

Gadgets and Contraptions: Science for 3–5 year-olds



We gratefully acknowledge the financial support of the Province of British Columbia through the Ministry of Education.

CAREGIVERS, PARENTS AND PRESCHOOL EDUCATORS provide many creative opportunities for young children to explore their world. That's why we've created *Big Science for Little Hands*, an evolving suite of science resources for teachers and caregivers of 3- to 5-year-old children. Our aim is to develop activities that inspire further exploration and discovery. We hope that these resource materials complement what you are already doing and offer additional ideas to inspire further exploration.

The activities have been designed for experiential learning. The intent is for children to experience each concept, rather than simply talking about it. Each activity can serve as a starting point for further exploration.

The activities are divided into the following categories.

Introductions—These could be used to set the stage for the topic, or to find out how much the children already know. They're low-preparation, low-mess activities for a large group to do together.

Explorations—These require a bit more set-up and clean-up. They work best with small groups of children. They're intended to be open-ended, with a teacher or other adult available to pose questions and expand the activity as required.

Make This—These explorations result in a product that children can take home or display.

All Together—This big whole-group activity would make a great wrap-up to the topic.

Connections—Ideas for extending the topic in cross-curricular ways.

You know your group best! There is no perfect way to order or arrange these activities. They can be combined to spend an entire day on one theme, or used one at a time over several weeks. Please pick and choose, expand or contract as makes sense for your group of children.



Find all these resource packages online:
scienceworld.ca/preschool

Science World British Columbia
TELUS World of Science 1455 Quebec Street, Vancouver, BC Canada V6A 3Z7
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Topics Now Available:

Round the Circle

Activities to explore round things and things that roll.

Wet & Dry

Activities to explore being wet and dry.

Sticky Stuff

Activities to explore stuff that sticks.

Size Matters

Activities to explore things that get bigger and things that get smaller.

Mysterious Mixtures

Activities to explore dissolving, separating, mixing and combining.

Super Sleuths

Activities to practice science process skills such as observing, comparing and contrasting and using tools like magnifiers.

Reflections & Shadows

Activities to explore light, mirrors, reflection and shadows.

Amazing Me

Discover the amazing things your body can do, both inside and out.

The Air Up There

Activities to explore wind and air.

Gadgets & Contraptions

Explore simple machines and how they work.

Gadgets and Contraptions

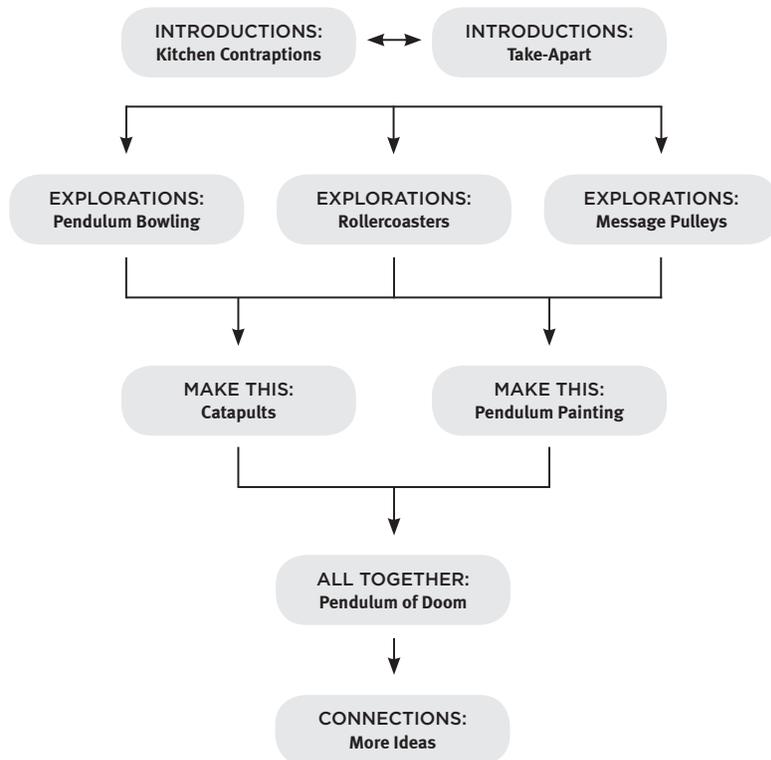


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A Path Through *Gadgets and Contraptions*

Here's one possible way to put the activities in this resource together.

