Northern Territory Preschool
Engineering Games

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THE UNIVERSITY OF MELBOURNE
GRADUATE SCHOOLS
MELBOURNE GRADUATE SCHOOL OF EDUCATION
Shaping minds, shaping the world

NORTHERN TERRITORY GOVERNMENT

The Northern Territory Government
Department of Education commissioned
the University of Melbourne to undertake this work.
An electronic copy may be downloaded from the website
of the Department of Education. www.education.nt.gov.au
How to cite this book: Hill, G., Guarrella, C., & Cohrssen, C. (2019).
Northern Territory Preschool Engineering Games,
Northern Territory Department of Education, Darwin, Australia.

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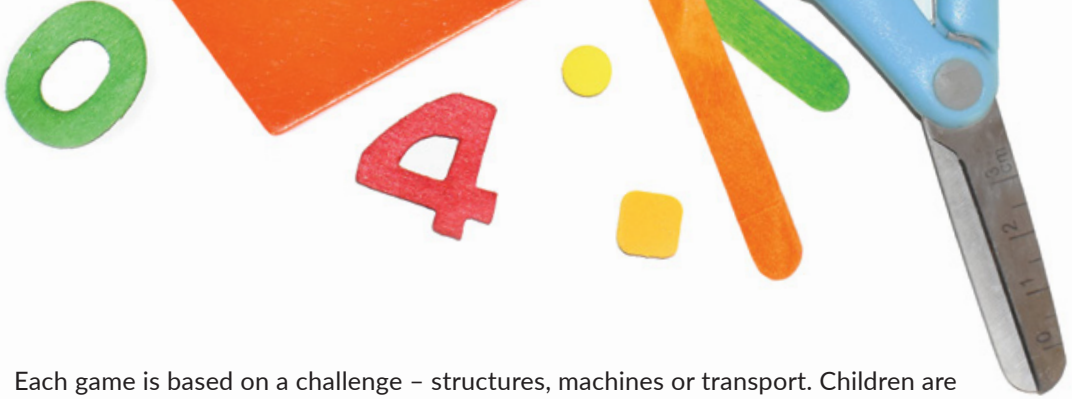


The NT Preschool Engineering Games have been developed by the University of Melbourne to support the implementation of the Northern Territory Preschool Curriculum. The games take the form of playful challenges and are designed to prioritise children's developing innovative, transferable, engineering and thinking skills. In these games, challenges are suggested that are authentic to children. However, teachers are encouraged to adapt the games to better suit their preschool contexts; it is important for teachers to focus on the engineering skills (the learning objectives) rather than the end product.

Almost everything we use in our everyday lives that does not derive from the natural world, has relied on engineering skills in its development and design. In fact, children's first intuitive and innate interactions with their environments that are designed to improve the way they achieve results, are early evidence of engineering thinking.

Engineering draws on creativity and innovation, as well as the application of scientific and mathematical thinking, to find ways to improve people's lives. Engineering starts with what we know already and what we would like to do differently, and is therefore context-specific.

Open-ended play suggestions will help you to introduce new concepts. The games are intended to be fun for children and easy to use for teachers. They focus on encouraging active participation, innovative thinking and reasoning, and back-and-forth conversations. The games are designed for use with individuals and small and large groups, acknowledging that play expands thinking. High-level thinking skills are encouraged during interactions with peers and adults.

The games use everyday materials typically found in 'Makerspaces'. This helps preschool teachers identify learning aims for Makerspace activities. Photographing children's constructions is encouraged, so that materials can be returned to the Makerspace to be reused. Opportunities are also set up for reuse, reduce and recycle conversations.

Each game is based on a challenge – structures, machines or transport. Children are encouraged to problem-solve solutions to the challenges in a systematic, collaborative and playful way; to plan, create, refine and reflect – this supports creative thinking, innovation, perseverance and problem-solving. These are key components of engineering. They also support the development of 21st Century skills. A final 'mega challenge' invites the children to draw on all their learning in the preceding games. Be sure to have used all of the other challenges before you attempt the mega challenge with the children! You may even choose to build up to it over several weeks.

Important words to model are provided. You may wish to print each word (and its meaning) on a card and laminate it. Then, the new words can be placed near the games. If children use gestures instead of words to explain their ideas, assist them by providing the new words. Explicit learning objectives assist educators to assess child learning, recognising that children demonstrate understanding in different ways. Extension, drop-back and open-ended play ideas are provided for each game. If you have co-teachers in your room, be sure to discuss the games together prior to using them.

The games strengthen opportunities for preschool teachers to respond to the knowledge, reasoning and language that children demonstrate as they transition into school, to plan for current and future learning, and thus to enact the planning cycle. The games also provide opportunities to apply mathematical and scientific thinking and support communication and language skills. Resist the urge to solve the children's problems for them – instead allow time and provide support to help them to work out the solution for themselves! Allow plenty of time for discussion.

Finally, observe what the children say and do, as well as whether they work individually, in pairs or in small groups. Noticing this will help you plan other learning experiences for each child. Have fun!

Department of Education. (2013). Northern Territory LearningGames®. Darwin, NT, Department of Education.

Contents

Design a solution together

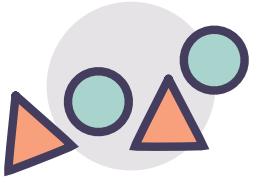
Each game is based on a challenge. Children are encouraged to problem-solve solutions to the challenges in a systematic, collaborative and playful way to think, plan, create, test and reflect. This supports creative thinking, innovation, perseverance and problem-solving. These are key components of engineering.

1. Think

5. Reflect

2. Plan

4. Test



3. Create

Moving cedar balls

Group size: Two or more children

The challenge

We need to transfer cedar balls across the wall from one container to another container, without any cedar balls touching the floor. How can we move the cedar balls from one container to the other container, using the materials provided?

Setting the scene

1. Place a container of cedar balls in one corner of the room on the floor. Place an empty container in another corner (close to the wall).
2. Invite two or more children to join the play. Introduce the challenge. Show the children the materials available to them to use.
3. Ask the children to suggest ways to transport the cedar balls from one container to the other, without carrying them or letting the cedar balls touch the ground, guiding children to focus on design ideas that are likely to be effective. You may need to start the discussion with a suggestion.

Big ideas

Gravity is an invisible force that acts on an object without touching it. Things that are near the Earth are pulled towards the Earth by gravity (unless something is holding them in place). This stops them floating away. Gradient describes how much a line or a surface has moved away from being horizontal. Children are invited to think about how they can use gravity and gradients to create speed and movement.

Open-ended play

Include different sized cardboard tubes in the Makerspace, along with various objects that fit inside the tubes. In addition, provide materials that allow children to experiment with ways to connect the tubes, such as Blu Tac, play dough, masking tape, a hole punch and string.

In the outdoor area, provide cedar balls, cardboard tubes and boxes or wooden planks. Encourage children to find new ways to make the balls move faster or slower down the planks or through the boxes.

