

After-School Science

HANDS-ON
ACTIVITIES
FOR EVERY
STUDENT



ACTIVITY GUIDE

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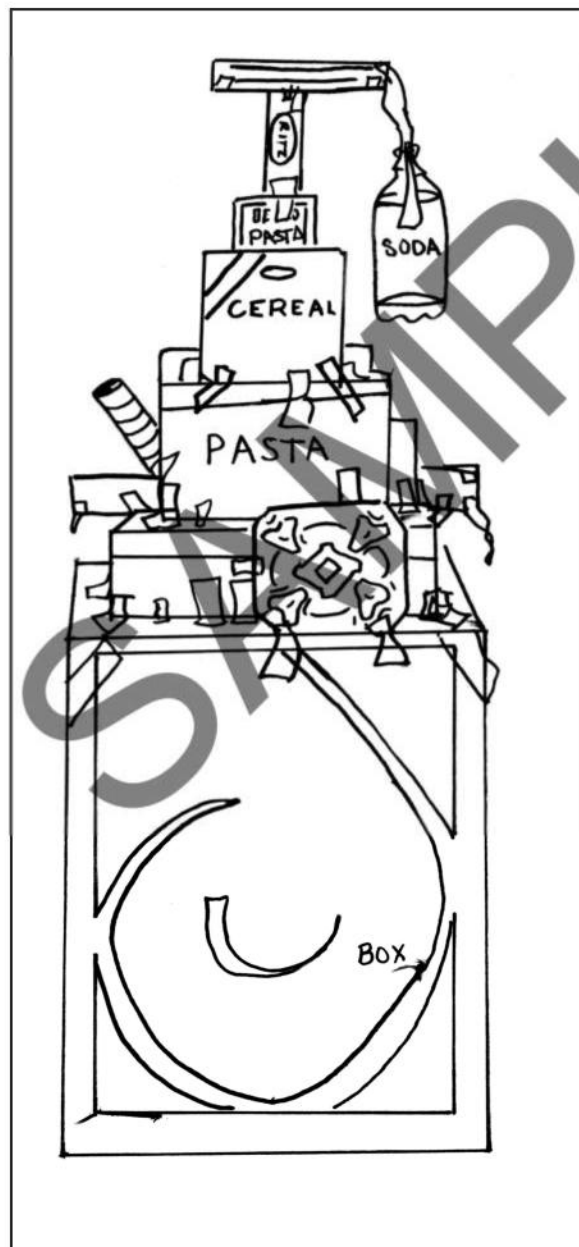
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BUILDING WITH WONDERFUL JUNK

In this construction activity, students have fun as they work in groups to plan and build large structures using recyclable materials they have brought from home. In addition to gaining experience with science concepts, this activity teaches interpersonal skills—presenting ideas, negotiating with other students, and organizing—skills that will serve them well in the future work force. Group leaders play an important role in helping students listen to and respect each other's ideas, and function together as a group.



"Junk" provides the material to make large structures that teach about balance and symmetry, working in group projects that are fun and get everyone involved.

➤ Estimated Time:

40 minutes

➤ Equity Ideas:

- It is important that girls, who often don't have opportunities to build, develop the skills that result from such activities.
- Recyclables which families send from home reflect the diversity of students' home cultures.

➤ Student Activities:

- Build a structure using clean, recyclable trash
- Negotiate, plan, and organize within a group
- Explore problems involving shape, size, scale, and stability
- Explore concepts of balance, weight, gravity, and symmetry
- Experience trial and error
- Learn about an environmental scientist and a physicist/astronaut

➤ Student Discoveries:

- Structures need a stable base
- Symmetry adds to the overall strength and stability of a structure
- Triangular shapes are rigid
- Some tubes are flexible, but add strength to a structure
- Seemingly flimsy material can be strengthened by folding or rolling

➤ Skills:

- Creative-thinking
- Decision-making
- Estimating
- Measuring
- Model-making
- Motor coordination (gross and fine)
- Negotiating
- Organizing
- Planning
- Problem-solving
- Spatial relations

