Build a Space Explorer

Children design and build a vehicle for exploring another world, using recycled materials. As they build, they are invited to describe the worlds their explorers will visit and the special tools they included in their designs. This activity can be used in a workshop or as a drop-in.

- 10–30 minutes
- Drop-in or Workshop
- Good for any sized group

Content Learning Goals

- Children create a space explorer with a purpose, perhaps related to investigating a specific planet or moon.
- Children begin to understand that exploring space requires special tools such as wheels, wings, rockets, and antennas.
- Children begin to understand that there are many kinds of robotic space explorers, including orbiters, landers, rovers, impactors, and even vehicles that carry people.

Science Practices

Children will begin to engage in science practices by:

- Considering how **tools** can be used to investigate new worlds.

Materials

- Cardboard base, any size and shape, up to 4"x4" (one per child)
- Glue sticks and/or tape dispensers
- Scissors
- Foam hair curlers, cut into slices (can serve as wheels)
- Drinking straws and/or wooden chopsticks (can serve as axles for the wheels)
- Aluminum foil, cut into 1' square sheets works best (can be used to cover the cardboard base)
- A pile of odds and ends to inspire imaginations. These can be recycled materials, dollar store party favors, stickers, cotton balls, and anything light and smaller than about 2". Shiny materials are favorites.
- Pictures of actual space explorers (posted as PDF on workshop page)
- For drop-in: Sign with invitation to build a space explorer (page 5)

SET-UP

- Prepare cardboard bases (at least one per child) in a variety of shapes and sizes, up to about 4"x4". Smaller cardboard pieces can serve as wings and other parts.
- Slice up foam hair rollers to serve as wheels.
- Prepare baskets or trays with a varied selection of recycled odds and ends that are lightweight and no bigger than about two inches in size, for example: bottle caps, buttons, thread spools, plastic tasting spoons, old photo slides, small toys, interesting pieces of packaging, pipe cleaners, yarn/string, electronics parts, plastic easter eggs, popsicle sticks, wine corks, pieces of egg carton. Reusable resource centers are a good source for doodads: http://www.reuseresources.org/find-a-center.html
- Place within easy reach on the table: cardboard bases, foil squares, foam wheels, straws or chopsticks, tape dispensers, glue sticks, scissors, baskets of odds & ends.
- Display the sign and place images of real space explorers around the table.

ACTIVITY DESCRIPTION

Invite children to build a space explorer, and ask prompting questions as appropriate, but also leave them time to design and build uninterrupted. The following questions are consistent with Developmentally Appropriate Practice and can be helpful in initiating and supporting children's engagement in the activity:

- We are building space explorers. You can build an explorer too! What materials would you like to use first?
- There are many types of space explorers. These pictures show some of the machines that humans have made to help them learn more about space. Some explorers are designed to search for water, others are designed to examine the clouds on a planet. Tell me about the purpose of your explorer.
- Where will your explorer travel? What will your explorer search for when it gets there?
- Is your explorer designed to use special tools for collecting information? What does this tool do? How will that tool help you learn new things about distant worlds?

Wrap up the activity by asking each child to tell you about his/her space explorer. This is where a lot of the creativity really shows up. Also encourage children to look for the Moon in the sky that week. We've sent robots and even people to the Moon!

Story Time

If you have time to read a book at the start of the program, we recommend *The Three Little Aliens & the Big Bad Robot* by Margaret McNamara and Mark Fearing.

DEVELOPMENTALLY APPROPRIATE STRATEGIES

This open-ended activity is designed to engage children with the idea that humans create tools to help them learn about distant places, places that they themselves cannot easily visit. The strategy for encouraging this learning is a maker-type activity that children of this age typically greatly enjoy. In fact, the fun of designing, selecting materials, gluing, and building makes it easy for children to overlook the content-related elements of the activity. Facilitators can help children make conceptual connections by using some developmentally appropriate strategies in combination, as described below.

Silence + Model + Narrate Your Behavior: Children will need ample time to plan their designs and engage in the making process. As they do so, it is important to avoid being overly intrusive. This does not mean that you should appear disengaged. Rather, explore the materials yourself in a way that does not result in creating an explorer (or children may simply try to copy what you've done). Instead, you could model the design process you hope children will adopt. For example, say to yourself: *"Hmm, I'm thinking about making a space explorer that can drive on a rocky surface. I can't decide whether to use the rollers as wheels, or the balls. I think I'll try the rollers first, but if those don't work, I'll try the balls."*

Behavior Reflection + Question: e.g., *"You're adding a clothespin to your explorer. How do you think the clothespin will help you learn about the planet?"*

Process Praise + Add Challenge: e.g., *"You worked really hard to find materials that would help your explorer fly through space. Let's think about how the explorer will move about once it lands on Mars. What could you put on the explorer to help it drive over land?"*

BACKGROUND INFORMATION

The following background information about learning science and astronomy is intended for the educator who will facilitate the "Build a Space Explorer" activity. The activity is a developmentally appropriate first step toward the children eventually understanding the concepts explained below, perhaps years later. We do not intend the educator to cover most of these concepts with the children during the activity. This information is provided to give the educator a good basic understanding of the scientific concepts that the activity is moving toward, and preparation to answer questions from very curious children or adults.