You will need

- A blank section of wall
- A container of cedar balls/ wooden beads/marbles (or anything else that rolls)
- An empty container (to catch the cedar balls)
- Different sized cardboard tubes – paper towel rolls/ inner tubes from gift wrapping paper/postage tubes (the kind used for posters)
- Thick paper/card (that can be rolled into cylinders)
- Masking tape

Learning objectives

For the children to:

- Volunteer and discuss ideas about how to move the cedar balls
- Test their ideas and make changes to their design, as needed
- Discuss what made the cedar balls move quickly
- Discuss what made the cedar balls move slowly (or stop moving)
- Discuss how the construction was improved

Important words to use

Design, transport, gradient, gravity, speed, movement, cylinder, horizontal, flat, vertical, steep, roll, fast and slow.

Moving cedar balls

New words

- ***Gravity*** *– is an invisible force that acts on an object without touching it. The gravity of Earth pulls objects towards the ground we stand on, so we (and other things!) don't float away.*
- ***Gradient –*** *describes how much a line, or a surface, has moved away from being horizontal*
- ***Speed –*** *measures how slow or fast an object is moving.*

Design a solution together

Think Encourage the children to think of different ways to use the tubes, card and tape to move the cedar balls across the wall to the other basket. Together, make predictions about how the position or gradient of the tube may change the way the cedar balls move through it. Ask questions such as, 'What happens to the cedar ball if the tube is flat on the floor? Why?'

Plan Discuss a plan with the children. Write down or draw their ideas. Discuss where they will start building and how they will know that the design is working. Discuss how the materials you have provided will be used in the construction. Encourage the children to think of ways to use the paper. Does the form of the paper need to be changed to prevent the cedar balls falling out?

Create The children use the materials to build a cedar ball run. While the children work on the solution, ask, 'How can the cardboard tubes be arranged to make the cedar balls move further (or faster)?' and, 'Do the cardboard tubes need to connect to each other, or can there be gaps between them?' Children may move back and forth between the 'create' and 'test' phases.

** Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test The children test the construction by rolling cedar balls from one container to the other. Do the cedar balls cross the wall from one container to the other? If not, how can the design be improved? Encourage the children to explain their reasoning.

Reflect When all the cedar balls have been successfully moved from one container to the other, invite the children to sit in a group with you. Discuss the challenges in moving the cedar balls. Encourage children to volunteer ideas about how gravity and gradients affected the speed and direction of the cedar balls. Remind children of their original plans and discuss how the final construction compares with the original plans. Remind the children to return the materials they used to the Makerspace. The photographs will remind them of their great work!

Drop back ideas

1. *Invite children to experiment with connecting different cardboard tubes to see how different objects move through them.*
2. *Using toy cars and two long cylinders, children can race their cars through the 'tunnels', adjusting the gradient to see how this affects the speed of the cars.*

Extension ideas

1. *Using towers of blocks, raise one end of the tube to increase the gradient. How does the gradient of the tube affect the distance travelled by the cedar balls?*[1]
2. *Cut the paper tubes to shorter lengths, to test how this affects the track. Remember to ask children to suggest ideas about what may happen before they test out the shorter tubes. After, reflect on whether their ideas were successful.*
3. *Increase the gaps between the tubes. Ask children to suggest ideas about what may happen before they test this out. Afterwards, reflect on whether their ideas were successful.*
4. *Discuss the gradient of the downpipes on the outside of the school building. Why are they there? Why are they designed that way? What would happen to the water if the downpipes were horizontal? Where else in the environment do we see pipes that are used to convey something?*

[1] *Links with NT Preschool Science Game, 'Cars and ramps' and with NT Preschool Maths Game, 'Lengths: Comparing how long things are'.*

Water, water, here to there

Group size: Small groups

The challenge

You have built a dam in the sand pit. In this game, you should transport water from a tap (or a pool) to the sand pit to fill your dam without the water spilling while you move it or leaking out of the dam. (You do not have a hose pipe!)

Setting the scene

1. Invite a small group of children to join in. Introduce the challenge. Show the children the materials available to them to use.
2. There is a tap nearby. The challenge is to work out a way to transport water from the tap to the dam in the sand pit without spilling it. (Avoid providing buckets and other 'obvious' containers as the goal is to encourage children to think creatively.)

Big ideas

Water is a natural resource that plants and animals need to live. Water can be used up. It is important not to waste it. Water is transported from rivers and dams to taps inside and outside buildings, but often we need to transport water from a tap to the place it will be used without spilling it.

This is an opportunity to invite a community elder to visit your preschool and explain traditional methods of storing and transporting water.

Open-ended play

Provide a range of containers and materials in a water play area. Invite children to explore concepts of capacity and volume. Encourage the children to observe and describe how different materials (paper, plastic, fabric, a sponge) react to water.

Provide toy dump trucks, wagons or dolls prams to encourage children to explore how these can assist in transporting things from one location to another.

You will need

- A tea towel
- A few sheets of A3-sized card or paper
- Rope or string of differing lengths
- A plastic bag, a waterproof table cloth or a tarpaulin
- Several large sponges
- Containers of differing sizes
- A water source (a tap or a pool)

Learning objectives

For the children to:

- Predict which materials will best hold water
- Think creatively about their design
- Share and try out their ideas
- Refine their ideas, making changes as needed
- Discuss what worked, what didn't work, what was challenging and what could be improved

Important words to use

Waterproof, leak, transport, capacity and volume.

Water, water, here to there

Design a solution together

Think Encourage the children to describe ways to transport water from the tap to the sand pit. Encourage the children to consider challenges they may experience. How will they overcome these challenges?

Plan Ask the children to think about how they have seen water transported. Ask questions such as, what do they notice about the materials used to carry water and what do they notice about the shape of objects used to carry water (such as buckets, watering cans and cups).

Create Lay out the materials you have gathered for the children to use. Discuss the different materials. What do they look like? How do they feel? Will all the materials hold water? How do the children know this? Encourage the children to volunteer ideas about how the materials could be used to transport water to the sand pit. The children may choose to draw their designs. Encourage the children to explain their designs. Children may move back and forth between the 'create' and 'test' phases.

** Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test The children create their water carriers, using the materials provided. Encourage the children to test their water carriers. Ask questions such as, 'Is any water being wasted?', 'Do you need to change your design?', 'What other materials would be helpful to transport the water?'

Reflect When the dam has been filled, invite the children to sit with you. Together, reflect on which water transportation method worked, which didn't work and the reasons for each. Remind the children to return the materials they used to the Makerspace. The photographs will remind them of their great work!