➤ MATERIALS

- Lots of clean, wonderful junk:
 - All kinds of empty boxes (cereal boxes, shoe boxes, small and large cartons, gift boxes, egg cartons, etc.)
 - Cups (paper, plastic, cardboard)
 - Tubes (paper towel rollers, toilet paper rollers, poster tubes, gift paper rollers)
 - Foil (pie plates, cake pans)
 - Plastic bottles (no cans or glass)
- Several rolls of masking tape
- Paper and crayons (optional)
- Camera (optional)

➤ GETTING READY

During the week, ask students to bring in clean recyclable junk as listed above. Plan where the activity will take place – you will need a large space for building and storing the structures. When you're ready, place your "wonderful junk" on the floor. Divide the clean trash into separate piles according to the number of groups that will be participating. We recommend groups of 4-6 students. Be sure each group has some large boxes that will make good bases. Have lots of masking tape nearby (2-3 rolls per group).

Reminder: Don't forget to send home the family letter! Families can participate by helping to collect junk for the activity.

► STEPS Building with Wonderful Junk

1. Explain to each group of students that they will be constructing with the “wonderful junk.” The instructions are to:
 - plan and work together;
 - use all the junk in their pile;
 - build a structure that can stand alone.
 2. Encourage all students to participate in the building process. If you see that someone isn’t involved, try suggesting that she or he pick out something special to add to the structure.
 3. As students work, ask open-ended questions that will lead them to problem-solve:
 - How could you make your structure steadier?
 - Where do you think the largest carton might be most useful?
 - Can you think of a way to attach that box to the top of the structure?
 4. If students like, they can name and label their structures.
 5. After the structures are completed, ask each group of students to talk about their structure and how it was built. If words like gravity, balance, or weight come up in describing the structure, be sure students know what they mean. (See “Defining the Terms.”)
- Note: Remember to give each group positive feedback on it’s architectural creation!**
6. If you have a camera, take a picture of each structure and its “building crew.” Mount and display the photos.
 7. Asking one or more of the following questions is a good way to wrap up the activity:
 - What did you learn doing this activity?
 - Was it fun? What made it fun?
 - Were you doing science? Why do you think so?
 8. Here are some ideas of what to do with the wonderful junk structures:
 - Save them to display at the next parent meeting or event. Or, if there’s space, display the structures in the hallway or entryway.
 - Have a discussion about shapes. Make a list of all the shapes students mention. Help students create a graph of different shapes in their structures. Write words or draw the shapes (square, rectangle, circle, triangle, etc.) along the bottom of a piece of paper; along the left side from bottom to top write the numbers one to ten. Count all the squares you see in a structure; enter the result on the graph. Next, count all the circles, etc. What shape was the most common? The least common?
 - Have students estimate the height of a given structure. Then measure it. How close were their estimates?
 - Monitor how long the structures last without falling apart. Make observations on a daily basis to talk about what’s happening to the structures. Are they beginning to lean to one side? Why might that be happening? Are certain pieces falling off? What are some guesses about why that is happening? The discussion may come in handy when you make plans to build your next structures.
 9. Finally, recycle your structures by taking them apart, sorting the materials, and discarding them in the appropriate recycling bins at your center or at your community recycling plant.



THINKING IT OVER

Reflect and ask yourself:

- Did students come away feeling good about their efforts?
- Was I comfortable with the science concepts, e.g., talking about balance, weight, symmetry?
- Did the group come up with ideas for other construction projects?
- Did I notice if boys were more involved than girls? If so, what can I do about this so that *all* students are fully engaged next time?
- Did I help students listen to each other and respect ideas other than their own?
- Did I provide enough space and materials for the activity?

► EXTENDING THE LEARNING

As usual, students are your best source for follow-up activities. Build on their ideas. Plus, consider the following ways to extend the learning and the fun:

- ☐ Use materials such as newspapers, straws, and paper clips or clay and toothpicks to create other structures.
- ☐ Have a "Structure Exhibit" and invite other students, staff, and family members to come for a viewing.
- ☐ Ask students to sort a pile of wonderful junk based on the different materials in it.
- ☐ Have a discussion with students about recycling. Ask them to think about this question, "Where would this junk be if it hadn't become part of your structure?" If possible, arrange a trip to a local recycling plant.
- ☐ Invite someone from the Department of Sanitation, or a recycling plant, to come in and talk about what happens to trash after it's been collected.
- ☐ Visit your local library to find the book, *50 Simple Things Kids Can Do To Save the Earth* (see Resources section), and, as a group, decide on a few actions to take. Have students write about their efforts in their journals.
- ☐ Take a trip around the block, observing and making notes/sketches about the buildings, stores, parks, fences, etc. Then, using recyclables, have students create a model of what they have observed.