- Do one or two *Introductions* at circle time in a large group.
- Have the children work on *Explorations* and *Make This* activities in smaller groups at stations around the room.
- Try *All Together* just before the end of the school day, or at the end of working on the topic.



Big Science for Little Hands supports the learning goals outlined in the British Columbia Early Learning Framework, particularly those in the area of Exploration and Creativity.

To promote exploration and creativity, adults provide an environment where young children can do the following:

- explore the world using their bodies and all their senses
- build, create and design using different materials and techniques
- actively explore, think and reason
- identify and try possible solutions to problems in meaningful contexts and situations
- be creative and expressive in various ways
- develop a sense of wonder for natural environments
- express a zest for living and learning

(BC Early Learning Framework: bcd.gov.bc.ca/early_learning/)

Share with us!

Please send us your feedback, suggestions and ideas.

Email bslh@scienceworld.ca or visit scienceworld.ca/preschool and fill in an online survey.

Thank you to the children and families around British Columbia who assisted with the testing of the activities in this package. Thank you to The Vancouver Public Library and the staff at Kidsbooks for recommending many wonderful children's stories.

Gadgets and Contraptions: Introductions



Kitchen Contraptions

Your home is full of gadgets and contraptions, many of which can be found in your kitchen. We use these gadgets everyday to help make our lives a little easier.

What you need

- Magnifying glasses
- Chopsticks, tongs, tweezers
- Whisk
- Garlic press, potato masher
- Can opener
- Turkey baster, droppers
- Ice cream scoop

Hands-on

1. Have the gadgets on a tray and covered with a cloth.
2. Bring out a gadget; try to guess what it might be used for.
3. Pass the gadget around and look at it using magnifying glasses.
4. Repeat with the other gadgets.

Questions to ask

What do you think we use this for?
How do we work it?
How does it make our job easier?

What next?

Have a few of each type of tool and compare them. For example:

How are two or three ice cream scoops the same? How are they different?

Ask children to look for contraptions in their own kitchens and bring in some examples.

Use the kitchen tools to make art. Drip paint with the turkey baster, make prints with the potato masher, etc.

Put basters and droppers in a water table to give children more opportunity to explore them.

Challenge your dexterity. Use tweezers, tongs, chopsticks, etc. to move small objects such as pompoms from one container to another.

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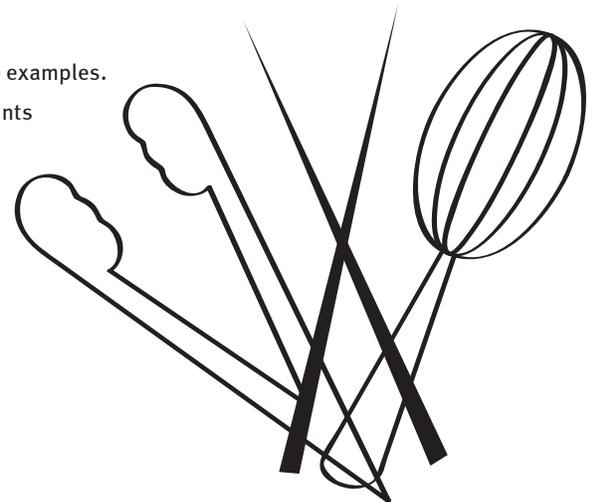
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Gadgets and Contraptions: Introductions



Take-Apart

Taking apart machines provides great insight into their inner workings. We use so many gadgets and machines every day, but often we don't know what makes them work. Opening the machine up allows us to see all the different parts and understand a little more about how they work.

What you need

- Old/used toasters
- Hair dryers
- Telephones
- Clocks with large gears
- Screwdrivers and other hand tools
- Book *The Way Things Work* David Macaulay, or website howstuffworks.com
- Camera (optional)

Hint: Value Village or thrift stores are good places to purchase older appliances

Hands-on

1. Examine the outside of the appliance. If possible, try turning it on.
2. Draw or describe the machine and how it works.
3. Remove the outer casing of the appliance using a screwdriver. Start by loosening the screws and let the children unscrew them the rest of the way. Record the process of disassembly with a camera, drawings or video.
4. Examine the inside of the machine and guess what each part does.
5. Repeat with another appliance of the same type.
6. Repeat with other types of appliances.

Hint: Practice taking apart the appliances beforehand and loosen all the screws.

Avoid appliances that are highly digital/computerized – there's not much to "see" inside.