New words

- ***Capacity*** *– of a container describes how much space it has to hold something like water or sand.*
- ***Volume*** *– of a container describes how much a container actually holds.*
- ***Transport (v.)*** *– means to take or carry people or goods from one place to another.*

Drop back ideas

1. *Invite children to explore ways to carry water shorter distances.*
2. *Water and sand play exploring volume and capacity, using different sized containers to transport water to the sand pit.*[1]

[1] *Links with NT Preschool Maths Games, 'Capacity and volume: Water play' and to NT Preschool Science Games, 'Watering plants'.*

Extension ideas

1. *Prior to constructing the water carrier, invite children to draw or write their plans. Encourage them to discuss the similarities and differences between the plan and the water transportation method. Encourage the children to explain why they refined their plans.*
2. *Challenge children to transport the water as quickly as possible. What is the quickest way to transport water, and why?*
3. *Challenge children to waste as little water as possible. Which method for transporting water wasted the least, and why?*
4. *Include a transportation method that has wheels, for example, a dump truck or a wagon. How does this affect water transportation?*

Boats afloat

Group size: Individual, pairs or small groups

The challenge

It is the wet season and rain has flooded the creek. The Northern Brown Bandicoot* cannot make it across the water to collect food from the berry tree. Can you make a boat to help the bandicoot make it to the other side of the flooded creek and safely avoid predators?

** Change this animal to make the challenge relevant to your local area.*

Setting the scene

This learning experience is suited to the outdoors – you may get wet!

1. Prepare the Makerspace with materials to make boats. Use fabric to represent the flooded creek and place the toy Northern Brown Bandicoot and the berry tree on either side of the creek. Invite the children to the Makerspace.
2. Introduce the challenge to the children. Show the children how the Northern Brown Bandicoot is separated from the berry tree by the flooded creek. Ask the children to think of a way to use the materials from the Makerspace to help the Northern Brown Bandicoot reach the berry tree.
3. Once children have designed a boat that floats, the focus shifts to how the boat moves. Paddles, sails, propellers and motors can be used to push a boat forward.

Big ideas

Boats are designed to float on top of the water. They are 'buoyant'. Boats provide a way of travelling on water and of transporting goods on water. The force of the water pushing up against the bottom of the boat keeps the boat on top of the water. When people or objects are on a boat, they create a downward force on the water. If the downward force is stronger than the upward force of the water, the boat will sink.[1]

[1] *Links with NT Preschool Science Game, 'Sink and float'.*

Open-ended play

Find pictures of different forms of water transport in books and on the internet. Place these images around the water play area. Collect different boats and place in a large tub of water. As the children play, identify the different features of the boats and make comparisons between their similarities and differences.

You will need

- A range of reusable materials including corks, plastic containers, foil and popsicle sticks
- Masking tape
- Scissors
- Paper on clipboards
- Markers or crayons
- A large tub containing just enough water to float small boats
- A plastic toy bandicoot or another small toy to place in the boat
- A piece of fabric
- A small pot plant or toy tree to represent the berry tree

Learning objectives

For the children to:

- Represent their plans in a drawing
- Use their plans to guide the design of a boat
- Test and refine the design of their boat to carry the bandicoot across the water

Important words to use

Float, sink, refine, test and transport.

Boats afloat

Design a solution together

Think Encourage the children to think of types of transport people use to move around. Then, help the children to think about the forms of transport people use on water. Ask the children, 'Would any of these forms of transport help the bandicoot get to the other side of the creek?' and, 'What could we build to help the bandicoot?'

Plan Provide each of the children with a clipboard, paper and a marker. Have the children draw a plan of what they are going to make to help the bandicoot. While the children draw, ask, 'Which materials are you going to use?' and, 'How will you make sure your boat does not sink?'

Create After the children choose materials from the Makerspace, help them to use their plans as models for their boat constructions. Point out features of their plans that you identify in their boats. Children may move back and forth between the 'create' and 'test' phases.

** Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test Gather the children around the large tub of water to test the design of their boats. The children take turns placing the bandicoot in their boats. If their boats sink, encourage the children to share ideas about why their boat sank. What did they notice happening when they put the bandicoot in their boat? How could the design be changed to make the boat float? Encourage children to take turns sharing and evaluating their ideas.

Reflect Once the children have finished making their boats, sit in a circle together. Have the children place their plan and their boat in front of them. Ask the children to talk about their plans and their boats. Prompt the children with questions like these: 'Does the boat you made match your plan?', 'Why are some of our boats different from our plans?', 'What did you need to change along the way?', 'Why did you make these changes?' Remind the children to return the materials they used to the Makerspace. The photographs will remind them of their great work!

New words

- ***Force*** *– is something that causes a change in the movement of an object, like a push or a pull.*
- ***Transport (n.)*** *– is a system for taking or carrying people or goods from place to place.*

Drop back idea

1. *Pour some water into a large tub. Provide the children with household goods that will float like a boat, for example, plastic bowls and plastic counting bears. As the children fill the plastic bowl with the counting bears, describe what the children are doing.*

Extension ideas

1. *Collect images of boats with sails. Discuss features of their designs with the children. Encourage the children to add a sail to their boats. Test the sails by blowing air towards them from the back of the boat.*
2. *Support the children to add propellers to their boats. To make a propeller you will need a thick rubber band, a popsicle stick and two pencils. Fix two pencils to the back of the boat. The pencils must stick out far enough so that the propeller does not hit the back of the boat when it spins. The pencils need to be parallel to each other and at least three centimetres apart. Tie the popsicle stick in the middle of the rubber band. Place the rubber band around the pencils. Twist the popsicle stick away from the boat and release it. This will propel it forwards.*

Here comes the sun (shade)

Group size: Two or more children

The challenge

People need a shady shelter to stay cool when they're outside in hot weather. Imagine that the teddy bears are people sitting in the sun. Use simple materials to make a sturdy shelter that stands up by itself. There must be enough room for all the teddy bears to shelter beneath it and be protected from the sun.

Setting the scene

1. First, talk with the children about the different types of shelters people need. Together, look for pictures of houses, garages, tents and other shelters in picture books, magazines or on a computer or an iPad.
2. Arrange the teddy bears in the sun, then invite two or more children to join the play. Start a conversation with the children about how we need shade to keep us cool when we are outdoors. How could we protect the teddy bears from the sun?
3. Guide the children to come up with the idea of building a shelter. Show the children the basket of materials they could use to build a shelter. The children could work together to design and build one shelter for all the teddy bears or separate shelters for each teddy bear. Many shelters will enable the children to compare how well each shelter works.

Big ideas

Building a stable structure requires children to explore how different materials and resources can be used alone or joined and then tested for stability. When a structure is stable, it won't topple over. If the centre of gravity of a structure is low and centred over the base, it is less likely to fall over.

The materials used to build a structure will determine whether it is able to resist pressure.

Open-ended play

Put a range of different materials such as sticks/twigs, masking tape, paper clips, bulldog clips, pegs, string, fabric, cardboard and paper into different baskets around the room. Avoid using 'wet' materials such as glue and paint, so that the materials can be reused.

Invite children to build anything they wish. Join in with their play, encouraging them to talk about what they are building. When they have finished building, invite them to take a photograph of their construction before returning the materials they used to the baskets, ready to be used again.

