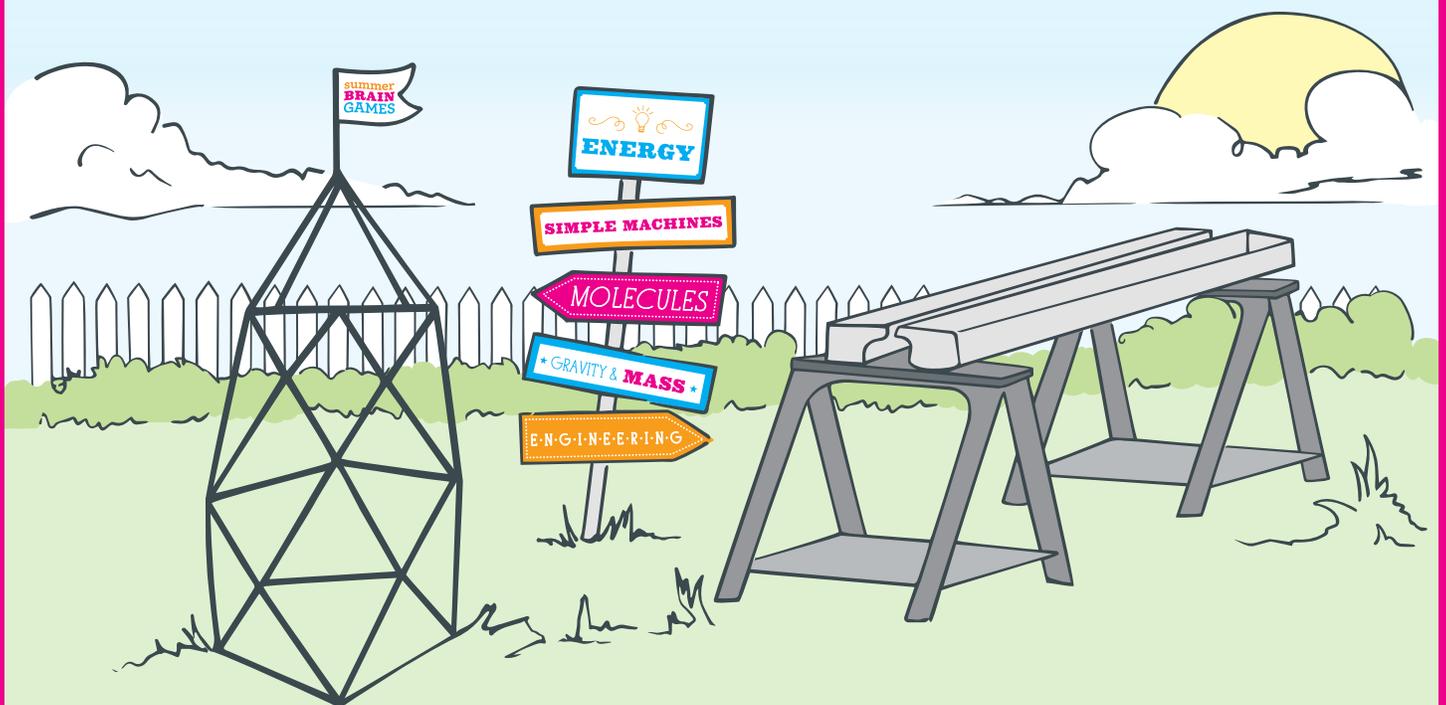




summer **BRAIN** GAMES

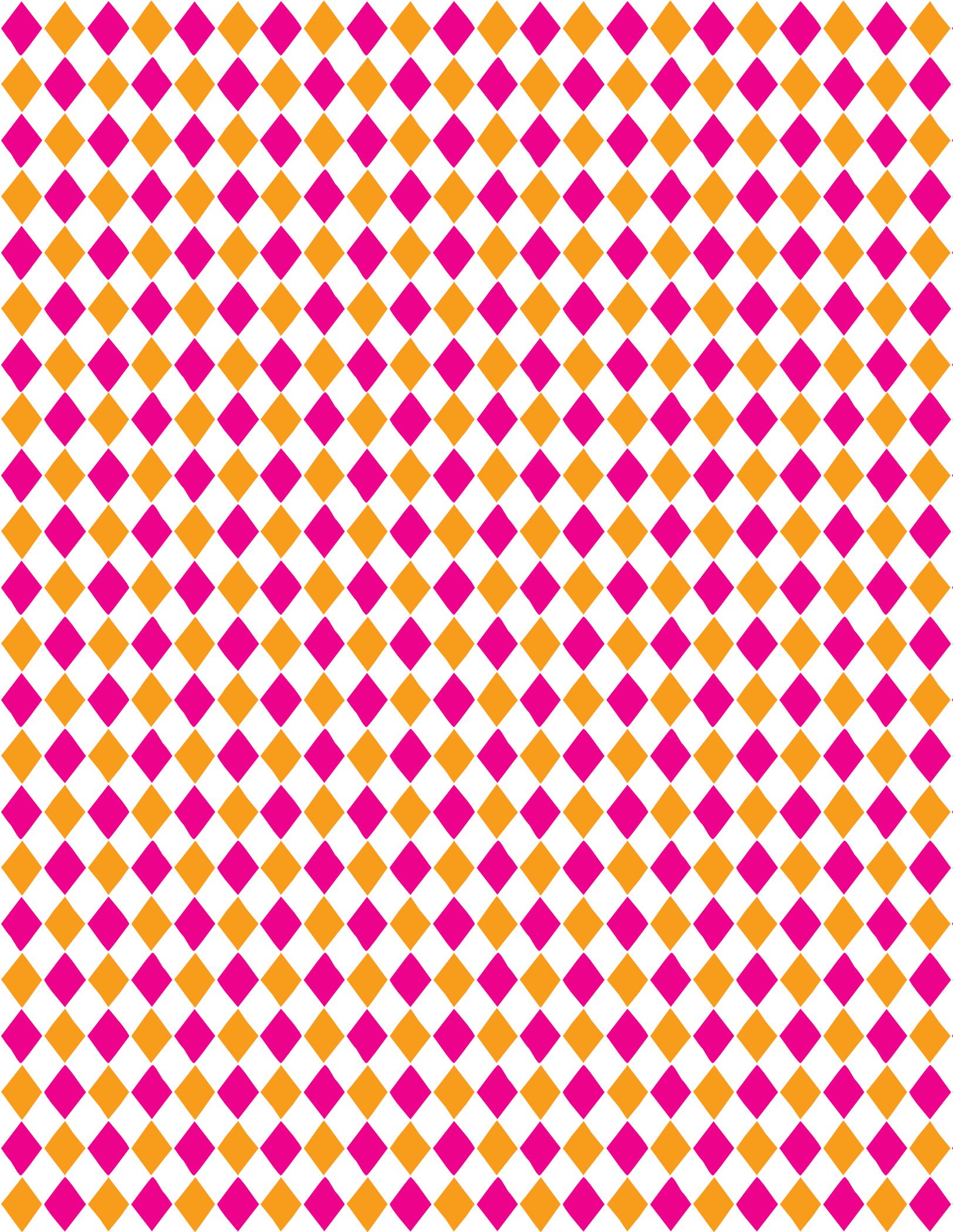


PLAY ALONG AT:

[MSICHICAGO.ORG/SUMMERBRAIN](https://msichicago.org/summerbrain)



museum of
science+industry
chicago





summer BRAIN GAMES

The Museum of Science and Industry, Chicago is your ticket to summer science fun. Summer Brain Games is eight weeks of free and fun at-home experiments that can easily be done by kids of all ages (with a little adult supervision).

This summer, we're exploring the science behind popular carnival games and activities. You'll learn about energy, pressure, engineering and more as you build and then play carnival games.

Register with Summer Brain Games online at msichicago.org/summerbrain and receive a pass for a free Museum Entry ticket! You'll also get a weekly email with tips and ideas on how to play with science all summer long.

So grab your friends, family or neighbors and throw a backyard science carnival this summer!

Sponsored by:



FREE MUSEUM ENTRY VOUCHER

Register at msichicago.org/summerbrain and get one free ticket per household.



SUMMER SLOPES

EXPERIMENT: SKEEBALL SKI JUMP

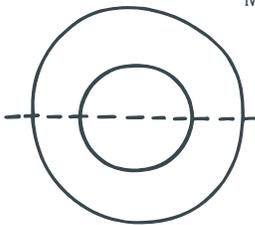
Try this twist on a classic carnival game. Experiment with variables of speed and height as you launch a marble down a ski jump to land in a target. Then build your math skills as you tally up your points!



MATERIALS

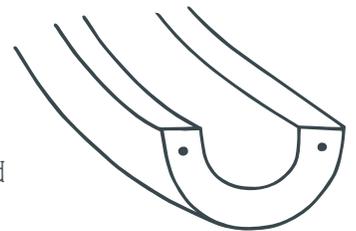
Pool noodle
 Pizza box
 Three paper cups
 Cardboard box
 Two 6-inch pieces of stiff wire or metal hanger
 Marbles
 Duct tape
 Masking tape or clear tape
 Scissors
 Pencil

INSTRUCTIONS

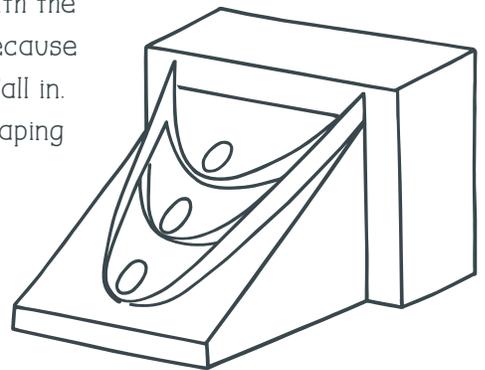


Make the ski jump. Cut the pool noodle in half lengthwise, so you have two pieces of track with a curved chute down the middle. Tape the tracks together to make one really long track. Be sure to put the tape on the outside of the pool noodle; if you put tape on the inside, it will cause friction and slow down the marble.

Carefully insert the wires into one end of the ski jump (ask an adult to help!). The wires should be embedded in the foam material and parallel to the curved chute. These wires will allow you to bend the end of the jump to adjust it.

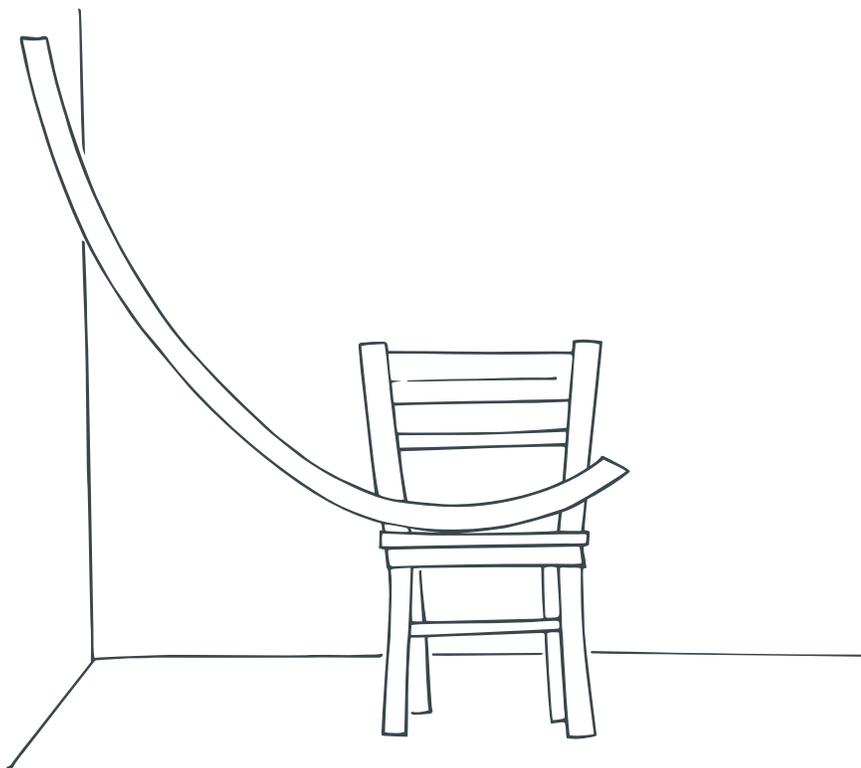


Make the skeeball target. Cut three holes in the lid of the pizza box that are the same size as the paper cup. Insert the cups in the holes so they are flush with the lid - there should be no lip because the marble won't be able to fall in. Secure the cups in place by taping around the lip. Assign a point value for each cup. Use some cardboard to prop open the lid so that the front with the cups is at an angle.



The bumpers that surround the holes are made from duct tape. For each bumper, put two pieces of tape together with the sticky sides touching. Attach each bumper to the target with clear tape so that they stand upright around each cup. Use a cardboard box as a backboard for the skeeball target – this helps deflect any poorly aimed marbles!