Questions to ask

- What does this appliance do? How does it work? What happens when it is turned on?
What do you think is inside this machine?
Which part of the toaster heats up and darkens the bread?
How does the toast pop back up?
Which part of the hair dryer moves the air? Which parts make the air hot?
Tell me the story of this machine.
What is the same about our two toasters or two hairdryers? What's different about them?
What is similar between a toaster and a hairdryer?

What next?

Try reassembling the toaster!

Try taking apart other common machines, such as pendulum clocks, telephones, radios and fans.

Machine art: use the appliance parts to make imprints in clay, to make rubbings using crayons and paper, and as stamps using paint.

Use parts of the appliances to create something new! For example, allow the students to craft sculptures or "inventions" using the appliance pieces.

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••••• Safety Notes:

Children must be supervised at all times. Some appliances will contain sharp pieces. Avoid taking apart televisions and large screens, which can store charge and pose a shock risk. Remove batteries before giving appliances to children. Once an appliance has been taken apart, do not use again.

Gadgets and Contraptions: Explorations



Pendulum Bowling

A pendulum is simply a weight hanging from a string. The path a pendulum takes as it swings back and forth is an arc.

What you need

- Two chairs, two tables or a doorway
- Wooden dowel or long ruler
- Masking tape
- String
- Wiffle balls or ping pong balls
- Several large metal washers
- Several clean, empty 500mL water bottles

Hands-on

1. Set up the chairs or tables with the wooden dowel bridging the gap between them. Tape down the ends of the dowel to secure it. Alternatively, hang the dowel across a doorway.
2. Tie several pieces of string of varying lengths to the dowel.
3. To the hanging end of the strings, securely tie:
 - a. a wiffle ball (or tape a ping pong ball),
 - b. a single washer
 - c. several washersYou should have a series of pendulums with varying lengths of strings and varying weights.
4. Set up the water bottles on one side of the dowel to act as bowling pins. Set up at several different distances.
5. Try to knock over the bottles by pulling back the pendulums and letting go.

Questions to ask

- Can you knock over the bottles with the pendulums?
- Which bottles are harder to knock down? Why?
- Which pendulums are more successful at knocking down the bottles?
- What did you have to do to knock all the bottles down?

What next?

- Fill some of the bottles with small amounts of water for an additional challenge.
- Competition — keep score as children take turns with the bowling to see who can knock down the bottles with the fewest number of swings.
- Replace the washers with a small bucket or film canister. Encourage children to alter the weight of the pendulum by adding/removing pennies from the bucket.

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Gadgets and Contraptions: Explorations



Rollercoasters

Rolling things down ramps and tracks encourages children to explore gravity (the force that pulls things down), friction (the resistance encountered by a moving object), momentum (how hard it is to stop something), and lots more!

What you need

- Foam pipe insulation, cove moulding, hot wheels tracks, cardboard and plastic tubes, etc.
- Masking tape
- Variety of balls (ping pong, golf, etc.)
- Other objects e.g. toy cars, blocks

Hands-on

1. Cut the foam insulation in half, lengthwise, to create 2 tracks.
2. Set up a basic track (Tape one end to a table or chair or lean it on a few blocks).
3. Explore! Try rolling some of the balls down the track, encouraging the children to observe which objects roll easily, how fast and how far they go.
4. Add, subtract and modify the track to create more complicated 'coasters.

Questions to ask

- Can you get these objects to roll down the track?
- Which objects roll down faster? How come?
- How can we change our track? Can we make the balls go farther?
- Can you make your track curve?
- What happens if our track is too steep?

What next?

- Roll objects side-by-side on two tracks to compare them e.g. golf ball and ping pong ball.
- Compare different starting heights for the track e.g. a table vs. a chair.
- Use stools or boxes to create "hills" for the track to go over and under.
- Try making the track turn a corner.
- Put all the tracks together to form one giant roller coaster for the whole class.
- Divide the children into groups and try racing their roller coasters.

Notes for next time

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Gadgets and Contraptions: Explorations



Message Pulleys

A pulley is a simple machine made from a wheel and cord. The cord moves through the pulley to change the direction of a pulling force (e.g. lift heavy objects UP by pulling DOWN, move objects LEFT by pulling RIGHT).