You will need

- Ten to 12 sticks of different shapes and sizes
- Rope, string of different lengths
- Two to three towels / pieces of fabric
- Masking tape
- Several teddy bears

Learning objectives

For the children to:

- Suggest different ways to build the shelter
- Try out their ideas
- Refine their ideas by adjusting their shelters
- Discuss what worked, what didn't work and what was challenging

Important words to use

Structure, stable, sturdy, strong, shade, build, join, attach, teamwork, easy, difficult and resistance.

Here comes the sun (shade)

Design a solution together

Think Remind the children that they are pretending that the teddy bears are people. Encourage the children to think of different ways to build a shelter. Ask questions, such as, 'How can we create shade for the teddy bears?', 'How can we join the materials together?', 'What will make the shelter stable?' and 'How can we make sure it doesn't fall over?'

Plan Discuss the pictures of shelters and the different materials available to use. Encourage ideas about how they could be used as part of the shelter design.

Create Encourage the children to create their shelters using the materials in the basket as well as any other fixed structures in the yard (such as poles or tree trunks). Children may move back and forth between the 'create' and 'test' phases.

** Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test When the children put the teddy bears inside the shelter, are all the teddy bears in shade? Are the shelters stable or do they wobble? How can the shelters be improved?

Reflect As each group finishes their shelter, talk about the experience with them. Or, discuss the shelters with all the children at group time. Ask questions such as, 'What was challenging about making the shelter?', 'How did you join the materials together?' 'How did you make the shelter stay upright?' 'Did the toys fit underneath the shade?' 'Did you work by yourself or with other children?' You may also like to share some of your observations of what the children said and did, and how you observed them overcoming challenges. Remind the children to return the materials they used to the Makerspace. The photographs will remind them of their great work!

New words

- ***Stability*** *– is the ability of a structure to stay upright. To be stable, the centre of gravity of the structure must be centred over the base of the structure.*
- ***Resistance*** *– is the ability of a structure to bear tension without breaking. The materials used to build the structure will determine its resistance.*

Drop back ideas

1. *Invite children to use play dough or clay, matchsticks and smaller pieces of fabric to build a shady shelter for smaller toys. This could happen indoors or outdoors.*
2. *Suggest children build a simpler structure for some toys using wooden blocks.*

Extension ideas

1. *Prior to building the shelter, ask children to draw a plan of what they are going to build. When they have built their shelters, encourage them to discuss the similarities and differences between the plan and the finished shelter. Encourage the children to explain why they refined their plans.*
2. *Leave the teddy bears under their shelter(s) all day. Look at them from time to time. Do they have shade all day? What can be done to the shelter(s) to make sure the teddy bears have shade all day?*
3. *Encourage children to build a stable structure using as few materials as possible.*
4. *First, remove the teddy bears so they don't get wet. Then, pour water from a watering can or spray water from a hose pipe onto the structure. Does it resist the pressure of the water? How would the design need to change to resist heavy rain?*

Moving through air

Group size: Two or more children

The challenge

The children have been noticing leaves falling from the trees at different speeds. They are interested in what makes some things fall quickly and some fall slowly. Can they design a way to help things fall slowly?

Setting the scene

1. Invite the children to join you in the Makerspace. Explain that you heard them talking about the falling leaves.
2. Hold a feather and a rock at the same height. Ask the children which one they think will move faster through the air? After they have made their predictions, drop the feather and the rock at the same time.
3. Introduce the challenge to the children and show them pictures of parachutes. Ask the children to think of ways to use materials from the Makerspace to make the rock fall more slowly.

Big ideas

When air pushes against an object to slow it down, a force called air resistance is created. Parachutes help to create more air resistance. This slows down the parachute, causing it to fall slowly.

Open-ended play

Provide a range of objects in the Makerspace for the children to drop from a height (a feather, a small stone, a tissue, a coin, some leaves). Join the children in their play and talk about the concept of air resistance together. Notice the differences between the objects as they fall through the air. Encourage the children to compare how fast or slow different objects move through the air.

You will need

- A range of fabrics of different thickness (calico, tissue, wrapping paper)
- Masking tape
- Scissors
- Ribbon or wool
- Plastic/paper cups
- A feather, a small rock or a small unbreakable object of their choice

Learning objectives

For the children to:

- Share their ideas about what parachutes are and how parachutes cause objects to move slowly through the air
- Suggest different ways to use the materials provided and design ideas
- Experiment with different ideas, persisting if things don't work out
- Reflect on the process of designing and creating a parachute

Important words to use

Fast, slow, air, movement, force and resistance.

Moving through air

Design a solution together

Think Discuss the process of making a parachute. Ask questions such as, 'What shape will your parachute be?', 'How big will the piece of material need to be?' and, 'Why does the material for the parachute need to be lightweight?'

Plan Using an iPad, a computer, books or magazines, research different parachute designs with the children. Be sure to look for different shapes and sizes. Ask questions such as, 'How will we connect the materials together?' and, 'How can we measure which parachute is moving the slowest through the air?' Write the children's ideas and questions on a large sheet of paper (or a white board). Encourage discussion and collaboration among the children by asking questions such as, 'Sara, what do you think about Max's idea?'

Create Encourage the children to construct their parachutes. Children may move back and forth between the 'create' and 'test' phases.

**Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test The test phase will likely be revisited many times. Ask questions such as, 'Does the design of your parachute slow down the movement of the rock through the air?' and, 'What changes can you make to slow down your rock even more?'

Consult Reflect on the design and construction process, and the successes and challenges of this experience. Ask questions such as, 'What was the hardest part of this challenge?' 'Would you do anything differently next time?', 'Did you have to change your design or plan along the way?' 'How did you do this?' Share some of your observations about what the children did or said during this process. Express admiration for the way they overcame the challenges and persevered until the work was done.

New words

- ***Force*** *– is something that causes a change in the movement of an object, like a push or a pull*
- ***Resistance*** *– is the ability of a structure to bear tension without breaking. The materials used to build the structure will determine its resistance.*

Drop back ideas

1. *Invite children to draw a parachute. They could use paper or a drawing application on an iPad. Encourage children to explain their designs to their peers.*
2. *On a windy day, open an umbrella outside. Support the children to move the umbrella through the air. Describe how their movement slows as air pushes against the umbrella.*

Extension ideas

1. *Invite the children to compare how effective their parachutes are. Agree on a starting height. How long does it take each parachute to reach the ground? (You could time this using a timer or by counting slowly.) What does this show about the design of the parachutes?*
2. *Investigate ways to reduce air resistance with the children. Design and make paper aeroplanes. Which design flies the furthest? Which design flies the fastest?*

You've got to move it, move it

Group size: Two or more children

The challenge

The children have decided to rearrange the indoor and outdoor areas. Now, they need to move all the wooden building blocks outdoors to a corner of the verandah. What is the most efficient way to transport these heavy blocks?

Setting the scene

1. During group time, explain to the children that you will all need to work together to move all the building blocks outdoors.
2. Invite the children who are interested in this challenge to meet in the block area for a planning meeting after group time.

