MINI STEM SHOWDOWN

Teacher Resource Guide

Adelaide University

Education Futures ACADEMY

Outreach STEMpire Programs

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Introduction

Mini STEM Showdown is a program for year 3 and 4 students that consists of four challenges; Science, Technology, Engineering and Mathematics. Students complete the challenges in class, learning about the scientific process, computational thinking, the engineering design process, and mathematical processes.

The CDFS boxes on the following pages highlight which cognitive skills are employed. These four skills are:
C - Computational Thinking is a problem-solving approach that teaches students to break down complex problems, recognise patterns, create step-by-step solutions (algorithms), and use logical reasoning.
D - Design Thinking is a student-centred, creative problem-solving approach that encourages learners to empathise, define problems, generate ideas, prototype solutions, and test them through reflection and iteration.
F - Futures Thinking is an approach that helps learners explore possible, probable, and preferred futures, develop long-term thinking skills, and make informed decisions in the present by anticipating change and uncertainty.
S - Systems Thinking is an approach that helps learners understand how parts of a system are interconnected, recognise patterns and relationships, and analyse how actions in one area can influence the whole.

The levels below indicate the workshop complexity for set up, delivery and pack up for each of the following actvities.

Level	Resources	Teacher Involvement	Pack up Rating
1	Worksheets and minimal equipment	Student driven once task is initially explained	Return all equipment to the front
2	Some pre-session set up needed	May need help sheets and answer questions	Clean up area, such as paper, tape etc.
3	Additional supplied and pre-session preparation required	Technical support and ongoing instructions throughout the session	Multiple items to pack up. Wipe down of work areas may be required

Science

C D **F** S

Individual **Team – recommended group size: 2 - 3**
Resources needed - Level 2
Teacher involvement - Level 1
Pack up - Level 2

Required Resources:

- Acrylic rod
- Sheepskin, cotton, polar fleece, satin, and one other material of your choice
- Paper cut up into small pieces
- Tissue paper (thin paper, or even single ply toilet paper sheets, can work)
- Sticky tape
- Balloons (one per student)
- Science worksheet per group (make sure all students write their name on it)
- Pencil

Set Up:

- Prepare a set of equipment (listed above) for each group

Recharge With:

- Fresh set of worksheets and balloons for each class

Task 1

Students investigate which material creates the strongest static electricity by rubbing different fabrics on an acrylic rod. There are many variables to consider so the focus of this task is the scientific process, not just the results of the experiment.
They begin by making a prediction about which material will pick up the most paper pieces, then test the different materials (sheepskin, cotton, polar fleece, satin, and another material of their choice, such as a T-shirt) to see which produces the greatest static charge. They use the charged rod to move small pieces of paper first and then when they have determined which material lifts the most paper pieces, they then try to lift their tissue paper person.

Task 2

Students can extend their investigation by: a) using the charged rod to move other lightweight objects, and b) consider how changing the type of paper used for the paper person might change their results. The activity encourages students to make predictions, conduct fair tests, record observations, and draw conclusions about static electricity.

Teacher Notes

Extension - Try it yourself. This could be a homework activity or a follow up session.
Students charge a balloon by rubbing it on their hair. They make predictions about how the balloon will interact with objects and then use the charged balloon to see what objects it can attract, move or stick to. They record their observations and compare the results with their predictions. This activity develops students' skills in predicting, observing, and explaining results.

Preparation
Prior to running this activity, sets of the following equipment/materials will need to be collated.
Each set will need:

- One acrylic rod
- One piece each of sheepskin, cotton, polar fleece and satin
- Small pieces of paper (approx. 20 pieces per group, max. 5mm x 5mm each piece)
- Scissors
- Tissue paper sheet (can use any thin paper, even a sheet of single ply of a toilet paper)
- One balloon per person (use latex free balloons if you have students with a latex allergy)

Additional Information
You could use confetti or paper offcuts for the small pieces of paper, or students can cut their own from a piece of paper, Ensure the pieces are kept small so they can be used more effectively.

Answers
Students will only be changing the type of material used to charge the rod; everything else should be kept the same. This is called a *controlled* or *fair* test - an experiment where one *variable* is changed while everything else is kept the same. This activity should increase awareness of experimental design.
Students need to think about how they could make this experiment more rigorous, imagining that they have no restrictions in equipment or time. For example, to work out if the paper moved, they could film it and play it back in slow motion to accurately count the pieces that moved, or they could set the pieces of paper up on a grid pattern to ensure they start the same for every test, or have a device keeps the distance between the paper and the rod the same for each test.