LEARNING SCIENCES

Learning through Making and Tinkering

This activity presents an open-ended opportunity for children to use creativity and imagination while focusing on ideas about space and space travel. Recent attention has been focused on the "maker movement", and "tinkering spaces" have emerged in many contexts, including museums.[1, 2] Much of this work has focused on teens and adults making and tinkering in open-ended settings. In a jointly negotiated research project in the Tinkering Studio at the Exploratorium in San Francisco, researchers and practitioners found that one such open-ended tinkering space seemed to result in evidence of deep engagement, initiative, social scaffolding, and developing understanding in participants from a variety of ages and backgrounds.[1] While less research has focused on making and tinkering in young children, Brahms investigated young children's engagement in a family maker space in a children's museum, and found evidence of children using social and physical resources toward learning.[3,4]

Creativity and Family Conversations

Conversations that parents have with children while engaging in open-ended science tasks can have impact on children's thinking.[5,6] Research on creativity has long shown that when instruction is too structured it can reduce the creativity of students' work.[7] And yet, consistent with the idea that creativity involves producing something that is "both novel and appropriate to some goal",[6] parents' and others' subtle guidance may sometimes support children's creative thinking. Nolan-Reyes, Callanan, & Haigh investigated parent-child conversations about improbable (e.g., having a lion for a pet) versus impossible (e.g., walking through a wall) events.[8] They found that children whose parents discussed speculative ideas about how improbable events might happen (e.g., maybe someone could have a lion for a pet if they raised it from when it was a baby) were more likely to engage in "possibility thinking" about unusual events on their own.

ASTRONOMICAL SCIENCE

The space explorers that the children are creating in this activity are space probes. A space probe is an unmanned robotic spacecraft launched from Earth into space with a set of tools to gather information about space or other planets and moons. Some probes gather information far out in space, while others orbit or land on a planet or a moon. These probes require a power source and a means for transmitting the data from space back to Earth by radio. There are different types of space probes because they collect different science information about very different environments and they need to be able to withstand the various extreme environments to collect data. Humans have been sending space probes into space since the 1950s.

The exploration of a new extraterrestrial environment often comes in three of four steps. We need to get the best look at what we're getting ourselves into so that we are properly equipped. We might take a first look through a telescope, but to truly explore a new world, we need to go there.

The first step in our history of exploring other planets has often been something we call a flyby. The Mariner 4, 6 and 7 (Mars), Pioneer 10 and 11 (Jupiter and Saturn), and Voyager 1 and 2 (Jupiter, Saturn, Uranus and Neptune) spacecraft flew by planets, taking images and making measurements as they approached the planet, as they flew past, and then looking back at the planet after they had passed.

Based on those exciting first looks, we might choose to send an orbiter, to spend some time gathering data over time. Noticing how things change over time and taking advantage of close approaches to other bodies, like moons, in the planet's system. The Cassini spacecraft is currently orbiting Saturn and sending back stunning images of the planet and its moons and rings. It also sent a probe, Huygens, to land on the surface of Saturn's largest Moon, Titan.

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[1] Bevan, B., Gutwill, J., Petrich, M., & Wilkinson, K. (2014). Learning through STEM-rich tinkering: Findings from a jointly negotiated research project taken up in practice. *Science Education, 99*, 98–120.

[2] Voussoughi, S., & Bevan, B. (2014). Making and tinkering: A review of the literature. Paper commissioned by the NRC Committee on Successful Out-of-school STEM Learning.

[3] Brahms, L. (2015). Making as a learning process: Identifying and supporting family learning in informal settings. Unpublished Ph.D. Dissertation, University of Pittsburgh.

[4] Brahms, L. & Crowley, K. (2015, in press). Learning to Make in the Museum: The Role of Maker Educators. In Y. Kafai & K. Pepler (Eds). *Makeology*.