Get ready to play! Tape the top of the ski jump track high up on a wall and prop the curved end of the ski jump up on chairs, boxes or other objects. Place the skeeball target opposite the ski jump track. Adjust its position after you send a test marble down the track.



To launch, place a marble at the top of the ski jump track and let it go. The marble should land in one of the cups without bouncing on the floor.

GAME ON

Challenge your friends to a game. Each person gets to launch three marbles, and you can adjust the ski jump track or the target position after each attempt. The person with the most points wins! Make the game more challenging by adding a loop or hill in your ski jump track.

LIKE THIS ACTIVITY?

You could be a ...

- Mechanical engineer
- Inventor
- Amusement park designer

▲ SAFETY FIRST:

Remember what grandma always says – don't run with scissors!



WHAT'S HAPPENING?

Several types of energy are at work in the ski jump skeeball. The marble has potential energy when it's sitting on the track before it starts to roll downhill. As it rolls, the potential energy transforms to kinetic energy or the energy of motion. Where the marble lands depends on two variables: how fast it is going when it leaves the ski jump and the angle at which it leaves. By changing these variables you can aim for the higher point targets. Generally, the marble will travel farthest if it leaves the ski jump at a 45-degree angle. And if the marble starts at the higher end of the ski jump track, it will travel faster and farther.

STEP RIGHT IN!

EXPERIMENT: NEWSPAPER TENT

Every carnival needs a tent or two ... where else are you going to buy tickets or get refreshments? Be an engineer and build your own tent from newspapers as you learn what shapes make structures strong.

MATERIALS

Lots of newspaper, about two full papers (traditional broadsheet size, like the Chicago Tribune)



Masking tape or duct tape

Stapler

Pipe cleaners

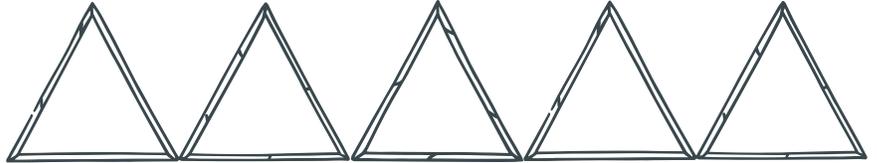
Craft sticks (optional)

Sheet (optional)

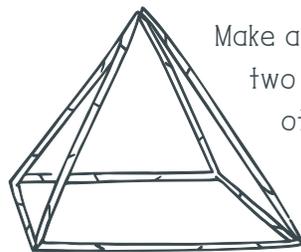
INSTRUCTIONS

Make newspaper rolls from two sheets of flat newspaper. Use open, two-page spreads, not single sheets. Roll them tightly from corner to corner – the tighter the roll, the stronger the support. Secure the end with tape. You'll need 37 rolls.

Use three newspaper rolls to make a triangle, attaching at each corner with staples. Make 11 triangles. The last four newspaper rolls will be used for bracing your tent.



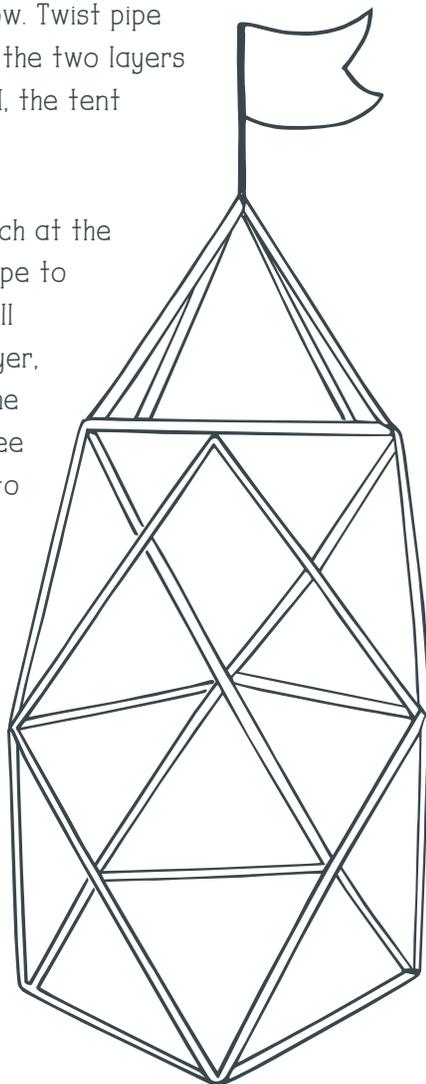
Prepare the base of your tent. Lay five triangles flat on the ground so that a side of each triangle forms a line. Attach the triangles to each other along the bottom edge with staples and/or tape. Prepare the middle layer by attaching four triangles to each other in the same way.



Make a pyramid for the top by attaching the last two triangles at their tops, opposite each other, and using two straight newspaper rolls to complete the square base.

Get someone to help hold things in place as you get ready to erect your tent! Take the bottom layer of five triangles and form them into the shape of a pentagram and staple the last two bottom corners together. The triangle points should stand upward somewhat but will tend to fall over, and that's OK. Take the middle layer of four triangles and position them on top of the bottom layer so that the bottom corners touch the pointed tops of the layer below. Twist pipe cleaners around each spot where the two layers join. As you work your way around, the tent should be more upright.

Place the pyramid on top and attach at the corners with pipe cleaners. Use tape to secure the last two newspaper roll braces diagonally from the top layer, forming a diamond-shaped door. The tent should be sturdy, but feel free to add tape or even craft sticks to reinforce any wobbly corners.



GAME ON

Your tent is sturdy enough to handle some weight, so cover it with a sheet and even put a flag on top! Use your tent at your science carnival as a spot for tickets, prizes or snacks. You can also experiment with different shapes of tents. Can you make a larger one? Or a taller one? See what you can design!

MORE WAYS TO PLAY WITH TENTS

There are many ways to make tents, so get creative! Try making a fort from blankets and pillows, or hang a hula hoop up high and drape it with sheets.

LIKE THIS ACTIVITY?

You could be a ...

- Architect
- Construction manager
- Engineer
- Building inspector

WHAT'S HAPPENING?

Triangles are considered the strongest shape because they can handle heavy loads without collapsing. Hold one of your newspaper triangles and apply some force on the sides. The triangle should feel sturdy and hold its shape. If you put force on a square or rectangle, the shape can tilt or collapse. The triangle's strength is why architects often use it in structures. Bridges are made up of trusses, which are triangles that share sides and connections. Look for triangles the next time you see a bridge or building under construction.