Big ideas

Pushing or pulling an object involves the use of force. When force is applied, an object will move if the force is not resisted. Applying more force can make an object move faster. Wheels are often used when heavy objects must be transported. Wheels allow the surfaces of the object to roll rather than slide over each other.

Open-ended play

Place heavy objects in the sandpit to incorporate in children's play.

When heavy objects in the room need to be moved, invite children to suggest ways to move them without lifting the objects.

You will need

- Five to six large pieces of fabric
- Rope or string
- Large buckets or other containers
- Wagon, toy truck or a 'dolly trolley'

Learning objectives

For the children to:

- Share ideas about how to transport all the blocks from indoors to the verandah
- Experiment with different ways of moving the blocks
- Work together to design an efficient solution, sharing their ideas
- Reflect on the process of finding the best solution

Important words to use

Transport, heavy, teamwork, cooperate, force, work, heavy, light, push, pull, move, slide, easy, difficult, quick and slow.

You've got to move it, move it

Design a solution together

Think During the planning meeting, encourage the children to think of different ways to move the building blocks from where they are now, to where they need to be. The children should not carry the building blocks as they are too heavy.

Plan Show the children pictures of heavy objects being moved. Discuss how the heavy building blocks are being moved.

Create Show the children the materials you have gathered. Ask them to suggest ways to use them to move the building blocks as quickly as possible to the new block area, without picking them up and carrying them. Children may move back and forth between the 'create' and 'test' phases.

** Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test The children play in small groups to test their ideas. Make it a race! Divide the blocks between the groups. See which group is the first to move their blocks to the verandah block area.

Reflect After the race, invite the children to sit with you again and talk about how they moved the blocks. Ask questions such as, 'If something is heavy, how hard do you have to push to move it?', 'How did you make it move so far?', 'Is it more work to push something heavy or to pull something heavy?' What helped the children to move the building blocks quickly? Why do you think that? You could also ask, 'What does it mean to push (and pull) an object?' 'What did you notice about the work your body did when you pushed (or pulled)?' and 'Have you ever seen other heavy objects being moved? How were they moved?' Remind the children to return the materials they used to the Makerspace. The photographs will remind them of their great work!

New words

- ***Transport (v.)*** *– means to take or carry people or goods from one place to another.*

Drop back idea

1. *The children draw or paint heavy objects they have seen in the world around them and talk about how they could move the objects.*

Extension ideas

1. *The children draw heavy objects they have seen in the environment around them and talk about how they could move the objects.*
2. *The children test more ways to move the heavy boxes.*
3. *Go on a wheel hunt in the school environment. Look for as many uses of wheels as you can. Discuss how the wheels help to transport large or heavy loads.*

Build it up, build it up, build it higher

Group size: Two of more children

The challenge

Three teddies are having a picnic in a clearing in the middle of the bush. They have forgotten the way home. The teddies decide to build a tall tower, so they can climb up the tower and see over the bush to find their home. Can you help them?[1]

Setting the scene

1. Prepare the Makerspace with building materials and the three teddies.
2. Find images of tall towers in picture books, magazines or on the internet.
3. Invite the children to the Makerspace. Introduce the children to the design challenge. Show the children the height of the trees the teddies need to see over. Talk about the difference between the height of the teddies and the height of the trees.
4. Use a large potted plant or create a paper tree to represent the height of the bush the teddies are trying to see over. Talk about how high the towers need to be. Encourage the children to build towers that are taller than the tree.

[1] *Links with NT Preschool Maths Games, 'A fun path'.*

Big ideas

Tall towers are designed to resist the force of gravity. If a tower is balanced, it will stay standing. If it becomes unbalanced, it will fall. There are many ways you can design towers to make them taller and to support them to stay standing.

Open-ended play

Display images of different towers in the Makerspace area. Include a range of natural and made materials that could be used to build a tower. Smaller items will encourage the use of fine motor skills and intricate tower building. Larger items will require more space for bigger towers.

As the children play with the materials and build towers, describe what they are doing. Identify when the children carefully balance materials on top of each other, when their towers are stable or when they begin to lean. Ask the children, 'What can you do to stop the tower leaning?' or, 'What features of your design help your tower to stay standing?'

You will need

- A range of stackable materials for example, blocks, paper cups, cardboard tubes and boxes
- A large open space to build the towers
- A large potted plant or a large cut-out paper tree

Learning objectives

For the children to:

- Think of ways to build tall towers
- Build the towers and refine their design
- Persist when faced with challenges in their design
- Discuss what worked, what didn't work and why

Important words to use

Tower, building, base, stable, unstable, balanced, unbalanced, height, tall, short, stack, wide and support.

Build it up, build it up, build it higher

Design a solution together

Think Encourage the children to think of different ways to build a tall tower. How will they check the building is tall enough for the teddies to see over the trees? What can they to do to make sure the tower does not fall over? Write down (or draw) the children's ideas.

Plan Look at the pictures together. Identify similarities and differences between the buildings. Ask the children what ideas they gather from the pictures. Do they have new ideas? Write down the children's ideas.

Create Show the children the materials that are available for them to use and invite them to create their towers. If the children's towers fall over, encourage them to persevere and try again. Say, 'I can see it is a challenge. Keep going – I believe you can do it!' Ask the children to suggest what they could do differently to make their towers more stable. Children may move back and forth between the 'create' and 'test' phases.

** Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test To test their designs, support the children to move the plant or paper tree close to their tower. Is the tower tall enough for the teddies to see over the bush? Is the tower big enough to hold at least one teddy? Does the tower stay standing with a teddy on top? Why (or why not)? Does the design of the tower need to change? If so, how?

Reflect When the children finish playing with their towers, encourage them to sit down together and review their ideas about how they made sure their towers stayed standing. Show the children the photographs and compare the different towers. Which aspects of the towers are the same and which are different? Ask the children to take turns to explain what they did to build a stable tower. Ask the children to take turns to explain why their towers fell over. Remind the children to return the materials they used to the Makerspace. The photographs will remind them of their great work!

Drop back ideas

1. *Using soft blocks, model how to make a small tower by stacking the blocks on top of each other.*
2. *Fill a basket with small cardboard boxes. Sit in a circle with a large group of children. Invite each child to take a box from the basket and stack them on top of each other. Have the children continue to take turns, each time narrating what the child is doing. Say, 'James is standing up on his toes and balancing the box on the top of the tower!'*
   Use words to describe the tower like 'leaning', 'balanced' or 'unbalanced'. Continue to build until the tower falls over. Ask the children, 'Why did our tower fall over?'

Extension ideas

1. *Repeat the challenge, providing the children with masking tape and play dough. Encourage the children to think about how these new materials will change their design.*
2. *This time, the teddies have decided to build their tower on a hill. Provide the children with a small wedge on which to build their tower. Ask the children what they will need to do differently when they build their tower on the hill. Invite the children to test out their designs.*
3. *All three teddies want to stand on the same tower to see over the trees. Encourage the children to build a tower that is strong enough to hold the weight of three teddy bears. Compare the design of this tower with the first structure. How did the tower change to support the weight of three teddies?*
4. *Encourage the children to draw a plan before they build a tower. When they have built their towers, encourage them to discuss the similarities and differences between the plan and the finished tower. Encourage the children to explain why they refined their plans.*

Build a shapely bridge

Group size: Small group of children

The challenge

The wet season has begun. A creek that is usually dry, is full of water. The water flows quickly and so it is not safe to swim across or drive through. A boat will be washed away. How could you get across the creek?