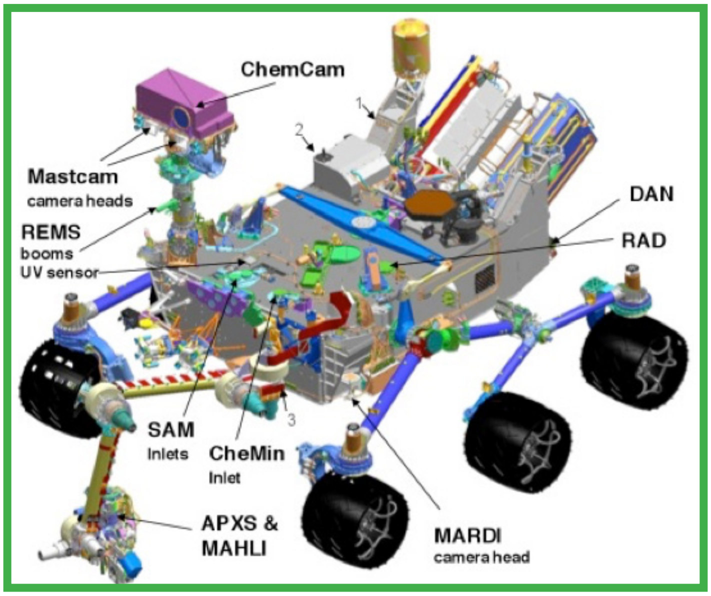
[5] Amabile, T. M. (1989). *Growing Up Creative*. New York: Crown.

[6] Amabile, T. M. (1996). *Creativity in Context*. Boulder, CO: Westview Press.

[7] Amabile, T. M., & Gitomer, J. (1984) Children's artistic creativity: Effects of choice in task materials. *Personality & Social Psychology Bulletin, 10*, 209–215.

[8] Nolan-Reyes, C., Callanan, M., & Haigh, K. (2015, in press). Practicing possibilities: Parents' explanations of unusual events and children's possibility thinking. *Journal of Cognition and Development*.

If the planet has a solid surface, the next step may be to send a rover. Then we must think about what kind of tools to equip it with. As humans, we explore our environment using our five senses: sight, hearing, touch, smell, and taste. Think about how you experience a new place with all of these senses. Going into space we use robot spacecraft with instruments that mimic those senses. To see what we can't because we're not there, we equip spacecraft with cameras. If we put two cameras side-by-side, we get a stereo view, like we do from our eyes. Sometimes the cameras are sensitive to light that we can't see, like infrared, ultraviolet, or x-ray. We don't sniff or taste other planets, per se, but we do equip our rovers and spacecraft with chemistry experiments that help us figure out what other worlds are made of, just as we sniff and taste a new recipe, trying to figure out the ingredients. We also put microphones on our spacecraft to hear the wind and other sounds on a planet. We have sent several rovers to explore the surface of Mars. Below is a diagram showing the many data-collection instruments on the Curiosity rover.



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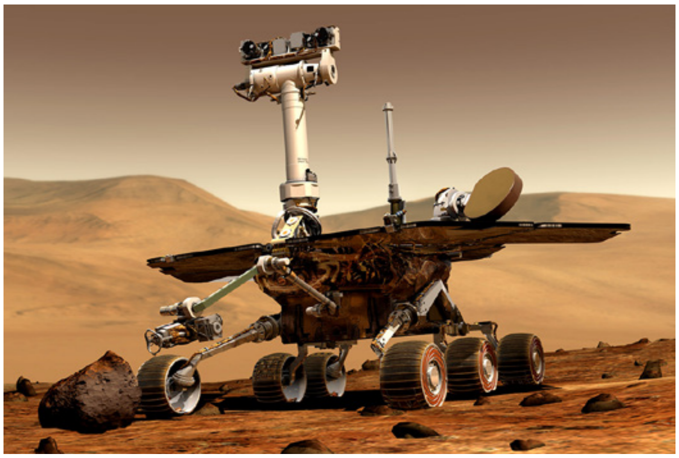
Explore distant worlds with a machine you build.

All space explorers have a few things in common:



NASA

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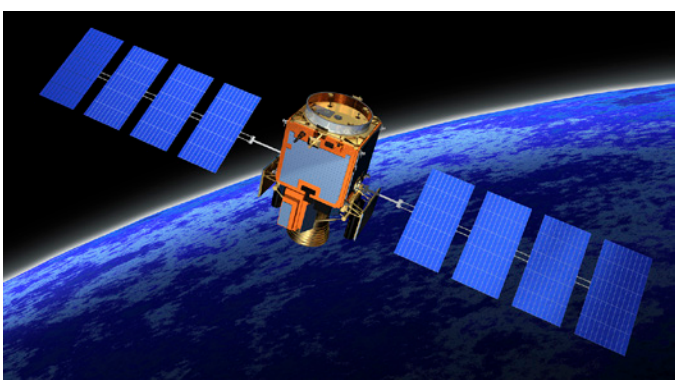
TOOLS

What is the mission?
What tools does it need?

COMMUNICATION DEVICE

How will it “talk” to Earth?



NASA

NASA

POWER SOURCE

How will it stay charged?

A WAY TO MOVE

How will it get around?