This tent is similar to a geodesic dome, which is a spherical or partially spherical structure formed from triangles. You can find geodesic domes on playgrounds as climbing structures. Another example is the giant sphere at Epcot.

BUBBLE BLOW-OUT

EXPERIMENT: SUPER BOUNCY BUBBLES



Come one, come all and be amazed by these durable bubbles! This bubble solution lets you make huge bubbles that like to linger. Experiment with the shape and size of bubbles as you design your own wands, make a colorful bubble snake and try to make giant bubbles.

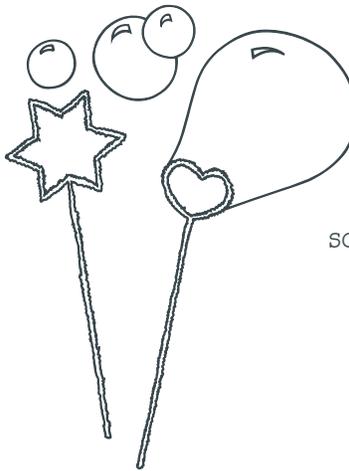


MATERIALS

Water
 Dish soap (original blue Dawn works best)
 Glycerin
 Sugar
 Food coloring
 Container with a lid
 Measuring spoons and cups
 Scissors
 Pipe cleaners
 Straws
 Tape
 Cotton string
 Cotton yarn
 20-ounce plastic bottle
 Washcloth or cotton fabric
 Rubber band
 Two dowel rods or sticks
 Beads (optional)

INSTRUCTIONS

Make longer-lasting bubbles that are harder to pop with this bubble solution. Mix 1 cup warm water, 2 tablespoons dish soap, 1 tablespoon glycerin and 1 teaspoon sugar. Stir thoroughly and store for at least an hour in a covered container. When you're ready to try your bubble solution, gently swirl the container in case ingredients have separated.

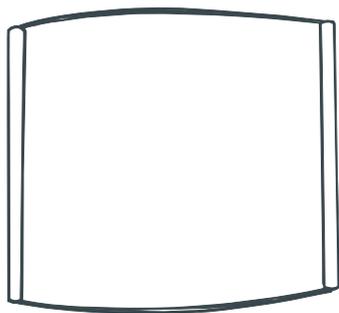


BASIC WAND: Design your own bubble wand using pipe cleaners. Be creative! Bend the loop into different shapes. If you'd like, decorate the handle with beads. Let the wand absorb the bubble solution for a few seconds then blow away!

RAINBOW BUBBLE SNAKE:

Cut the bottom off a 20-ounce plastic bottle and keep the top half. Use a rubber band to secure a piece of washcloth or other cotton fabric over the wide opening. Dip the fabric end into the bubble solution and move it around to absorb the liquid. Gently blow into the drinking side to create a long chain of bubbles. Make a rainbow bubble snake by adding a few drops of food coloring to the fabric before dipping it into the solution.



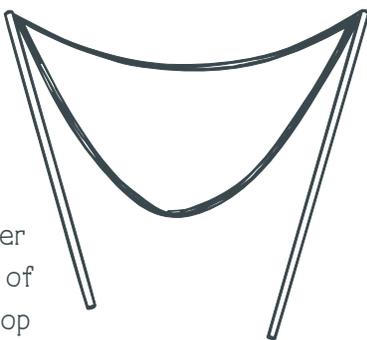


BUBBLE WINDOW: Thread a piece of string through two straws and tie the ends together. Position the straws so they are opposite each other, forming a square. Hold the straws together and dip the square "window" into the bubble solution.

Lift it out with the straws still

touching and then make the square, this time with a bubble inside! Blow gently or move your arms to make a huge bubble. Experiment with different lengths of string to see how big of a bubble you can make.

GIANT BUBBLE WAND: Use yarn to make two braids, one that's 18 inches long and another that's 36 inches. Tape one end of the long braid to the end of one dowel and tape the other end to the other dowel. Tape the shorter braid in the same way on the same end of the dowel. Both braids should form a loop with the shorter braid at the top and the longer braid at the bottom. Dip the wand into the bubble solution and let the yarn soak in plenty of solution. Lift out the wand and slowly move it around to create huge bubbles!



TIPS

You can find glycerin in the cosmetic sections of stores or with the cooking supplies.

MORE WAYS TO PLAY WITH BUBBLES

Fill a kiddie pool with bubble solution. Put a hula hoop in it and soak it for 60 seconds. Have someone get in the middle of the hula hoop and sloooooowly pull the hula hoop up to see if you can encapsulate the person in the middle!

LIKE THIS ACTIVITY?

You could be a ...

- Cosmetic chemist
- Beverage technologist
- Bubble gum manufacturer
- Physicist

▲ SAFETY FIRST:

Food coloring usually doesn't permanently dye fabrics, but it's best to go outside so you don't ruin mom's carpet. Accidentally stained items should be soaked in a solution of one tablespoon each of vinegar and dish soap added to one quart of water.

WHAT'S HAPPENING?

A bubble is a thin film of soapy water filled with air. The soapy film is made up of three layers: one layer of water molecules sandwiched between two layers of soap molecules. Hundreds of these molecules will stick together to form the spherical shape of a bubble. No matter what your wand looks like, a bubble will always take on the shape of a sphere. The sphere shape minimizes the surface area of the bubble, which makes it the easiest shape to form using the least amount of energy.

Adding glycerin and sugar to the bubble solution help the bubbles last longer. The water in bubbles evaporates quickly, which makes the bubble pop. Adding glycerin and sugar slow evaporation, which makes bubbles last longer.

THE AMAZING FLYING DAREDEVIL



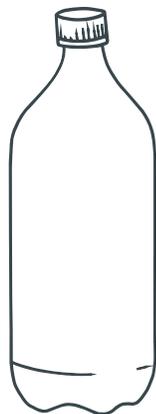
EXPERIMENT: STOMP ROCKET

Rev up the excitement at your science carnival with a daredevil who harnesses the power of pressure to launch himself like a rocket through the sky!