What you need

- 2 chairs, tables or 2 door handles
- 2 pulleys or rollers from a hardware store
- String or ribbon in 2 different colours
- Clothes pins
- Pieces of cardstock
- Markers or crayons
- Plastic cups
- Paperclips
- Pennies, variety of small plastic animals or other toys

Hands-on

1. Set up two pulleys, one at either side of a room (about 2-4 metres apart), and attach firmly to the chairs/tables/door handles.
2. Tie together equal lengths of the 2 different coloured strings. Each piece of string must be long enough to reach between the two pulleys, with a bit extra. Thread the string from one pulley to the other and back, and then tie it to make a continuous loop.
3. Draw messages and pictures on the card. Clip these to the string using the clothespins and work the pulley to send them to the other side of the room.
4. Pull the opposite string (the one without the message attached) towards you, to make the message move away. Use the different coloured strings to emphasize this difference.
5. Construct a bucket using the plastic cups and string. Use a paperclip to easily hook the bucket on and off the string. Send items across the message pulley in the bucket.

Questions to ask

Can you send your message to the other end of the string?

Which direction do you pull the string to make the message move to the other end? Hint: Putting a small piece of coloured tape on the string may help children visualize which direction the string is moving.

Why do we pull the opposite direction to where we want our message to go?

How many pennies can you send in the bucket?

What happens if you put too many pennies in?

What next?

Try creating a "landscape" for the children to send messages and items across e.g. over a river, between two castles.

Make a giant pulley system outside in the playground or between 2 trees. Use it to transfer bigger items.

Set up a vertical pulley to lift heavy objects up by pulling down.

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Gadgets and Contraptions: Make This



Catapults

A catapult is a lever, a stick or beam propped up by a fulcrum (a pivoting point). A lever will magnify the force you put on it if the fulcrum (the pivoting point) is closer to your force than it is to the load. The catapult magnifies your force to throw a pompom. The larger the force, the farther the pompom goes.

What you need

- A lever arm (e.g. wooden ruler or jumbo popsicle stick)
- A round fulcrum (e.g. spool of thread or fat marker)
- Elastic bands
- Plastic spoons
- Chalk or masking tape
- A load (e.g. pompoms)

Hands on

1. Assemble the catapults ahead of time.
2. Create "target zones" on the ground or a table using chalk or tape, based on your catapult's range.
3. Demonstrate how to load and launch the catapults.
4. Encourage children to try them out.
5. Try adjusting the force you use with the catapults to fire the pompoms different distances into different zones (e.g. push gently to move the load a short distance, push hard for a longer distance).

Questions to ask

Can you get your pompom to the target/across the "water"?
How can you change the distance the pompom travels?
Where should the pivot point (fulcrum) be positioned to make the pompom travel the shortest distance?

What next?

For younger children, set up the fulcrums of several catapults, each in a different position. Which catapult flings the pompom farther?

For older children, challenge them to adjust the location of the fulcrum themselves and see how it affects the distance the load travels. Hint: Set up the catapult with the fulcrum positioned so that it is least efficient at the start of the exploration to encourage children to adjust it.

Theme the target zones, such as water with alligators or castles with guards. Add boxes or buckets to aim for.

Competition – who can make their pompom travel the furthest?

Have children design and decorate their own catapult.

Learn about the history of the catapult and trebuchet.

Explore teeter-totters and other levers in your neighbourhood.

Build a giant catapult outdoors and launch water balloons or pumpkins.

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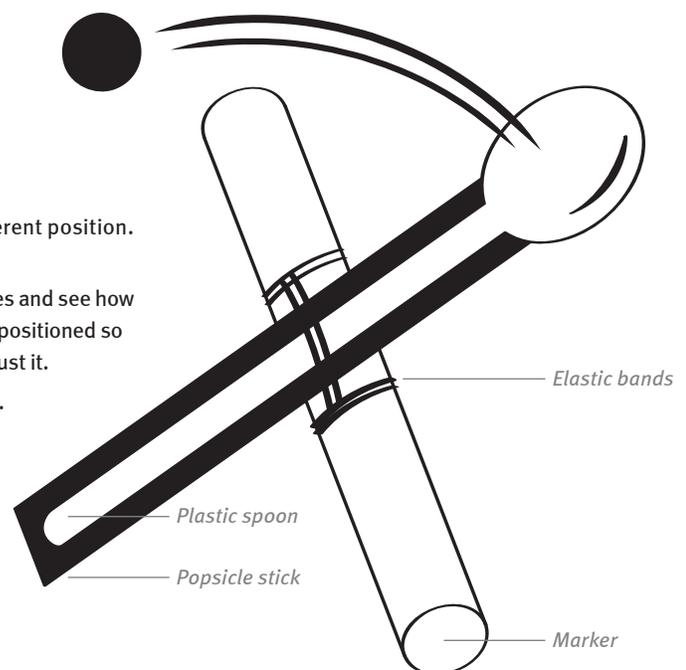
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Gadgets and Contraptions: Make This



Pendulum Painting

Use a swinging pendulum to create art! As a pendulum swings, it follows an elliptical path. The paint allows children to see the path the pendulum is following, and experiment with how they can alter this.