Theory
Electrostatics is the study of stationary charges and their interactions. Tiny negative particles, called electrons, can transfer from one object to another. Items become either positive (if they lose electrons) or negative (if they gain electrons). An electric shock is caused by electrons redistributing to get the charges back to neutral. It is static electricity until the electrons move, once they start moving a current of electricity is formed. Lightning occurs when a static charge difference between the clouds and the ground produces a flow of electrons, redistributing the charge.

C D F S

Individual Team

Resources needed - Level 2
Teacher involvement - Level 2
Pack up - Level 1

Required Resources:

- Coloured beads - minimum of 2 different colours of the same sized bead. Approximately 15 of each colour per student
- Small beads (ideally glow in the dark) - 3 per student
- Elastic thread (30cm piece per student)
- Pipe cleaner per student
- Paper plates and a container to hold the beads per group
- Technology worksheet per student
- Pencil

Set Up:

- Prepare containers with beads for students to share at their tables
- Give each student a paper plate to place their required beads on, and a pipe cleaner with the elastic tied to the middle.

Recharge With:

- Fresh set of worksheets and set of beads and elastic thread for each class

Task 1

Using the binary code on the worksheet students write their initials (including middle name if they have one) in binary code. Each letter will be represented by 8 coloured beads, each letter separated by a smaller bead. Three letters/initials will make the correct size bracelet.

After they have worked out the code for each letter, they will then need to colour code the letters on the 'Colour Code' worksheet; one colour for 0 and another colour for 1.

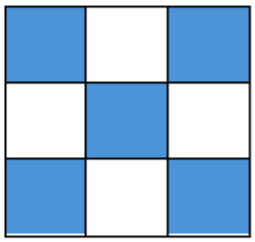
Once students have colour coded their initials, they can use the beads and elastic given to them to make a bracelet. They will need to separate each of the three letters using the smaller bead.

Task 2

Once their bracelet is tied up around their wrist, students can write a secret word using binary code on their worksheet, and get a classmate to solve it!

Teacher Notes

Extension - Try it yourself. This could be a homework activity or a follow up session.
Students can make pictures on the grids in the worksheet using binary code. They do this by colouring in a square (1) or leaving it blank (0).



1	0	1
0	1	0
1	0	1

Preparation
Prior to the lesson, put beads in containers or bowls ready to put on the tables.
Cut lengths of elastic (approx. 30cm pieces). Rather than tie a knot in one end of the elastic, use a pipe cleaner and twist the end of the elastic around a pipe cleaner. This makes it easier for students to thread their beads on as they don't have to worry about them falling off the end. It also makes it easier to tie around each student's wrist once it is completed.

Additional Information
We recommend using pony beads as they are bigger and easier to manipulate, then smaller beads for in-between each letter. Give each student a paper plate to put their beads on. This helps to minimise the beads from rolling off the desk.

Answers
The final result should look soemthing like this:



There should be 8 coloured beads for each letter and 3 smaller beads in-between each letter.

Theory
Binary code is a data system that uses two symbols, 0 (off) and 1 (on), known as bits. To make a letter computers use 8 bits. A group of 8 bits is called a byte. This code is used to send images, audio, video and text across networks.

Engineering

C D F S

Individual Team – recommended group size: 2
Resources needed - Level 2
Teacher involvement - Level 1
Pack up - Level 1

Required Resources:
- Balancing bird toy
- Modelling clay (small grape sized piece per group)
- Toothpicks (9 per group)
- Engineering worksheet per group/student
- Pencil
- Scissors

Set Up:
- Set of modelling clay and toothpicks per group.
- Balancing bird model per table for students to share.

Recharge With:
- Fresh set of worksheets and top up toothpicks and modelling clay for each class

Task
Students investigate the engineering principles of balance and centre of gravity by observing a balancing bird toy and identifying where they think the weights are positioned to keep it balanced. They then apply this understanding to design, build, test, and refine their own balancing bird using 3 toothpicks and modelling clay.