MATERIALS

- Pool noodle
- Tube that fits into the pool noodle, like a short piece of 1" PVC pipe or a glow stick canister
- 2-liter bottle
- Ping pong ball
- Duct tape
- Scotch tape
- Paper
- Fabric
- Markers
- Scissors
- Hula hoops or other rings (optional)

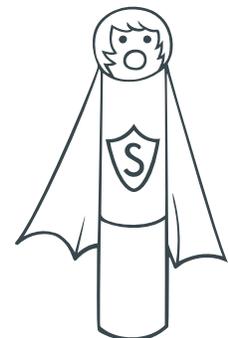
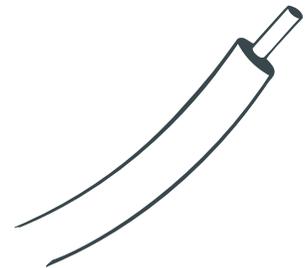
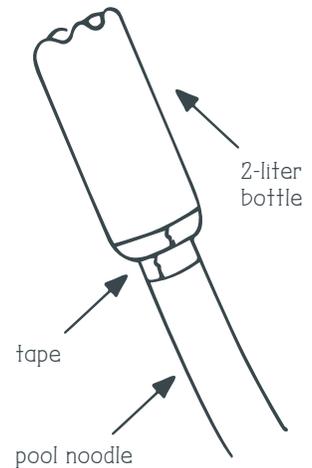


INSTRUCTIONS

Build the launcher by inserting the mouth of the 2-liter bottle into one end of the pool noodle and secure thoroughly with duct tape, trying to make it as air tight as possible. Insert the PVC piece or other tube into the other end.

Make your daredevil by rolling a piece of paper so that it fits inside the launching tube. Check the diameter by putting the paper roll into the pipe and letting it unwind so it fits snugly, then tape the roll so it remains that size. Remove the paper roll.

Draw an awesome face or attach a photo on the ping pong ball, then use Scotch tape to secure it to one end of the paper roll. Make a cape from a piece of fabric and attach it near the ping-pong ball head.



Load the daredevil into the tube. Place the 2-liter bottle on the ground and aim the launcher. It may be easier to ask a partner to hold the launcher for you. Stomp on the bottle to watch the daredevil fly! To launch again, just blow forcefully into the tube until the bottle re-inflates.



TIPS

The duct tape or bottle will eventually wear out from stomping. When that happens, cut off the end of the pool noodle and attach a new bottle.

If you don't have a pool noodle, any tube you can make airtight will work, such as a bike inner tube or PVC pipe.

MORE WAYS TO PLAY WITH ROCKETS

See real rockets – including artifacts like the Apollo 8 spacecraft and the Apollo 11 training module – in MSI's Henry Crown Space Center.

LIKE THIS ACTIVITY?

You could be a ...

- Rocket scientist
- Pneumatic engineer
- Aerospace engineer
- Pilot

GAME ON

Adjust the launcher's angle and see what sends the daredevil the farthest. Does how hard you stomp on the bottle change how far he flies? Challenge your buddies to a friendly competition and see whose daredevil flies farthest. Hang hula hoops or rings from a tree branch, assign a point value and see who aims best. Reward the winner with a cool summer treat!



WHAT'S HAPPENING?

When you stomp on the bottle you compress, or squish, the air inside. This compressed air has to go somewhere, so it escapes through the easiest way out – which is the other end of the launcher. By placing the daredevil over the other opening, this escaping air pushes him out of the way!

If the compressed air didn't have an escape route, like the launching tube, the container would burst. That's why compressed air or gas containers like pressure cookers and propane gas cylinders always have a safety valve that keeps the pressure from getting too high.

▲ SAFETY FIRST:

It's a good idea to aim into a clear area where you know your friends (and their eyeballs) are safe from unexpected daredevil collisions.

TEST YOUR MIGHT

EXPERIMENT: SOLAR SYSTEM HIGH STRIKER

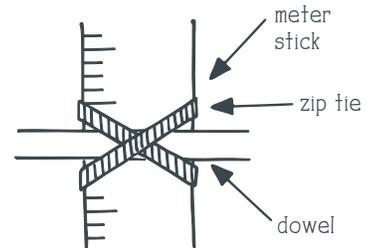
Make your own high striker game just like at a carnival, then test your strength against gravity as you try to get a spaceship to reach the Sun!

MATERIALS

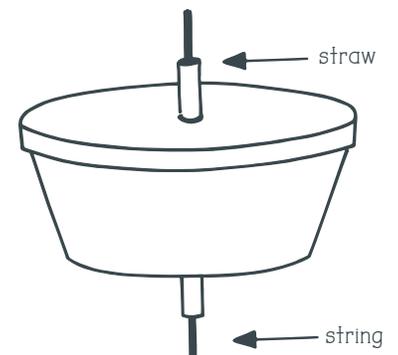
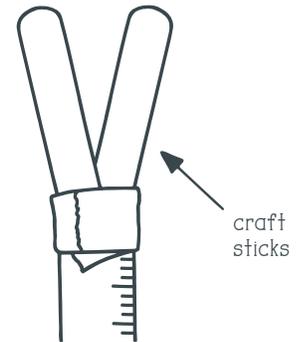
Dowel rod
 Meter stick
 Two milk jugs
 Plastic container with a lid (such as yogurt, sour cream, etc.)
 Two craft sticks
 Straw
 Tape
 Nylon string (at least 8 feet)
 Zip ties
 Paper, Styrofoam or foil bowl
 Paper shreds or confetti
 Small, light weights (marbles, small toys, beans, etc.)
 Heavy weights (cans, books, bricks, etc.)
 Box cutter or drill
 Scissors
 Paper, markers and other craft items
 Solar system images (available at msichicago.org/summerbrain)

INSTRUCTIONS

Find a location near a wall or tree, somewhere with some height. Make a lever by attaching a meter stick perpendicular to the dowel rod using two zip ties in an X shape. Tape two craft sticks to one end of the meter stick so they extend out and form a V shape that will fit around the string. Fill the milk jugs with water, cap them and set them on the ground. Put the dowel rod through the handles of the milk jugs.

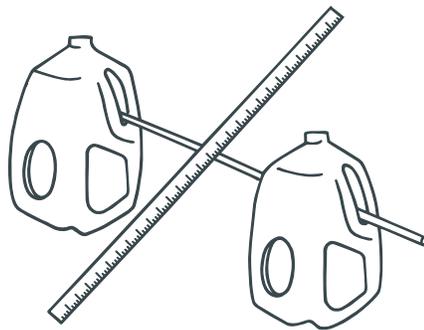


Make your spaceship by poking or drilling a hole in the top and bottom of the plastic container. Decorate the container to make it look like a spaceship! If the holes have rough edges, cut a length of straw that will extend through both holes and the center of your container and tape it into place. This will reduce friction. Thread the nylon string through the holes of your spaceship container. Make a launching pad base by holding down one end of the string with cans or other heavy weights.