What you need

- 2 chairs, 2 tables or a doorway
- Long ruler or wooden dowel
- Masking tape, string, paperclips, scissors
- Thin cardstock rolled into cones and secured with tape
- Paint (thinned out with water to get a good dripping consistency)
- Large sheets of paper
- Large plastic sheet, newspaper or a few garbage bags

Hands-on

1. Set up the chairs or tables with the wooden dowel bridging the gap between them.
2. Tape down the ends of the dowel to secure it.
3. Tie a piece of string to the dowel and attach a paperclip "hook" onto the free end.
4. Spread out the plastic sheet beneath the pendulum and put a large sheet of paper on top.
5. Prepare several cones using the thin cardstock. The cone should be closed at the point. Punch three or four holes in the sides of the cone, near the top, and thread some string through.
6. Add some paint to the cone and hook the cone onto the pendulum.
7. Demonstrate how to swing the pendulum, then snip the tip off the cone.
8. Have the children swing the pendulum back and forth, and around and about. The path of the pendulum will appear on the paper in paint drips. Hint: Do a practice painting first to make sure the consistency of the paint and the size of hole you snip in the cone are appropriate.

Questions to ask

What pattern is the pendulum making? What does our painting look like?
What happens if you don't stop the pendulum? Why are our paint lines/loops getting smaller?
What happens if you swing the pendulum gently? More forcefully?
How can you make a shape that's rounder? Skinnier?

What next?

When the paint dries, look at the different patterns. What can you tell about the movement of the pendulum from the pattern?

In place of the cones, using a bottle with an adjustable opening, (such as a hair dye bottle) will allow greater control over the flow of paint.

Try doing pendulum paintings with different lengths of string and compare.

Instead of paint, try using coloured sand in its place. Cover the paper with glue prior to releasing the sand if you want the pattern to be permanent.

Tie a paint brush to a string and swing it over paper as a pendulum to create art.

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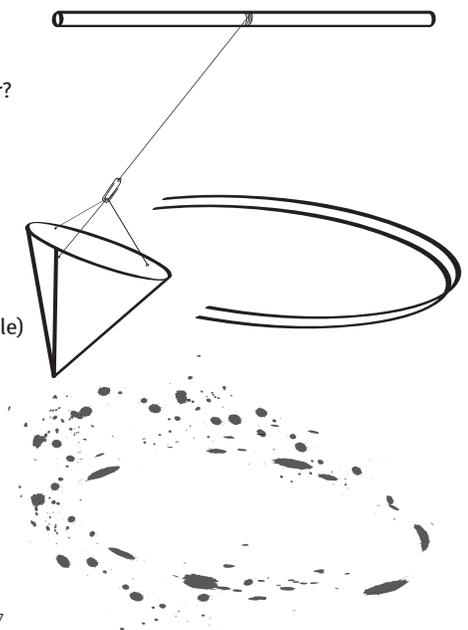
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Gadgets and Contraptions: All Together



Pendulum of Doom

When we lift a pendulum, we transfer energy to it. This energy allows it to swing back and forth when we let it go. If we don't add any more energy, the ball will swing less and less until it finally stops. The arc of the pendulum will never be longer than the first arc when we let the ball go. It is this "conservation of energy" which means that the pendulum of doom will come close, but never actually hit you!

What you need

- Large soft ball with handle (e.g. a dog toy from a pet store such as Softflex Best Ball Gripper)
- Length of rope (enough to reach from the ceiling to the floor)
- Masking tape

Hands on

1. Tie one end of the rope to the ball.
2. Tie the other end of the rope to a secure point in the ceiling (e.g. a light fixture or hook) so that the ball hangs about 60cm off the floor. The ball must be able to swing freely.
3. Demonstrate that this is a pendulum, just like the ones they have already experimented with, by swinging the ball back and forth.
4. Make a line on the floor where you are standing using the masking tape.
5. Keeping the rope taut, pull the ball up to just in front of your face. Let go and don't move!
6. Repeat step 5, inviting a child to stand behind the line. Bring the ball up to their face and let go, making sure they don't move.
7. Allow others to have a turn, one at a time.