Setting the scene

1. Invite a group of children to join you at the construction table. Explain the challenge to the children.
2. Look at pictures of bridges on an iPad or in books. Encourage the children to point out the shapes they can see in the pictures. Draw their attention to arches and triangles.
3. Show the children the materials that you have gathered and invite the children to design a bridge that is strong and stable enough to support a toy car.

Big ideas

Shapes such as triangles and arches[1] are commonly used in bridges to provide strength and stability. Triangles are strong because force is shared by the three sides. Arches spread added force throughout the whole arch shape. Squares and cubes can be strengthened when a diagonal piece is placed across the middle – this makes two triangles that are joined together. The triangular form is sometimes called a 'truss'. Arch bridges are strong because they have support at both ends, but truss bridges are usually even stronger.

[1] *Six games in the NT Preschool Maths Games focus on shape and spatial thinking. Providing those games in your classroom would support children's thinking as they investigate building bridges.*

Open-ended play

While children are playing with a train set or building with blocks, draw their attention to the bridges. Talk about the purpose of bridges: a bridge is a structure that allows a path, a road or a railway to cross over an obstacle like a river.

Then, add a range of materials that could be used to create shapes and build structures to the Makerspace. These materials could include sticks and twigs, masking tape, paper clips, bulldog clips, pegs, string, fabric, cardboard and paper. Avoid using 'wet' materials such as glue and paint, so that the materials can be reused.

Invite children to build anything they wish. Join in their play, encouraging the children to talk about what they are building. When they have finished building, invite each child to take a photograph of their construction before returning the materials they used to the baskets, ready to be used again.

Invite children to fold paper to make new shapes. Talk about the sides, corners and surfaces of the shapes they make.

You will need

- Paddle pop or ice cream sticks
- Blu Tack or play dough
- Masking tape
- A4-size poster paper (thick paper)
- Scissors
- Images of bridges
- Wooden blocks of different shapes
- Toy cars

Learning objectives

For the children to:

- Share their ideas about shapes and why shapes may be strong or weak
- Experiment with different ideas and materials to create a strong structure
- Persevere with their structures if faced with challenges
- Discuss what worked, what didn't work, what was challenging and what could be improved

Important words to use

Design, structure, bridge, shape, strength, strong, weak, corners, sides and gradient.

Build a shapely bridge

Design a solution together

Think Invite children's suggestions about what bridges do and how they are built. Ask questions such as, 'How high does the water rise when the creek is full?', 'How high does the bridge need to be?', 'How wide does the bridge need to be?', 'How strong does the bridge need to be?' and, 'How will the car move from the road to the bridge?'

Plan Encourage the children to look at the images of bridges. Ask questions such as, 'What is important to remember when we design a strong, stable bridge?', 'How could we use the different materials in our construction?', and 'How can we join the materials together securely?' Encourage the children to plan their bridges before they build them.

Create Provide plenty of space and time for the children to work on their bridges. You may choose to model different ways to use the materials. For example, folding paper makes it stronger. Encourage the children to talk about their constructions, the materials used and the designs of their bridges. Offer hints to help overcome construction challenges and encourage persistence. Children may move back and forth between the 'create' and 'test' phases.

** Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test Are the bridges strong and stable enough to hold a toy car? How could the bridge designs (or constructions) be changed or improved?

Reflect Invite the children to look at all the completed bridges and discuss whether some bridges are stronger or more stable than others. Discuss the shapes in the bridge constructions. Which shapes worked best? Discuss the similarities and differences between the plans and the finished structures. Encourage the children to explain why they refined their plans. Encourage the children to share what they have learnt about building strong, stable bridges. Remind the children to return the materials they used to the Makerspace. The photographs will remind them of their great work!

New words

- ***Stability*** *– is the ability of a structure to stay upright. To be stable, the centre of gravity of the structure must be centred over the base of the structure.*
- ***Force*** *– is a push or a pull that occurs when any two objects come into contact.*
- ***Design (v.)*** *– is the process of developing the plan or drawing.*
- ***Gradient*** *– describes how much a line, or a surface, has moved away from being horizontal.*

Drop back ideas

1. *Using triangular and arch-shaped blocks, invite children to build a bridge.*
2. *Provide children with pipe cleaners and encourage them to make shapes. They may choose to join some shapes together to build a construction.*
3. *Join in with the children's play. Model words like 'corner', 'side' and 'gradient'.*

Extension ideas

1. *Challenge the children to use only one piece of poster paper to create a structure that will hold a toy car above the ground. Encourage children to explain the designs of their constructions.*
2. *Invite the children to find pictures of more structures that use strong shapes. Here, they can use an iPad, a book or magazines. How many can the children find? What shapes can they identify in the structures?*
3. *Invite the children to make their bridges strong enough to hold something heavier than a toy car. Encourage children to use the think-plan-create-test-reflect process. What changes to the design and construction are needed if the bridge needs to hold a heavier object?*

Build a strong wall

Group size: Two or more children

The challenge

The children's favourite game is hide and seek, but more hiding places are needed outdoors. What could they build to make another hiding place?

Invite the children to build a wall in or near the sand pit. The wall needs to be high and wide enough for two children to crouch behind.

Setting the scene

1. First, take a walk around the school and look at walls in the school environment. Observe and discuss the patterns used in the design of these walls. Look at the way the bricks are stacked: each brick is positioned above the gap between the bricks below it. Invite the children to suggest reasons for this.
2. If there are ant hills in your school yard, look at them too. Help the children to describe the ant hills. Are they hard or soft? Tall or short? What stops the ant hills from falling over?
3. Invite the children to help design and build a wall.

Big ideas

A strong, stable wall resists the force of gravity and should not fall over. As a wall gets higher or longer, it needs strong materials and support to ensure it remains stable.

Open-ended play

Invite children to bring empty two-litre milk bottles and milk cartons to preschool to add to the sand pit. What shapes can they make? Encourage the children to think creatively about structures they could design and build.

You will need

- Sand
- Water
- Empty two-litre milk bottles or milk cartons cut in half, or empty ice cream tubs

Learning objectives

For the children to:

- Share ideas about how to build a strong, stable wall
- Work with peers to build walls and persevere in the face of challenges
- Reflect on the process of building the wall, discussing what worked well and what could be improved

Important words to use

Construct, pattern, hard, soft, stable, support, teamwork, height, length, measure, flat and curve.

Build a strong wall

Design a solution together

Think Talk about why people build walls. The first step in this challenge is to decide how tall and how wide the wall needs to be. How could they make bricks using sand and the containers?

