AUTOMATA: STORYTELLING DEVICES TEACHER GUIDE

2022 / 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 Hmong folktales, “Why the Farmers Carry Their Crops” and “The Sun and the Moon.” The folktales will be presented with videos where the folktale is told by storyteller Brian Xiong in both English and Hmong and shown with animated images created with artwork from Yinkong Vue.

SCIENCE AND ENGINEERING CONNECTION

The engineering activity is centered around the creation of an automaton to show a scene from one of the Hmong folktales. 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

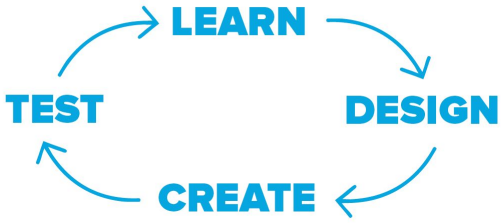
Cam and Cam Follower Device

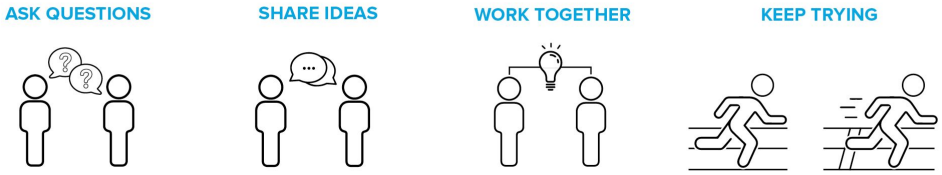
Pendulum Powered Lever Device

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 explanation of the device physics
- Teacher guide
- Folktale Artwork
- Folktale Texts

Online resources

- Collaborative Padlet web page to share finished automata and view the work of classes from other schools
- “The Sun and the Moon” animated story video
- “Why the Farmers Carry Their Crops” animated story video
- Pendulum Powered Device video
- Cam and Cam Follower Device video
- Parallel Motion Device with 4-Bar Linkage video
- Materials video
- PDFs of printed materials (artwork, student guide, teacher guide, folktale texts)

POSSIBLE TEACHING PROGRESSION

- Lesson 1 - The motions of the devices and exploring the materials
- Lesson 2 - Story 1 and why the artist chose the motions and images to represent the story
- Lesson 3 - Story 2 and why the artist chose the motions and images to represent the story
- Lesson 4 - Plan and begin construction of their storytelling device
- 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.

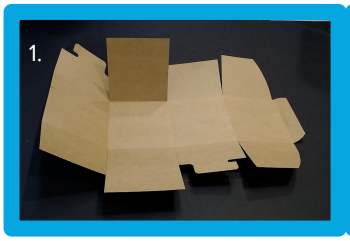
SOURCES

- 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

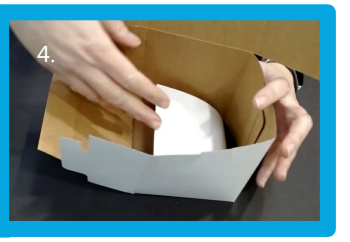
1. Crease the box at each fold lines to make folding easier.



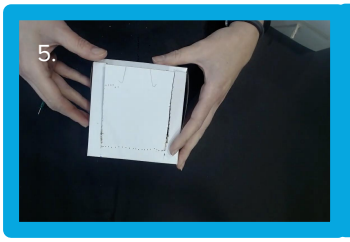
2. Fold up the square side flaps.

3. Tuck the notches through the slits.

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

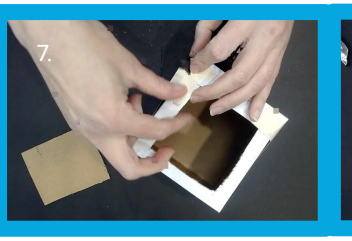


5. The lid is the top side. Draw an opening on a no-flap side.

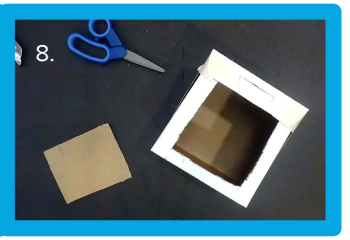


6. Cut out the opening.

7. Use masking tape to give extra support.



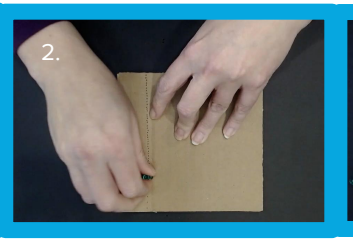
8. Make another opening on the opposite box side.