Questions to ask

- What will happen when we let go of the ball?
- What will happen if we leave the ball swinging?
- Do you think the ball will come back and hit me?
- Why won't the ball swing any further?

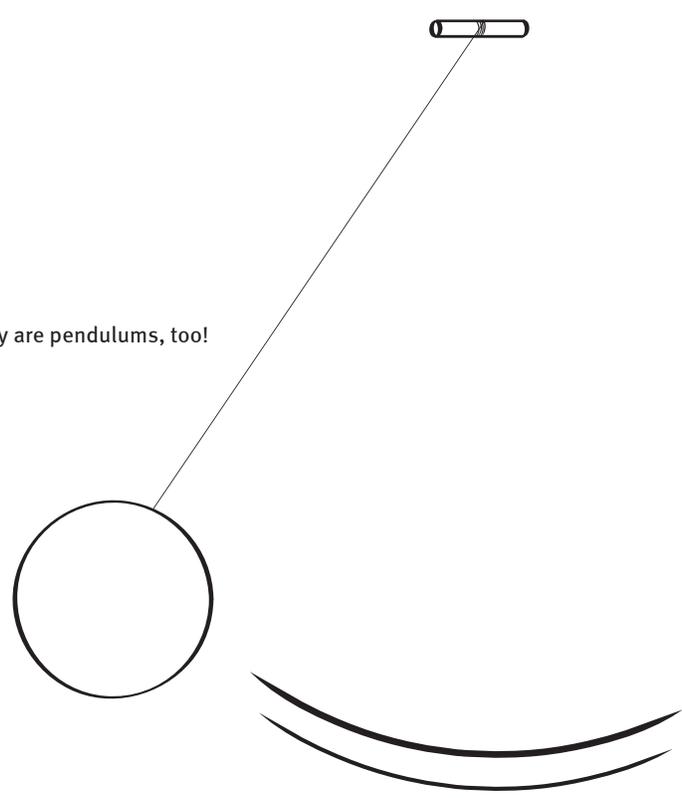
What next?

In the playground, investigate different kinds of swings – they are pendulums, too!

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Gadgets and Contraptions: Connections



More Ideas

Gadget and Contraptions Songs, Rhymes and Circle Games:

- Button Factory
- Hickory Dickory Dock
- Down by the Station
- The Wheels on the Bus
- I've Been Working on the Railroad
- I'm a Little Tea Pot

Gadget Snacks:

- Eat snacks using chopsticks, tongs, etc.
- Snacks like pretzels and raisins can be weighed out into equal portions for each student using a simple balance/scale.
- "Deliver snacks from one end of the room to the other using your message pulleys.

Children's books about Gadgets and Contraptions:

- *Mechanimals* by Chris Tougas 🍁
- *Monsters on Machines* by Deb Lund
- *Wendel's Workshop* by Chris Riddell
- *Tool Book* by Gail Gibbons
- *Not a Box* by Antoinette Portis
- *The Dragon Machine* and *The Tin Forest*, both by Helen Ward and Wayne Anderson
- *Lights Out*, *Pigs from A to Z*, and *Oops*, all by Arthur Geisert
- *Inclined Planes* and *Pulleys*, both by Michael Dahl (series from Bridgestone Books)
- *Using Ramps and Wedges* and *Using Levers*, both by Wendy Sadler (series from Raintree)
- *Ways to Join it!* by Henry Pluckrose

Resources for Teachers:

- *How stuff works* <http://www.howstuffworks.com/>
- *The Way Things Work* by David Macaulay
- *Science Arts* and *Preschool Art* both by MaryAnn Kohl
- *Deconstructed* <http://science.discovery.com/tv/deconstructed/deconstructed.html>
- *The Preschool Scientist* by Robert Williams, Elizabeth Sherwood, Robert Rockwell, David Winnett
- *Science in Seconds for Kids* by Jean Potter
- *Sandbox Scientist* by Michael Ross
- *Raceways: having fun with balls and tracks* by Bernie Zubrowski
- *Spotlight on Teaching Preschoolers 2* Derry Koralek, editor. An NAEYC publication
- *Marvelous Moving Things* Mickey Sarquis, editor

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