AUTOMATA: MAYA STORYTELLING DEVICES TEACHER GUIDE

2023 / GRADES 3-5

This project was designed to engage youth in an engineering activity that represents the cultural stories of their community. The intention is to support engagement through greater personal relevance.

CULTURAL CONNECTION

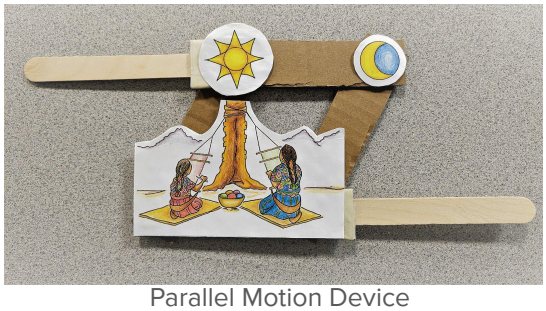
This year our project is focused on two Maya stories, a personal narrative “My First Tejido” and the folktale “La Chatona.” The video of these stories will be narrated by storyteller Raquel Kaprosy in both English and Spanish and presented with animated images created with artwork from Zamara Cuyun.

SCIENCE AND ENGINEERING CONNECTION

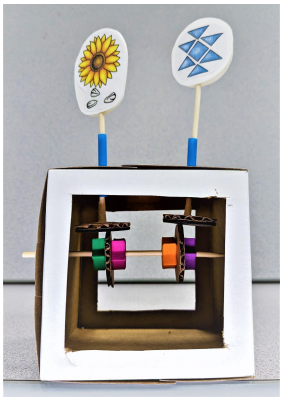
The engineering activity is centered around the creation of an automaton to show a scene from one of the Maya stories. Automata are mechanical devices that use wheels, axles, levers, and other simple machines to make something move. Students will practice building and problem solving skills as they go through multiple cycles of the Engineering Design Process.

ENGINEERING PHILOSOPHY

Our goal in creating engineering activities is to engage students in the process of creating, building, and problem solving. The final product isn’t as important as the confidence and academic skills that students build while cycling through the Engineering Design Process.



Parallel Motion Device With 4-Bar Linkage



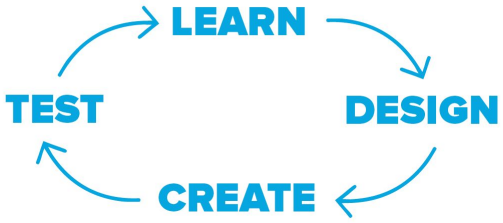
Cam and Cam Follower Device

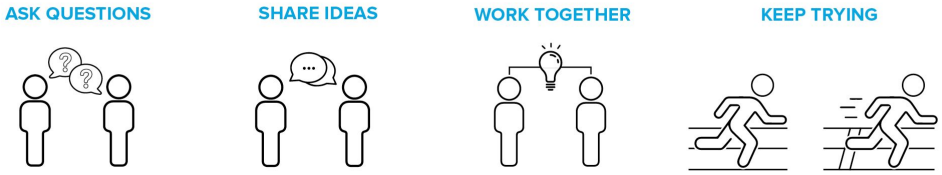
Pendulum Powered Lever Device

THE ENGINEERING DESIGN CYCLE

This is one example of an Engineering Design Cycle - a way to think about how engineers solve problems. An engineer might start by learning about a problem, designing a solution, creating a product, and then testing it out. They would learn a lot by testing and might make some redesigns - starting the cycle all over!

While engineers are moving through that cycle, they have to remember to ask lots of questions, share ideas, and work together - engineering is a lot harder when you do it alone! Engineers keep trying because setbacks and failures are all a part of the process.





Questions to Ask to Encourage Students to Think Like Engineers

- When a device doesn't work as planned
  - Does your device work in a way that you like better than what you planned? If so, how can you build on this happy accident?
  - What parts of your device are not working the way you want them to? How can you make changes to just that part without starting over?
  - Are there any materials you didn't use that might help solve your problem?

- When a device works as planned
  - Explain how your device works.
  - What parts of your design plan worked the first time? What parts of your design plan did you have to make changes to?
  - What can you do next? What part could you change to upgrade your device?
  - Are there any materials you didn't use that you could experiment with? What features could you add? What materials could you change out?
  - Are there any different devices you could make that could use the same movement mechanism? What are they? What would they do?

LEARNING GOALS

- Minnesota communities all have their own history of folktales and of how they gather and share their scientific knowledge.
- Science and engineering is for people of all cultures and gender identities.
- Engineering is a process that involves making mistakes, learning from them, and then trying again.