** Links with NT Preschool Maths Game, 'Lengths: Comparing how long things are'.*

Plan Plan the wall. Ask questions such as, 'How wide should the bridge be?' and 'Can you estimate how many sand bricks we might need for our wall?' Plan where the wall will be built and how the bricks will be laid.

Create Start building the wall. As the wall grows higher or longer, how do they prevent the wall from falling over? Children may move back and forth between the 'create' and 'test' phases.

Test Remind the children about stacking the bricks so that the wall is strong and stable. Encourage the children to compare their own height with the height of the wall (direct comparison), to see which is taller. Is the wall large enough for two children to hide behind?

Reflect When the wall building challenge has been completed, discuss the process of building the wall. Ask questions such as, 'What was the hardest part of this challenge?', 'Would you do anything differently next time?', 'Did we have to change our design or plan along the way?', 'How did we do this?' Share some of your observations about what the children did or said during this process. Express admiration for the way they overcame the challenges and persevered until the work was done. Remind the children that the wall is for hiding behind, NOT for climbing on.

Drop back ideas

1. *Complete the same challenge using recycled cardboard boxes and masking tape. What makes the wall strong? What makes it stable?*
2. *Using blocks or another construction material, invite children to complete the same challenge on a smaller scale: build a wall that is tall enough and wide enough for toy animals to hide behind.*

Extension ideas

1. *Invite the children to measure the height and length of the wall they have built, using informal units of measurement (such as wooden blocks) or formal units of measurement (such as centimetres). Ask the children to draw a picture of the wall and record the measurements. Display their drawings in the room.*
2. *Transfer the concept of the staggered building pattern to other constructions such as building a tower or wall using plastic cups. How high can the children build the tower?*

Ramp it up

Group size: Small group of children

The challenge

The children have been collecting large rocks to use in the sandpit. They have put all the rocks into toy dump trucks. Now they need to move the dump trucks over a low wall in order to empty the rocks into the sandpit, but the dump trucks are too heavy to lift and carry. How can they move the dump trucks over the wall?

Note: This challenge idea needs a raised or sunken sandpit, so the ramp can help move the heavy load up or down. Adapt the game to fit your setting. Anywhere that a ramp can be used to move a heavy object from one point to another point (whether higher or lower) will work.

Setting the scene

1. Introduce the idea of a ramp during group time. Look on the internet and in books for pictures of ramps to help you explain the idea.
2. Look at the pictures with the children and ask, 'What is a ramp?', 'How can it help us in everyday life?' and 'Where have you seen a ramp used?'
3. At the end of the discussion, invite children who would like to help you solve a problem. If you have enough materials, you might like to have a few ramps being created by different groups.

Big ideas

A ramp is a flat surface, with one end higher than the other[1]. Ramps can be at different gradients. Ramps are used in different ways to help move heavy objects up or down. Using a ramp requires less force than lifting an object up or down.

[1] *Links with NT Preschool Science Games, 'Cars and ramps'.*

Open-ended play

Slides attached to climbing equipment are ramps. Talk with the children about the gradient of the slide. What would happen to the slope of the slide if the steps went higher?

Include materials in the Makerspace that allow children to build and experiment with ramps, such as recycled cardboard boxes.

Provide opportunities for children to incorporate ramps into block play, by providing strips of cardboard or plywood and objects with wheels to push up or roll down the ramps.

You will need

- Two toy dump trucks
- A collection of small rocks (or any heavy objects)
- Two flat objects such as a plank of wood, thick cardboard or the lid of a large plastic tub

Learning objectives

For the children to:

- Contribute to a discussion about why ramps help us to move heavy objects
- Share their ideas about how to set up the ramp
- Set up and use the ramp to transport the rocks into the sandpit
- Discuss what they learnt from this challenge

Important words to use

Ramp, transport, force, heavy, incline, gradient, slope and load.

Ramp it up

Design a solution together

Think Gather the children in a small group and encourage them to think of easier ways to move the heavy dump trucks than lifting them. Guide the children to suggest using a ramp.

Plan Encourage the children to discuss together how they could build a stable ramp that will hold the truck. What materials will they use? Show them the planks, cardboard and box lids. Encourage the children to plan what they could do.

Create Give the children time and space to use the materials provided to create the ramp and find a solution. Children may move back and forth between the 'create' and 'test' phases.

** Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test When the children have found a solution, test the solution one more time by moving the truck into the sandpit using the ramp.

Reflect After the activity, gather the children together and ask them to describe the solution they developed. Encourage them to think of more ways in which ramps can be used to help move heavy objects up or down.

New words

- ***Force*** *– is something that causes a change in the movement of an object, like a push or a pull.*
- ***Gradient*** *– describes how much a line or a surface has moved away from being horizontal.*
- ***Inclined planes*** *– are flat surfaces that have one end higher than the other. An inclined plane is also known as a ramp.*
- ***Transport (v.)*** *– means to take or carry people or goods from one place to another.*

Drop back idea

1. *Add flat, strong surfaces and objects with wheels to the block corner so that children can explore using ramps. Notice how the speed of the car changes when the gradient of the ramp changes.*

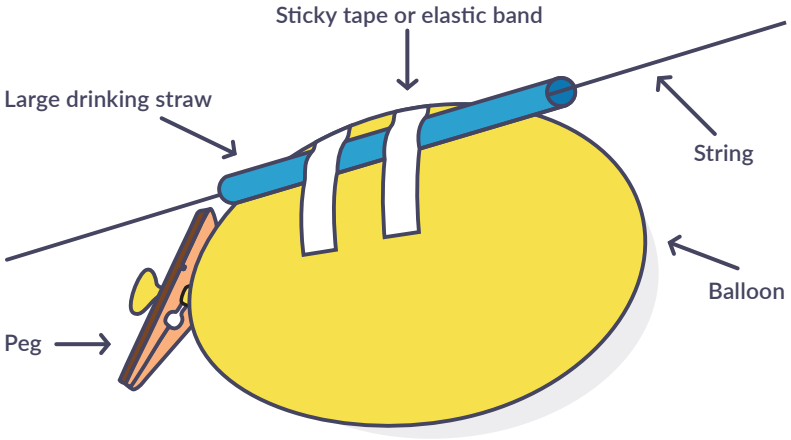
Extension ideas

1. *Explore what would happen if the obstacle to get over was much higher. Encourage the children to investigate changes that would need to be made to the ramp.*
2. *What if the truck is too heavy to push? Experiment with using a 'pull' force instead of a 'push' force[1]. How could the truck be pulled up the ramp?*
3. *Is it possible to build a paper ramp that will support a toy car? How would the design be adjusted?*

[1] *Links with NT Preschool Engineering Game, 'You've got to move it, move it'.*

Three, two, one, blast off

Group size: Two or more children



The challenge

You are an astronaut. You need to fly to the moon and you need to get there quickly! Design a balloon-powered rocket that uses air power.

Setting the scene

This learning experience can take place in the Makerspace or outdoors. Invite a small group of children to join the play. (You may need to assist the children with blowing up balloons and attaching them to their rockets.)