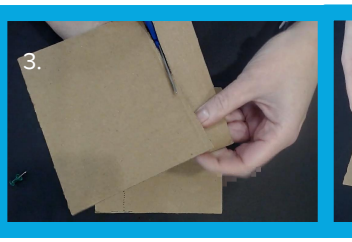
CUTTING CORRUGATED CARDBOARD

1. Measure and draw lines parallel to the corrugations.

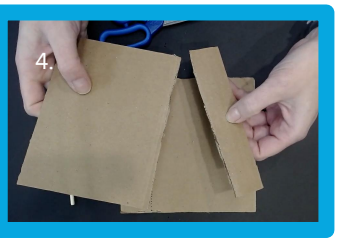
2. Use a push pin, to make a line of close-set holes



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

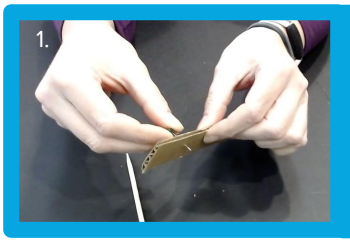


4. Continue measuring and cutting as needed.

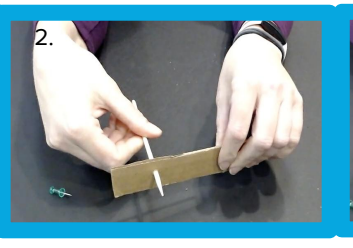


PUSH PIN AND SKEWER HOLE

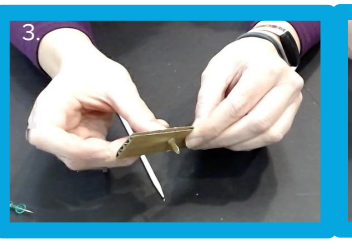
1. Use a push pin to make a starting hole.



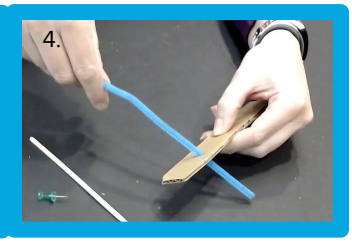
2. Poke a wood skewer through the hole.



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

Yinkong Vue

Yinkong Vue is an Illustrator and Designer based in the Midwest. He is a first generation Hmong-American whose family came to the United States as refugees after the Vietnam War. He graduated from the Minneapolis College of Art and Design with a Bachelor of Fine Arts Degree in Animation. He has worked in gaming and has done freelance illustrations for the past several years. His personal work consists of bold digital illustrations that are focused on creating expressive characters and exploring stories inspired by the Hmong culture, lore, and the everyday Hmong-American experience. Yinkong is currently freelancing and developing personal projects.

Brian Xiong

Dr. Brian V. Xiong is a Hmong scholar, researcher, and college multicultural affairs and student affairs professional. His research covers a wide variety of interdisciplinary and multidisciplinary studies, including Multicultural, Race & Ethnic Studies; Gender & Sexuality Studies; Asian-American & Critical Hmong Studies; Counseling & Student Personnel; College Student Affairs & Multicultural Affairs; and Diversity, Inclusion & Social Justice in Higher Education. He is a former Page Scholar, Wallin Scholar, Cornwell Scholar, Diversity & Equity Fellow, and author.

Mekala Nava

Mekala Nava is a reconnecting Nahua/Yaqui illustrator with a passion for storytelling. She likes to incorporate folktales, myths, legends, and history into her work and hopes to move into the realm of graphic novels. Mekala graduated from Cornish College of the arts with a degree in Visual Communications and a focus in animation and motion design. She likes to focus on the "human-ness" of storytelling and how it has inspired and connected people throughout our histories— past, present and future.