Once their bird balances successfully, students extend the challenge by engineering a perch for their design using 3-5 toothpicks and modelling clay. Throughout the activity, students engage in the engineering design process by planning, testing, evaluating, and improving their designs while exploring how weight distribution affects balance and stability.

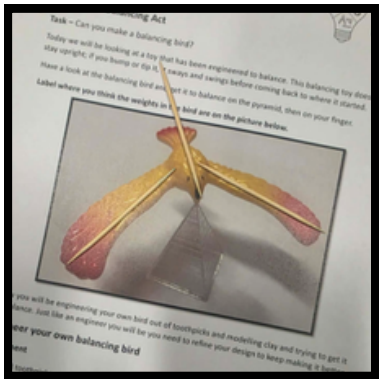
Task 2
Students can brainstorm how to make a larger balancing bird. If time permits make a larger balancing bird using equipment that is readily available in the classroom, such as, pop sticks, and see if it works.

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Teacher Notes

Extension - Try it yourself. This could be a homework activity or a follow up session.
Students can make their own balancing bird out of paper using the template in the worksheet

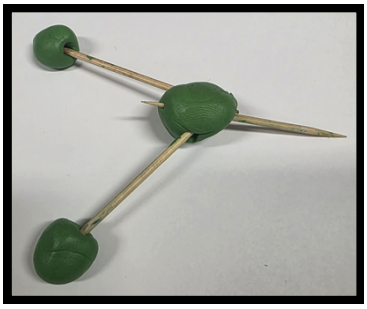
Additional Information

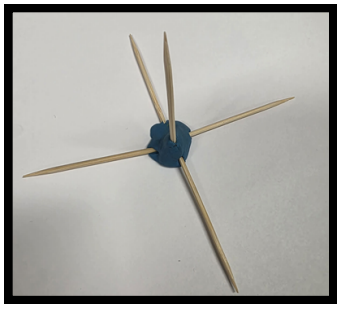


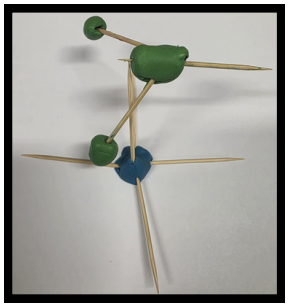
Prior to the activity put the toothpicks and modelling clay for each group into bags/containers to make it easier to hand out and pack up. They will need 3 toothpicks and one ball of clay for their bird and 6 toothpicks and one ball of clay for their perch. If students are struggling with design ideas for their balancing bird, it's helpful to lay the toothpicks out on the picture of the balancing bird. This should then show them how to use their tooth-picks to get the right shape; it's essentially like the bird's skeleton!

Answers

For the bird to balance effectively a centre weight and an equal amount of weight on the end of each wing is needed.





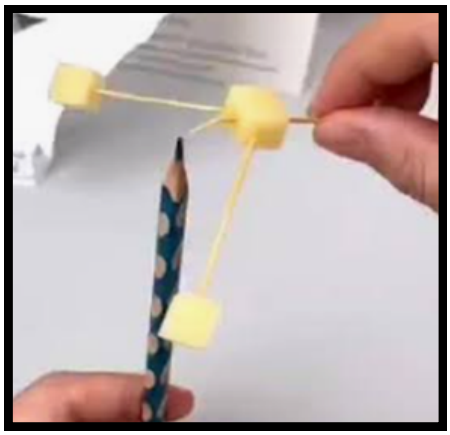


The perch can be the student's own design, but the picture above (middle) is an example of a simple working perch.

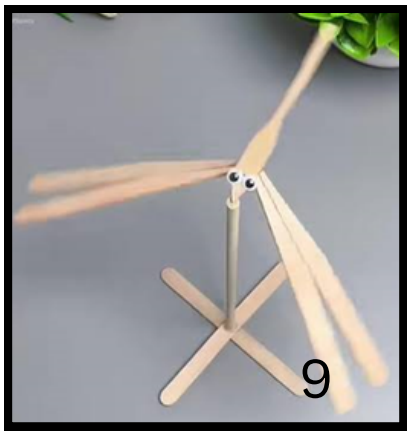
Theory

The average position of the combined mass of an object is called the Centre of Mass (CoM). For an object to balance, the point of support must be directly underneath the Centre of Mass. The balancing bird toy has a centre of mass below the pivot point (the beak), causing it to hang on the support, like a picture frame on a hook. If you push the tail up or sideways, the Centre of Mass swings upwards but gravity pulls it back down, correcting the movement and returning it to a steady balance.