Make the top of the high striker by poking a hole through the bottom of a bowl and threading the string through. The bowl is at the top of your high striker, so hold it in place by taping it to the

wall. Tape the top of the string to the wall above the bowl. Fill the bowl with confetti or paper shreds. Print the solar system game templates and tape them to the wall behind the string in this order, starting at the bottom: Neptune, Uranus, Saturn, Jupiter, Mars, Earth, Venus, Mercury and the Sun.

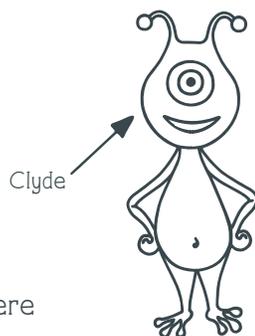


To play, put the spaceship container on the launching pad base and place the V-shaped lever arm under the container. Launch by hitting the other end with your hand or by pressing down. Can you make it all the way to the Sun?

GAME ON

Clyde the Alien (named for Clyde Tombaugh, the discoverer of Pluto) needs to gather resources from each of the planets in the solar system before delivering them all to the Sun. Make your spaceship stop at each planet to collect the resources below; each one is a significant compound found on each planet. At each stop, add one small item like a marble or bead to your container to represent the resources. Can Clyde get everything and reach the Sun?

- NEPTUNE:** Solid icy methane from the atmosphere
- URANUS:** Hydrogen from the atmosphere
- SATURN:** Icy water from Saturn's rings
- JUPITER:** Helium from the atmosphere
- MARS:** Iron oxide from the surface
- EARTH:** Silica from the outer crust
- VENUS:** Carbon dioxide from the atmosphere
- MERCURY:** Oxygen and sodium from the atmosphere



WHAT'S HAPPENING?

The high striker uses the weight of the container to measure how powerful you are. Weight is caused by gravity, a force of nature that pulls everything towards the Earth. Gravity pulls on mass, or how much "stuff" something is made of, which means it weighs more. Adding more mass to the spaceship container – by adding marbles or other weight – means that more force has to be used to send it up. Launching a container with a bunch of stuff inside to 5 feet takes more force than launching an empty container to the same height.

TIPS

Nylon string works best because its smooth surface creates less friction. You can use other string, but it may be more difficult for the spaceship to fly high.

Try raising the milk jugs up on a stack of books or a box to help your spaceship fly higher.

MORE WAYS TO PLAY WITH GRAVITY

Experience other forces at work in MSI's *Science Storms* exhibit. You can experiment with the movement of granular materials in the Avalanche Disk or change the angle and velocity of a tennis ball that you launch across the balcony.

LIKE THIS ACTIVITY?

You could be a ...

- Mechanical engineer
- Astronomer
- Planetary scientist
- Astronaut

ANCHORS AWAY

EXPERIMENT: DESIGN AND RACE BOATS



Experience how pressure makes things move. Design a boat and sail, then see if it can make it to the finish line before your opponent's in a breath-powered boat race!

MATERIALS

Boat materials, such as aluminum foil, Styrofoam cartons, pieces of pool noodle

Sail materials, such as paper or foam craft sheets

Two 10-foot vinyl rain gutters

Four gutter end caps

Blue food coloring

Straws

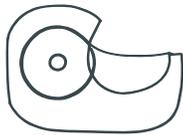
Craft sticks

Tape

Scissors

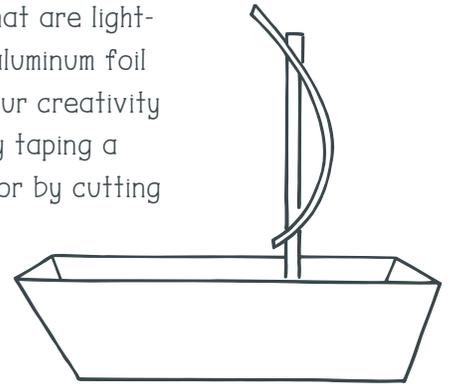
Long table or several chairs

Water



INSTRUCTIONS

Build your boat using materials that are light-weight and waterproof, such as aluminum foil or pieces of pool noodles. Use your creativity and imagination! Make the mast by taping a straw or craft stick to the boat or by cutting a slit into a pool noodle and inserting the craft stick. Cut a piece of lightweight paper or foam craft sheet to act as the mainsail. Think about what shape will help your boat move fastest. Poke a hole in either end of the sheet and slide the sail onto the mast through the holes, or tape it to the mast. Decorate your boat in any way you'd like.



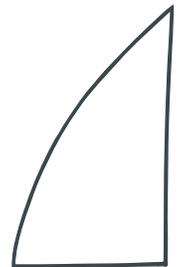
POSSIBLE SAIL SHAPES:



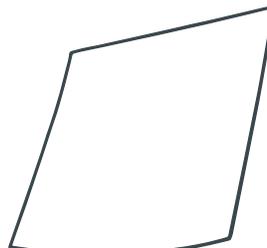
lateen



square head



roached

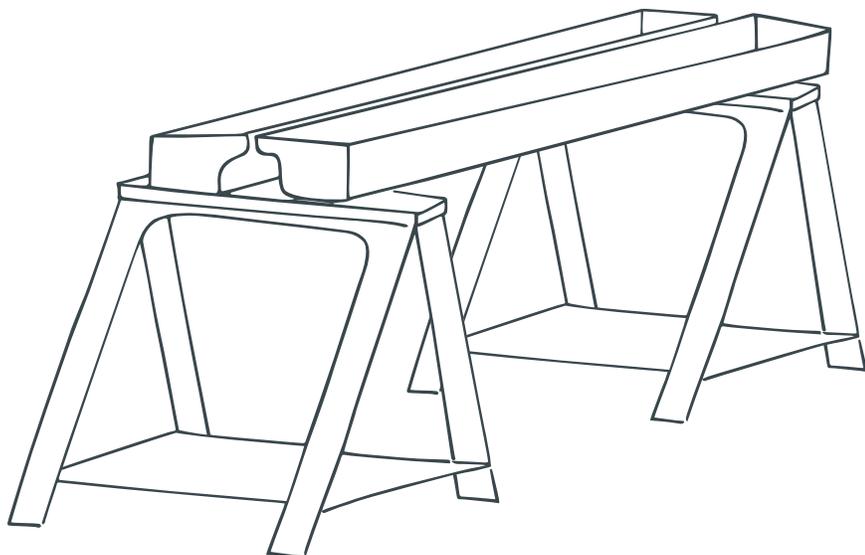


lug sail

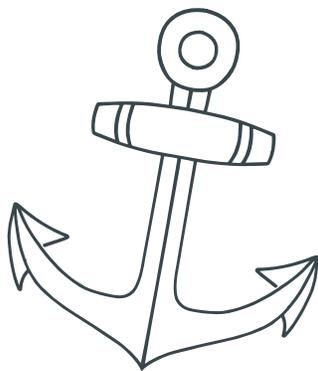


settee

Prepare the racing track. Snap the end caps in place on each gutter and lay the gutters side by side on a long table or on chairs. You may need to tape the gutter to the table to make sure it remains upright. Fill each gutter with water and add a few drops of blue food coloring.