► DEFINING THE TERMS

Here are some key words related to this activity. Terms are given in English and Spanish.

Balance (Balancear): *A state of equilibrium; a stable state in which all forces are cancelled by equal, opposing forces.*

Ask students to think about using a balance scale in school. To make the scale balance, they had to put objects of equal weight in each pan. If one pan had a heavier object, the scale would tilt, not balance.

Flexible (Flexible): *Able to bend without breaking.*

Rubber is a flexible material. Ask students to find other things in the room that are flexible. Are their bodies flexible? How?

Gravity (Gravedad): *A force that pulls objects toward each other.*

The earth's gravity pulls on you, giving you weight and keeping you here on the ground. Ask students, "Can you jump and stay up in the air?" "Why not?"

Recycle (Reciclar): *To reuse products.*

Metal, rubber, plastic, glass, and paper are among the items that we recycle. Find out from students if their families recycle materials. What becomes of the materials we recycle?

Rigid (Rígido): *Unbending, stiff, or unyielding.*

Steel beams are rigid and are used to give strength to large buildings. Ask students to try to make their bodies very rigid. How did they do it?

Symmetry (Simetría): *A balanced, mirror-image correspondence of size, form, and arrangement of parts.*

For a hands-on example of symmetry, ask students to fold a piece of paper in half, then cut out a design along the fold. When they open up the paper they will see that the design is exactly the same on both sides, creating symmetry.



CAREERS AND ROLE MODELS

Ask students to generate a list of careers that involve knowing about building structures and the environment. Here are some hints:

Architect: a person who designs buildings and homes

Carpenter: a person who makes or repairs wooden structures

Construction Engineer: a person who plans how a structure will be built

Construction Worker: a person who does the actual work of building a structure

Recycling Plant Worker: a person who works at a place that recycles materials

Environmental Scientist: a person who studies some aspect of the environment

Ask if any students are thinking of working in these kinds of careers. If not, what career ideas do they have? Would any require knowing about science and math? Invite a person who's made a career out of architecture, carpentry, construction work, or another related field to visit and share information about her or his work. (See "The Mystery Science Visitor" activity for tips.)

Role Models:

Teresa Alvarado, Environmental Scientist and Dr. Franklin Chang-Díaz, Physicist/Astronaut (Full biographies about Teresa Alvarado and Franklin Chang-Díaz can be found at the end of this activity)

Both Teresa Alvarado and Franklin Chang-Díaz work for the National Aeronautics and Space Administration (NASA). Teresa Alvarado is an environmental compliance specialist who studies the effects of air and space technology on the air and water. Dr. Franklin Chang-Díaz earned a degree in physics at the Massachusetts Institute of Technology (MIT), and then pursued his childhood dream of becoming an astronaut.

Make copies of biographical information about Teresa Alvarado and Franklin Chang-Díaz for students to add to their science journals. Ask for a volunteer to read the short biographies aloud. Ask students to write questions in their journals they would like to ask Ms. Alvarado and Dr. Chang-Díaz.



THE LITERACY CONNECTION

You can extend students' learning experience and help them cultivate important reading, writing, listening, and speaking skills, with these follow-up activities.

- ☐ Select some books about buildings for students to read and for ideas about other building activities (see Resources section).
- ☐ Students can work in pairs to write a story or poem about their structure to present to the group. They can choose to read it or act it out.
- ☐ On your next trip to the library, have students find out about famous structures around the world: the pyramids of Egypt, the Empire State Building, the Eiffel Tower. Plan a time for them to share what they find out.

Resources

Books

Build It Strong! by Julian Rowe and Molly Perham (Chicago: Children's Press, 1994).

Excellent information and photos of ethnically diverse children building structures with strong foundations.

Building a House by Byron Barton (New York: Mulberry Books, 1990).

What does it take to construct a home? This colorful picture book offers simple illustrations and just enough text to clearly portray the work and the thinking involved in building a house.

50 Simple Things Kids Can Do To Save the Earth by the EarthWorks Group (Kansas City, Mo.: Andrews McMeel Publishing, 1990).