VOCABULARY

Automaton – a mechanical device that uses wheels, axles, levers, and other simple machines to make something move.
Axle – a rod or bar that goes through the hole in a wheel or cam
Cam – a disk or wheel on an axle that transfers the force from a circular motion into a cam follower that moves up and down
Cam follower – a machine part which moves back and forth in contact with a cam rotating on an axle
Energy – the ability to do work; energy makes things happen
Motion – a change in position compared to a place or an object
Force – a push or pull that causes motion or a change in position
Lever – a simple machine that has a bar or board that rotates on a fixed point, or fulcrum
Pivot – to rotate, swing, or move back and forth
Fulcrum – the point where a lever pivots around or balances on
Mechanism – a tool used to convert or control motion or transfer force in a machine

CONNECTION TO STANDARDS

MN Science Standards 2019: 3.2.2 Students will be able to use their understanding of scientific principles and the engineering design process to design solutions that meet established criteria and constraints. 4E.3.2.2.1 5P.3.2.2.1
MN Science Standards 2019: 4.2.2 Students will be able to gather information about and communicate the methods that are used by various cultures, especially those of Minnesota American Indian Tribes and communities, to develop explanations of phenomena and design solutions to problems. 3E.4.2.2.1 4E.4.2.2.1
MN Social Studies Standards 12/2020 draft: 17. Explore spatial ways of thinking, ways of knowing (culture), and ways of being (identity) from different perspectives, including indigenous voices.
MN ELA Literature Standards: 3.1.2.2 Recount stories, including fables, folktales, and myths from diverse cultures; determine the central message, lesson, or moral and explain how it is conveyed through key details in the text.
MN ELA Literature Standards: 4.1.3.3 Describe in depth a character, setting, or event in a story or drama, drawing on specific details in the text
MN ELA Literature Standards: 4.1.7.7 Make connections between the text of a story or drama and a visual or oral presentation of the text, identifying where each version reflects specific descriptions and directions in the text.
MN ELA Speaking, Viewing, Listening and Media Literacy: 3.8.2.2 Determine the main ideas and supporting details of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.
Next Generation Science Standards
Disciplinary Core Ideas: Defining and Delimiting Engineering Problems (3-5-ETS1.A), Developing Possible Solutions ((3-5-ETS1.B), Optimizing the Design Solution (3-5-ETS1.C)
Science and Engineering Practice: Asking Questions and Defining Problems (3-5-ETS1-1); Planning and Carrying Out Investigations (3-5-ETS1-2); Constructing Explanations and Designing Solutions (3-5-ETS1-3)
Crosscutting Concepts: Influence of Engineering, Technology and Science on Society and the Natural World (3-5-ETS1-1) (3-5-ETS1-2)

FACILITATING THE LESSON

Teachers have the following resources to use as they guide students:

Printed materials

- Student guide – contains device diagrams and an explanation of the physics behind the movement for each device
- Story Artwork
- Story Texts

Online resources

- Collaborative Padlet web page to share finished automata and view the work of classes from other schools
- “My First Tejido” animated story video
- “La Chatona” animated story video
- Pendulum Powered Lever Device video
- Cam and Cam Follower Device video
- Parallel Motion Device with 4-Bar Linkage Device video
- Materials video
- PDFs of printed materials (artwork, student guide, teacher guide, folktale texts)

POSSIBLE TEACHING PROGRESSION

- Lesson Prep- Teachers who completed this project in earlier years recommended building examples of the different devices ahead of the first lesson. Many students benefited from being able to touch the devices and see them from multiple angles.
- Lesson 1 - What is an Automata? Explore the device motions and kit materials.
- Lesson 2 - Story 1 - Why did the artist chose the motions and images to represent the story?
- Lesson 3 - Story 2 - Why did the artist chose the motions and images to represent the story?
- Lesson 4 - Plan and begin construction of storytelling devices.
- Lesson 5 - Continue constructing, testing, and troubleshooting the devices.
- Lesson 6 - Class share out.

This progression is just a suggestion. Extend or condense the lessons and activities to best meet the needs of students and other participants.

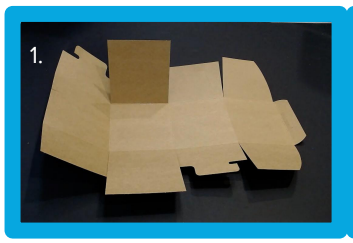
SOURCES

- Cardboard Automata. (2021, February 4). Exploratorium.https://www.exploratorium.edu/tinkering/projects/cardboard-automata
- “Pecking Hen Folk Toy To Make” from CuriosityShow https://youtu.be/nGYqcGjVU1s
- “How To Make Pecking Rooster Toy” from Learning World https://youtu.be/RnShybeshG8
- “Force & Motion 2-3: MechAnimations” by G. Benenson & J. Neujahr, City Technology, City College of NY https://www.citytechnology.org/docs/MechAnimations%20aug%2009.pdf

TIPS AND TRICKS FOR THE MATERIALS

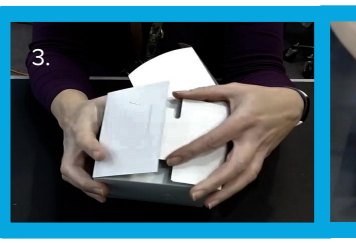
ASSEMBLING THE CAM AND CAM FOLLOWER DEVICE BOX

1. Crease the box at each fold lines to make folding easier.

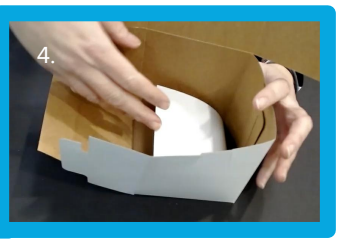


2. Fold up the square side flaps.

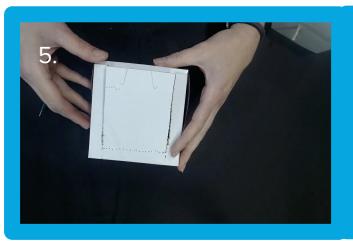
3. Tuck the notches through the slits.