Maths

C D F S

Individual Team – recommended group size: 2

Resources needed - Level 1
Teacher involvement - Level 2
Pack up - Level 1

Required Resources:

- Numbered cup set to make the number pyramids pictured on the worksheet
- Various dice (Dungeons and Dragons dice sets have good variety)
- Track Tiles worksheet, (plus scissors and tape if students are making their own sets)
- Worksheet per student
- Pencil

Set Up:

- Selection of dice for each student/each group
- Track Tile set per group

Recharge With:

- Fresh set of worksheets and Track Tile sheets for each class

Task 1

Students explore number patterns and addition strategies by building a cup pyramid where each cup contains the sum of the two cups directly below it. Students generate starting numbers by rolling dice and place these values in the bottom row before calculating the values of the cups above. They repeat the activity using larger or more complex numbers (such as a multi-sided die or two dice) to investigate how changing the starting values affects the final number at the top of the pyramid.

This activity develops students' understanding of addition, number relationships, patterns, and mathematical reasoning while encouraging them to experiment and compare results.

Task 2

Students will also solve mathematical problems that do not use numbers. Using the "Track Tiles" the task is to make a continuous loop in the colour named on the back of the tile. They will increase the difficulty by increasing number of tiles to make their track. The colour on the highest numbered tile is the colour of the track loop they need to make.

Teacher Notes

Extension - Try it yourself. This could be a homework activity or a follow up session.
Students can use the template in their worksheet to make their own chatterbox and fill it with maths questions to solve. They can test these questions on their family and friends.

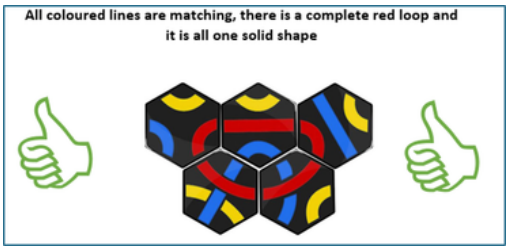
Additional Information
Activity 1 - When it all stacks up
Use the paper cups included in your kit to demonstrate how to create a number pyramid. Make a pyramid using the cups. The number on any cup is the sum of the two cups below it.
For example:
Base Row (Given numbers):
4, 6, 3, 5
Second Row (Sum of Two Below):
10, 9, 8
Third Row (Sum of Two Below):
19, 17
Top Row (Final Sum):
36

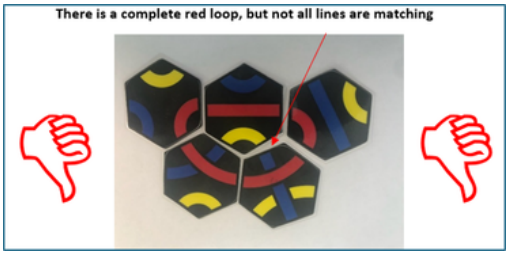


Track Tiles
Using the Track Tiles, students need to make a continuous loop in the colour named on the back of the tile, using only the numbered tiles listed.
e.g. Tiles 1-5 Red Path (see diagram below)

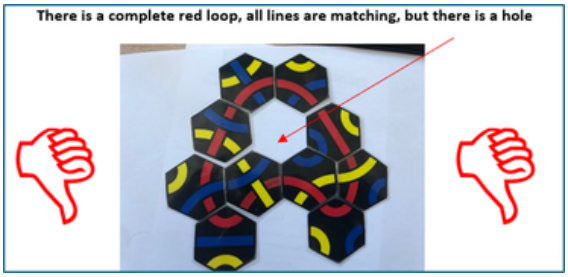
The rules are:

- The colour of the loop must match the colour on the back of the tile with the highest number.
- All coloured lines must match up, not just the main loop.





- Students must use all the tiles listed on the back of the highest number tile.
- There can't be a hole in the middle.



Conclusion to Mini SSD

When you have completed Mini STEM Showdown make sure to email a list of student names and the names of any teachers involved in delivering the program to:

STEMpire@Adelaide.edu.au

Adelaide University will provide participation certificates for all students that were involved; as well as Professional Learning Certificates for the teachers that delivered the activities.