Many ideas about everyday things kids can do to help the environment.

Here Comes the Recycling Truck by Meyer Seltzer (Morton Grove, Ill.: Albert Whitman & Company, 1992).

Demonstrates the role that sorting and classifying play in recycling, through the story of a young woman who drives a recycling truck.

Houses and Homes by Ann Morris, photographs by Ken Heyman (New York: Lothrop, Lee & Shepard Books, 1992).

From palaces to straw huts, this book has photos of homes from cultures all over the world, plus a map to help locate them.

New Road! by Gail Gibbons, illustrated by Paul Mirocha (New York: HarperCollins, 1987).

Children learn about what goes into building a road. The book features women and men reading plans, using surveying tools and computers, and driving heavy machinery. Bright four-color illustrations are both multicultural and nonsexist.

The Wonderful Towers of Watts by Patricia Zilver (New York: William Morrow, 1994).

Describes building of the famous "junk" sculpture in the Watts section of Los Angeles, which uses recyclables to create wonderfully colorful and imaginative towers. Triangles, circles, domes, ovals, and ramps combine to form art.

Careers and Role Models Resources

(Note: All website addresses are preceded by <http://>)

www.nasa.gov

National Aeronautics and Space Administration website (select "education," then "Women of NASA").

Site has biographies, resource materials and "real time" conversations with women in science and technology at NASA. Has information specifically for students. Website is frequently updated with new information.

www.sacnas.org

Society for Advancement of Chicanos and Native Americans in Science website.

This site features information on role models, conferences and educational programs, and resources on science as an issue within the Chicano and Native American communities. This site is also an excellent source of biographies to help dispel stereotypes (www.sacnas.org/bio/index.html).

National Aeronautics and Space Administration. Washington, DC 20546-0001; 202-554-4380.

NASA poster series includes "Your Attitude Determines Your Altitude in Space" poster, which features a diverse group of astronauts and students. On the back of the poster is biographical information for both astronauts and students, as well as information on accessing NASA's educational department. Poster is available free of charge.

SAMPLE

► BIOGRAPHY

"I Made a Commitment"

Teresa Alvarado: Environmental Scientist

When Teresa Alvarado was growing up, in San José, California, she once told a school guidance counselor that she wanted to be a lawyer. He told her she should find a goal that was more "realistic." The guidance counselor had a stereotyped attitude. He didn't have high expectations for Teresa – but she had them for herself!

If he could see Teresa Alvarado today, that counselor would be surprised! The first woman in her family to graduate from college, Ms. Alvarado became an environmental compliance specialist working for the National Aeronautics and Space Administration (NASA) in an office in California. She is concerned about the effects that all of NASA's work with air and space technology might have on the land and people who live nearby. She writes and talks to people at the agency and elsewhere about how to keep our land and water clean.

Although Teresa Alvarado has a job in science today, she says that when she was still in high school, she was nervous about taking science or math classes. "Like many women, especially women of color," she explains, "I was happy to pass my algebra and geometry courses, and I was not encouraged by my school to strive higher." It wasn't until Ms. Alvarado reached college that she decided she needed to work harder in school. "I made a commitment that since I had not paid enough attention or been self-driven enough in high school, that I would face the challenge now," she says. Now that Ms. Alvarado has met her challenge, she would particularly like to see other girls doing the same thing.



► BIOGRAPHY

"Pursuing a Childhood Dream"

Dr. Franklin Chang-Díaz: Physicist and Astronaut

When Dr. Franklin Chang-Díaz was born in San José, Costa Rica, his grandfather named him after Franklin D. Roosevelt, a former American president. Growing up, Franklin thought often about moving to America – but not to become president. He wanted to be an astronaut. Even as a boy, he was fascinated by planes and rockets.

When he was still a teenager, Franklin came to the United States. He spoke no English and had almost no money, but he studied very hard and was able to attend the University of Connecticut on a scholarship. There, he got a degree in mechanical engineering. He followed it up with a Ph.D. in physics from the Massachusetts Institute of Technology (MIT). But Dr. Chang-Díaz was still pursuing his early dream, and in 1981, that dream came true. He became an astronaut with NASA!