Get ready to race! Place the boats at the starting line. When the official says, "Go!" each player blows through a straw aimed at their boat to get it to move. Don't use the straw to push the boat forward! Follow the boat down the track and blow at the sail as you go. The first player to get their boat to the finish line is the winner!



GAME ON

Use a stopwatch to time your boat races. Then redesign your boat and sail to see if you can make an even faster one. What boat shape will move more quickly? What sail material is most effective?

TIPS

Find inexpensive vinyl rain gutters at home improvement stores. Or race your boats in a bathtub or pool by making "lanes" with pool noodles or other long objects to help them sail straight.

MORE WAYS TO PLAY WITH BOATS

See a large boat up close in MSI's *U-505 Submarine* exhibit (msichicago.org/u505). This year is the 70th anniversary of the capture of this German submarine during WWII.

LIKE THIS ACTIVITY?

You could be a ...

- Mechanical engineer
- Naval architect
- Sailor
- Boat mechanic

WHAT'S HAPPENING?

Air is made up of tiny particles called air molecules. When you blow on your hand, you can feel the air because you are pushing the air molecules with your breath. The force of air molecules pushing against the surface of an object in scientific terms is known as "pressure." In this case, air pressure can move the boat because more force is being exerted on one side of the boat than the other. The harder you blow, the faster the air molecules move and the more pressure you put on the boat. Your breath is acting just like wind on real boats!

AIM TO DUNK

EXPERIMENT: DUNK BUCKET

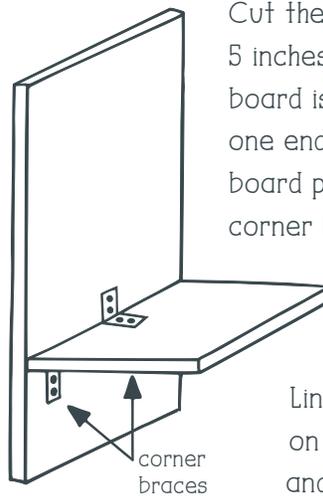


Cool off on a hot summer day with this fun take on a carnival classic. Instead of dropping a person into a dunk tank, douse your friend from above with a bucket precariously perched on a tipping shelf. It's all about balance!

MATERIALS

- 24-inch piece of 1-by-6-inch board
- Two 2-inch strap hinges
- Four 2-inch corner braces (also called L brackets)
- 1-quart plastic container
- Meter stick, cut down to 24 inches
- Short wood screw (1/2 inch)
- Washer
- Pencil
- Ruler
- Duct tape
- Pieces of pool noodle or other padding
- Small plastic plate or cardboard circle
- Wood saw
- Screwdriver
- Water
- Bean Bag

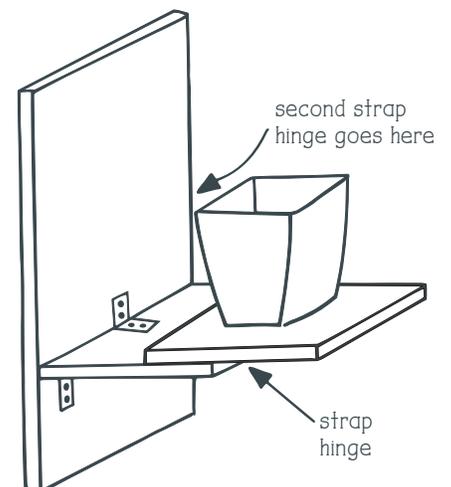
INSTRUCTIONS



Cut the wood into three pieces – two that are 5 inches long and one that's 14 inches. The 14-inch board is the backboard. Measure 3 inches from one end of the backboard and connect a 5-inch board perpendicular at that point, using the corner braces. Use two corner braces on the bottom of the shelf and one on the top in the middle.

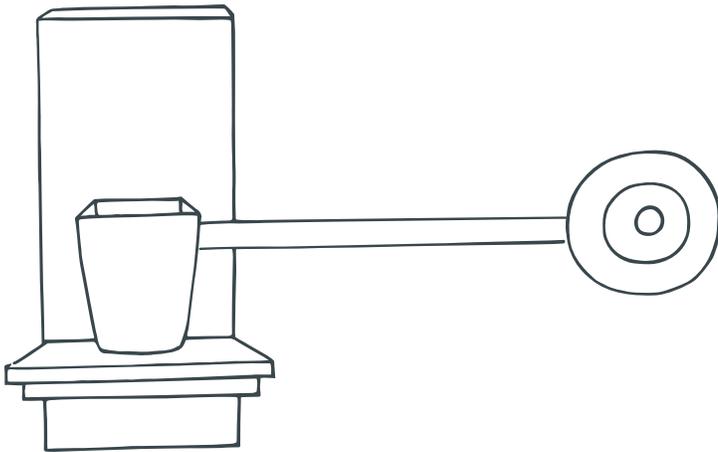
Line up the pivot part of the strap hinge on the top center edge of the 5-inch shelf and screw the hinge into the wood. On the unused 5-inch board, draw a line 2.5 inches from the end and attach the other half of the hinge along the center line. If done correctly, the small board should sit on top of the shelf in an offset position and should be able to tip forward.

Attach the plastic container to the tipping shelf. Line up the center of the container so it is a half-inch behind the pivot on the hinge. Attach the container with a short wood screw through a washer and into the board below. The washer helps distribute force and will keep the container from cracking.



Test the tipping shelf by holding the backboard vertical (such as against a wall) and filling the container with water. The container should tip with a gentle nudge. If it takes too much force to tip, reposition the container away from the backboard so that its center is right over the hinge. If the container won't stay put and always tips, reposition the container towards the backboard. The key is to have the center of mass just behind the hinge pivot.

Find the location for the lever arm by marking a line on the backboard that's just under the rim of the container. Screw the other strap hinge to the right edge of the backboard along this line so that the hinge opens out towards the container. The center of the hinge should be near, but not above, the top rim of the container. Close the hinge and use duct tape to attach the yardstick to the hinge so some of the stick is behind the container but the longer end extends out to the right. Tape the cardboard target to the far right end of the lever. Tape pieces of pool noodle or other padding to the lever arm that's behind the container so there is no gap between the lever arm and the container.



