of the child made Hera realize that her husband had been unfaithful to her, and she brought down divine wrath upon Callisto. She cursed the nymph to live as a bear, wandering in the wild like an animal.

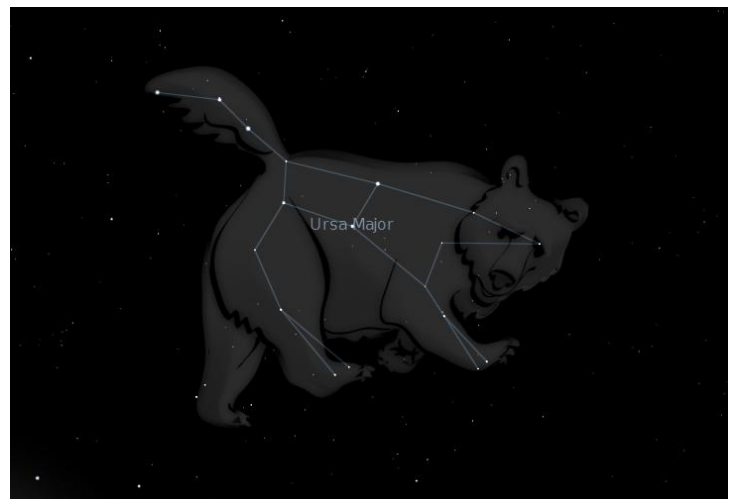
Callisto's hands twisted into massive paws, and her body grew a coat of fur. She grew large, and her face pressed into a shortened muzzle. The beautiful woman had become a great and terrible bear.

For many years, Callisto wandered the forests and plains. She was a magnificent bear and many hunters sought to capture her and to claim her hide. Arcas grew up to be a powerful hunter, and one day while he was hunting, he came upon the great bear. She was drinking water from a stream, and did not see him. Unaware that the animal was his mother, Arcas pulled out an arrow and waited for the best moment to fire.

If Arcas were to release that arrow, he would have slain his own mother. Zeus, who normally paid little or no attention to his old lovers, took pity on the pair. Seeing that Arcas was about to shoot, Zeus changed him instantly into a bear and hauled both of them into the sky by their tails. It is for this reason that both Ursa Major and Ursa Minor have long tails.

Your mission:

- ★ Imagine that you have traveled to a new part of the universe and are charting star groups never before seen. Use the black paper and glow in the dark star stickers to create a picture of this uncharted sky.
- ★ First choose what **form, animal or character** you want your constellation to represent and create your constellation story. You can write your story down or tell it to someone else.
- ★ Draw a picture of your form, animal or character on a separate piece of white paper. (Check out this drawing of **Ursa Major** as an example.) → → → → → → → →
- ★ On the white paper, plan where you want the stars to appear within the shape and how they will connect. Think of this as a really simplified skeleton.
- ★ Now that your plan is complete, use a pencil to lightly mark the locations of your constellations stars on the black paper. Stick the larger stars and circles in those spots.
- ★ Use the smaller stars and circles to fill out the rest of the night sky.
- ★ If you would like, use a pencil or white colored pencil to draw dotted lines to connect the stars that form your constellation. You can also use your metallic Sharpies to add more background stars!



Images from the Hubble Telescope

Included in your Space Kit are 4 of our favorite images captured by the Hubble Telescope of awe-inspiring phenomena in our universe. If you want to see more, check out <https://hubblesite.org>!

What is the Hubble Telescope?⁴

Orbiting high above the Earth, the Hubble Space Telescope has a clear view of the universe free from the blurring and absorbing effects of the atmosphere. In addition to observing visible and near-infrared light, Hubble detects ultraviolet light, which is absorbed by the atmosphere and visible only from space. The telescope has beamed hundreds of thousands of celestial images back to Earth during its time in space.

Launched in 1990, Hubble has been visited by astronauts four times in order to make repairs and add new instruments. Each instrument that flies on Hubble has special features that let astronomers study the heavens in different ways. Hubble's unique capabilities can also be partnered with other space observatories and those on the ground to enable scientists to explore the universe in ways that no single mission could ever accomplish alone.

Hubble is one of NASA's most successful and long-lasting science missions. It has beamed hundreds of thousands of images back to Earth, shedding light on many of the great mysteries of astronomy. Among its many discoveries, Hubble has revealed the age of the universe to be about 13.8 billion years, much more accurate than the old range of anywhere from 10 to 20 billion years. Hubble played a key role in the discovery of dark energy, a mysterious force that causes the expansion of the universe to accelerate.

Hubble Spacecraft Systems Operated From the Ground:

Communications antennas

Hubble performs in response to detailed instructions from people on the ground. The antennas allow technicians to communicate with the telescope, telling it what to do and when to do it. Four antennas receive and send information to a set of satellites, which in turn communicate with Earth.

Solar arrays

Hubble is powered by sunlight. Each wing-like array has solar cells that convert the Sun's energy into electricity. Some of that electricity runs the telescope, some is stored in onboard batteries for the periods when Hubble is in Earth's shadow.

Computers and automation

Several computers and microprocessors reside in Hubble's body and in each science instrument. There are two main computers. One talks to the instruments, sends commands and other information, and transmits data; the other handles pointing control, gyroscopes and other system-wide functions.

Thermal protection

Hubble has a blanket of multilayered insulation, which protects the telescope from temperature extremes.

⁴ <https://hubblesite.org/mission-and-telescope>