4. The cam axle will go thru the sides with flaps.

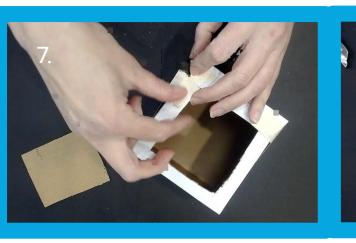


5. The lid is the top side. Draw an opening on a no-flap side.

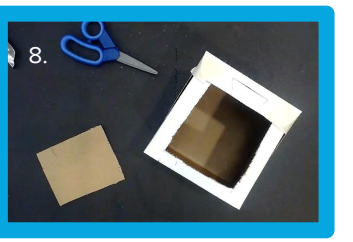


6. Cut out the opening.

7. Use masking tape to give extra support.



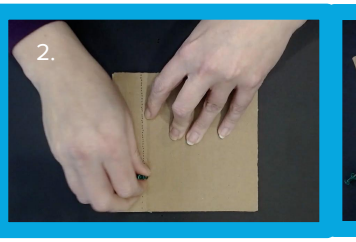
8. Make another opening on the opposite box side.



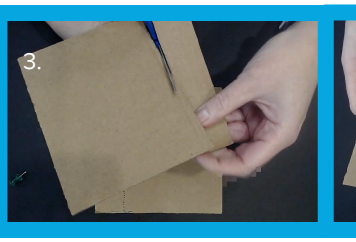
CUTTING CORRUGATED CARDBOARD

1. Measure and draw lines parallel to the corrugations.

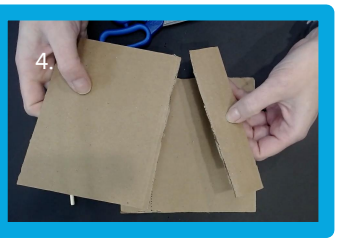
2. Use a push pin, to make a line of close-set holes.



3. Use scissors to cut through the push pin holes.

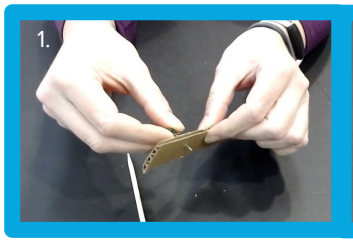


4. Continue measuring and cutting as needed.

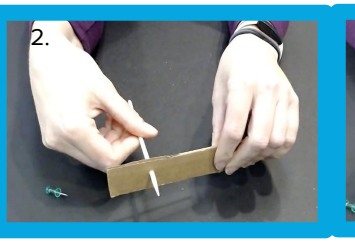


PUSH PIN AND SKEWER HOLE

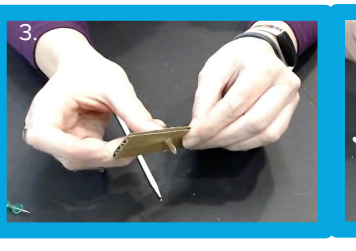
1. Use a push pin to make a starting hole.



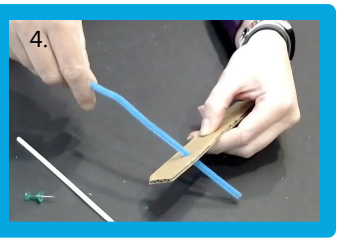
2. Poke a wood skewer through the hole.



3. Wiggle the skewer in a circle to widen the hole.



4. Test if the hole is big enough; make it bigger if needed.



ARTIST BIOS

Raquel Kaprosy - Story Teller

Raquel Kaprosy is an indigenous Maya Kaqchikel weaver from San Antonio Aguas Calientes Sacatepéquez, Guatemala. She is a first generation student who graduated with a Bachelor's degree in Biology and a Chemistry minor and is currently living in Minnesota. Raquel is passionate about staying connected with her indigenous Kaqchikel roots that she has continuously taken every opportunity to honor her heritage. She has showcased her weaving techniques at the Saint Paul Landmark Center, Red Wing Hispanic Heritage Festival through Neomuralismos and TPT series Worn Within.

Zamara Cuyún - Artist

Zamara Cuyún is a self-taught, “Gringindia” artist of de-Indigenized Guatemalan Highland Maya ancestry - born and raised in Minneapolis. She works in acrylics, using elements of Maya history, iconography, and worldview. Themes inspiring her work include histories of colonization and resistance, persecution and genocide of Indigenous populations, calls for justice, decolonization and the central role of women in this process. www.zamaracuyun.com

Grant Kirkpatrick - Animator

Grant Kirkpatrick is an animator and storyteller who loves to make 3D art and program interactive experiences. In his free time he likes to forage, sculpt, and explore the world. He lives in Seattle with his partner and their three cats.