1. Explain the challenge to the children and show them the materials available to them.
2. Agree on the 'launch pad' and 'the moon' and tie a piece of string firmly to these objects. This will be the rocket path.

Big ideas

We cannot see air, but it is all around us. It takes up the space of the container that is holding it. When we blow air into a balloon, the air fills the balloon and stretches the balloon. When a balloon is blown full of air, if you let go of it without tying it closed, the pressure of the air outside the balloon will push the air out of it. The air escapes from the balloon very quickly, making it fly around.

Open-ended play

The 'drop back' ideas from 'paper bag lungs' in the NT Preschool Science Games apply here. At different times of the day, take time with the children to notice their breathing. When the children are relaxed, describe their slow, calm breaths. When they have been active, describe how they are breathing fast. Draw their attention to the air moving in and out of their lungs as they breathe.

You will need

- Balloons
- Air
- Sticky tape
- Clothes pegs
- String
- Straws
- Masking tape
- Empty water bottles
- Clean, empty milk cartons
- Cardboard roll inners
- Connecting blocks
- Card for cutting

Learning objectives

For the children to:

- Design and build a rocket that uses air power to fly
- Discuss, refine and test their designs
- Compare which rocket flies furthest and/or fastest
- Reflect on how their original ideas were adapted in order to make their rockets move

Important words to use

Air pressure, heavy, light, push, move, slide, quick, slow and air.

Three, two, one, blast off

Design a solution together

Think Encourage the children to think of ways to build a rocket using the materials provided. In particular, encourage them to think about how 'balloon power' (air) could be used to move their rockets. Suggest that each child blows a little air into their balloon and then releases the balloon without tying it closed. What happens, and why?

Plan Show the children pictures of the rocket (car and boat). Discuss how the balloons are fixed to the vehicles in these pictures. Invite the children to volunteer ideas about why the balloons need to be fixed to the rockets. How will the air be held inside the balloons until it is time for the rocket to move?

Create Encourage the children to build their rockets. Throughout the creating process, provide hints and tips to encourage children to persevere with building their rockets. Children may move back and forth between the 'create' and 'test' phases.

** Take photographs of the work in progress to refer to in the 'consult' phase. (The children may prefer to take the photographs themselves.)*

Test The children test their rocket designs. Encourage the children to give and receive feedback to/from their peers in order to refine the design and construction of the rockets. Measure which rocket flies the furthest.

Reflect After all the rockets have been built and tested, invite the children to sit with you and talk about how they designed, created, tested and refined their rockets. Ask questions such as, 'Which rocket travelled the furthest?' 'What was the reason for this?' and 'What other types of movement could be powered by air?' Remind the children to return the materials they used to the Makerspace. The photographs will remind them of their great work!

Drop back idea

1. *Invite the children to play 'Length: Comparing how long things are' from the NT Preschool Maths Games.*

Extension ideas

1. *Design a rocket that can carry a small toy. What refinements need to be made to the design?*
2. *Design a balloon-powered car or boat. What refinements need to be made to the design?*
3. *When they have built their rockets, encourage the children to discuss the similarities and differences between their rockets. Encourage the children to explain how they refined their designs.*

The MEGA challenge:
The Treehouse Animal Hospital

NOTE *It is best to explore all the learning games in the NT Preschool Engineering Games **BEFORE** you attempt the mega challenge with the children. The complexity of this challenge will enable multiple children to collaborate in designing engineering solutions to overcome challenges. You may choose to break down this challenge into parts and focus on one part for a few days before moving onto the next.*

The challenge

Emergency! The children have found an injured kitten. They do not know whose kitten it is. The kitten needs help.

First, the Treehouse Animal Hospital must be designed and built. It needs to be off the ground so that the injured kitten is safe. Then, the injured kitten needs to be transported to the hospital. Finally, a flag must be raised to tell the kitten's owner where to find it.

Setting the scene

1. During group time, explain the challenge. Encourage the children to share their ideas about the steps that need to be taken. Support turn-taking and model careful consideration of each suggestion.
2. Invite the children who are interested in working on this challenge together to meet in the yard after group time. If many children wish to take part, you may suggest that there are two animals that need to be taken to a hospital.

You will need

Ensure that the following materials are available in the Makerspace, however encourage the children to select the materials they need to use.

For the stretcher and animal hospital

- Five or six large pieces of fabric or netting (old fishing net, scarves, blankets or towels)
- Rope or string of different lengths
- A soft toy to be the kitten
- Ten or more sticks of different thicknesses and lengths
- Fabric to use as a bandage

For the flagpole pulley

- Play dough
- One long stick (approximately one metre)
- Two bulldog clips
- String or rope
- Paper or light-coloured fabric (to make a flag)

For the steps or ramp

- Old cardboard boxes, for example, cereal boxes or tissue boxes, of various sizes and shapes
- Masking tape
- Sand, dirt or rocks (to stabilise the lower boxes)

The Treehouse Animal Hospital

Design a solution together

By now, the children will be familiar with the engineering process skills: **think; plan; create; test**; and **reflect.** Apply each as previously.

1. Encourage the children to break down the mega challenge into parts:
   - build the Treehouse Animal Hospital
   - make and raise a flag
   - transport the injured kitten to the hospital
   - raise the animal to the hospital where it will be safe from predators.
2. Show the children the materials available to use.
3. Agree on each of the steps in this challenge. The children need to plan how they will collaborate to achieve their goal.
4. Help the children to apply the engineering process skills to each part of the challenge.

Learning objectives

For the children to:

- Share creative ideas with other children and educators
- Consider the contributions of other children
- Experiment with different plans and ideas, adapting and problem solving during this process
- Demonstrate persistence when faced with an obstacle
- Collaborate with other children to design a solution
- Reflect on the process of finding the best solution

Important words to use

Transport, design, plan, build, structure, teamwork, cooperation, pulley, ramp, challenge, solution, process, order and communication.

New words

Capacity of a container describes how much space it has to hold something like water or sand.

Design (n.) is a plan or drawing that shows the look, function and workings of a building, structure or object.

Design (v.) is the process of developing the plan or drawing.

Force is something that causes a change in the movement of an object, like a push or a pull.

Friction is the name for the resistance of movement: happens when one object rubs against another object because each object works against the other to slow down the movement.

Gravity is an invisible force that acts on an object without touching it. The gravity of Earth pulls objects towards the ground we stand on, so we (and other things!) don't float away.

Gradient describes how much a line, or a surface, has moved away from being horizontal.

Inclined planes are flat surfaces that have one end higher than the other. An inclined plane is also known as a ramp.

Resistance is the ability of a structure to bear tension without breaking. The materials used to build the structure will determine its resistance.

Speed measures how slow or fast an object is moving.

Stability is the ability of a structure to stay upright. To be stable, the centre of gravity of the structure must be centred over the base of the structure.

Transport (v.) means to take or carry people or goods from one place to another.

Transport (n.) is a system for taking or carrying people or goods from place to place.

Volume of a container describes how much a container actually holds.

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