Now find a willing assistant to sit under the dunk bucket as you throw a bean bag at the target!

⚠ SAFETY FIRST:

Since throwers occasionally have less-than-perfect aim, bean bags provide plenty of force to trigger the water spill without fear of being hit by a wild pitch.

TIPS

The offset on the tip shelf is important. With the proper offset, the container of water will be on the verge of tipping and will require less force to push it over. Without this offset, the bucket would be difficult to tip over.

GAME ON

Challenge your friends to see who has a more accurate aim. How many times does it take you to hit the target before the water falls? What happens if you stand farther away, or closer?

MORE WAYS TO PLAY WITH BALANCE

Play tug of war with your friends – when forces on both sides are balanced, the rope doesn't move.

LIKE THIS ACTIVITY?

You could be a ...

- Engineer
- Physicist
- Industrial designer
- Mechanic

WHAT'S HAPPENING?

The dunk bucket is a lesson about the center of mass (also called the center of gravity) and balance. When the container full of water is positioned over the pivot point, there should be an equal amount of mass on either side of the pivot. The water is balanced at the edge. That means it will take very little force to push the container over and tip the water on your friend!

COOL UNDER PRESSURE



EXPERIMENT: WATER BLASTER AND TARGET

Witness the never-ending struggle as air and water battle it out to equalize the pressure in an enclosed container as you make your own water blaster. Then build a target for your own version of a carnival water gun game.

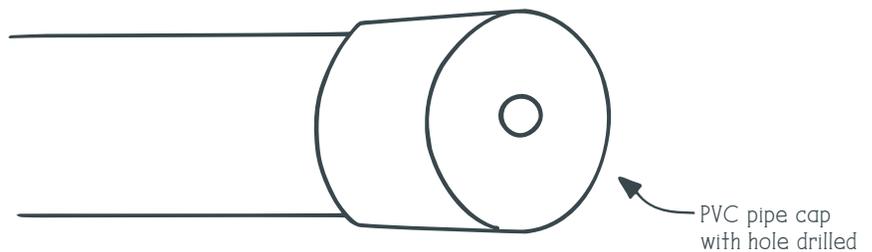


MATERIALS

2 feet of 1-inch PVC pipe
 PVC pipe end cap
 3 feet of 1-inch dowel rod
 Expanding glue
 (like Gorilla Glue)
 Metal washer
 Screw
 Pool noodle
 Two 2-liter bottles
 Tape
 Ping pong ball
 Large bucket
 Rocks or sand
 Scissors
 Screwdriver
 Drill
 Water

INSTRUCTIONS

The blaster has two parts: the housing (PVC pipe and cap) and the plunger (a pool noodle plug attached to a dowel rod). Make the housing by gluing the PVC pipe to the cap with an expanding glue and following the directions to let it dry. Once dry, drill a hole in the middle of the PVC end cap; this is your blast nozzle. A small hole will shoot water farther while a large one will drench someone quickly!



Make the plunger plug by cutting a 2-inch piece of pool noodle so that it lays flat. Firmly press the open end of the PVC pipe onto the pool noodle until you see an impression of the pipe. Cut around the impression so that your piece is slightly bigger than the inside of the PVC pipe. Test to see if it fits firmly in the end of the PVC, and don't be shy about making new ones. Place the pool noodle plug on one end of the dowel. Put a washer on top of it, then screw the washer and plug to the end of the dowel.



To use, put the plunger into the housing and push it almost all the way to the end. Put the capped end into a pail of water and pull back on the plunger. If you have a good seal with the pool noodle plug, the water should not drip out of the nozzle. Aim the blaster, push the plunger and soak the world!

TIPS

If your piston blaster doesn't hold water, the seal between the pool noodle plug and the housing isn't airtight. Make the plug a little bigger so it fits snugly.

The pool noodle plug in the piston blaster will eventually get worn out. When that happens, remove the old one and attach a new one.

MORE WAYS TO PLAY WITH WATER

Shoot streams of water at targets in MSI's *Idea Factory*.

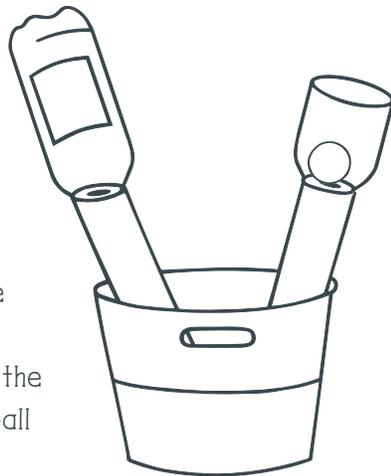
LIKE THIS ACTIVITY?

You could be a ...

- Hydraulic engineer
- Water treatment specialist
- Mechanic

GAME ON

Build a target to see how well you can aim your blaster. Cut an empty 2-liter bottle in half and discard the bottom. Take another 2-liter bottle and cut a square window in one side. If the edges are rough, cover with tape. Cut a 2-foot piece of pool noodle and push each bottle mouth into the pool noodle ends. Curve the pool noodle so the bottles are vertical. Make sure the pool noodle isn't pinched because water needs to flow through it. Place the curve of the pool noodle into a bucket and fill with rocks or sand to stabilize. Position the bottles so that the bottle with the window opening is higher than the other. Put a ping pong ball in the shorter bottle and mark a "finish line" about an inch from the top edge. Squirt water into the window opening until the ping pong ball rises up and passes the finish line!



WHAT'S HAPPENING?

The blaster works by using pressure. When you put the blaster in the water and pull back, the pressure on the water outside the PVC pipe pushes it into the empty pipe. This happens because you are increasing the volume, or space, inside the blaster and "stretching" out the air trapped inside. If you think of the trapped air as a spring, when you stretch it out it is going to try and return to its original size. The only way it can do that is by drawing water up inside the blaster.



INSPIRING THE INVENTIVE GENIUS IN EVERYONE

The Museum of Science and Industry, Chicago (MSI) offers thousands of fun and interactive exhibits and one-of-a-kind, world-class experiences to inspire the inventive genius in everyone. Come visit and find your inspiration! MSI is open every day except Thanksgiving and Christmas Day, and summer hours are 9:30 a.m. to 5:30 p.m. every day. The Museum is supported in part through the generosity of the people of Chicago through the Chicago Park District. For more information, find MSI online at msichicago.org or call (773) 684-1414 or (800) GO-TO-MSI outside of the Chicago area.

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Illustrations by Alison Neidt Toonen.