In 1986, Dr. Chang-Díaz was launched into orbit on a six-day flight, becoming the first Latino-American ever to travel in space. By 1999, he'd been on six flights and spent over 1200 hours in space. He was on the first United States/Russian Space Shuttle mission. On another flight, he spent more than two weeks in space, traveling 6.5 million miles!

Today, Franklin Chang-Díaz directs a lab that's trying to design better rockets. Because he believes it's important to help people coping with difficult problems, Dr. Chang-Díaz also worked with a program specifically for Latinos combatting their drug abuse. Costa Rica, where Dr. Chang-Díaz's mother, brothers, and sisters still live, is proud of him! In 1995, the country gave him a high honor: even though he's now a U.S. citizen, they made him an "Honorary Citizen of Costa Rica."



► FAMILY LETTER



Dear Families,

Hold on! Don't throw away those egg cartons or cereal boxes! Don't toss out that cardboard tube! Those things aren't trash—they're "Wonderful Junk!"

For this week's After-School Science PLUS activity, **"Building with Wonderful Junk,"** we're asking you to send us your clean, recyclable trash. Students will use it to build structures, and as they build, they'll be learning about the concepts of gravity, balance and symmetry. They will talk about shape, color, size, and sorting. These building activities can help develop important problem-solving, mathematical, and spatial-relations skills.

Once your child has built with junk in the after-school center, it will be easy for her or him to do this activity at home. You can help by setting aside a place where junk can be saved. Before your child starts the building project, talk about some guidelines. How will you hold the junk together: tape? string? glue? Should the junk be sorted first? Should the structure be as tall as the tallest person in the family? Should it be a building or something that moves like a car or bus? The possibilities are endless—so be creative and have fun!

And remember to ask your child about Teresa Alvarado and Dr. Franklin Chang-Díaz, the role models highlighted in this week's activity. Ms. Alvarado is an environmental scientist employed by the National Aeronautics and Space Agency (NASA). She monitors the effects of air and space technology on the people who live nearby NASA headquarters. Dr. Chang-Díaz, who was born in Costa Rica, is a physicist. His childhood dream was to become an astronaut, and in 1986, his dream became reality when he was launched into space on a six-day mission.

► FAMILY LETTER

Queridas Familias,

Esperen! No boten esos envases de huevos o cajas de cereales! No rompan ese tubo de cartón! Esas cosas no son para desechar — son “Basura Maravillosa”!

Para esta semana, en la actividad denominada **“Construyendo con Basura Maravillosa”** del Programa Post-Escolar de Ciencia PLUS, les pedimos que nos envíen su limpia basura reciclable. Los estudiantes la usarán para construir estructuras, y a la vez que construyen, ellos estarán aprendiendo acerca de los conceptos de gravedad, balance y simetría. Los estudiantes hablarán sobre la forma, colores, medidas y selecciones. Estas actividades constructivas pueden ayudarlos a desarrollar importantes habilidades para resolver problemas, tanto matemáticos como de relaciones espaciales.

Una vez que su hija/hijo ha construido algo con basura en el Centro post-escolar, será fácil para él o ella hacer esa actividad en el hogar. Ustedes pueden ayudar en dándole un espacio donde pueda coleccionar la basura limpia. Antes que su hija/hijo empiece con su proyecto constructivo, hablen sobre algunas orientaciones. Cómo logrará que la basura se mantenga unida: Cinta adhesiva? Cuerdas? Pegamento? Debe seleccionar la basura primero? Será la estructura tan alta como la persona más alta de la familia? Será un edificio, o algo que se mueva como un carro o un ómnibus? Las posibilidades son infinitas—así que sean creativos y diviértanse!

Y recuerden preguntarle a sus hijo/hija sobre Teresa Alvarado y el Dr. Franklin Chang-Díaz, las personas-modelo para la actividad de esta semana. La Srta. Alvarado es una científica ambientalista empleada en la Agencia Nacional de la Aeronáutica y el Espacio (NASA). Ella monitorea los efectos del aire y la tecnología del espacio en las personas que viven cerca de la sede de la NASA. El Dr. Chang-Díaz, quien nació en Costa Rica, es un físico. Su sueño de la niñez fue convertirse en astronauta, y en 1986, su sueño se hizo realidad cuando fue lanzado al espacio en una misión de seis días.