

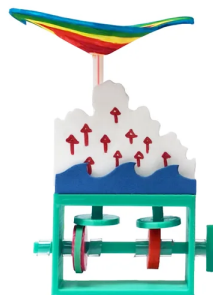
Automata with 3D Printing

Shared by: Edgerton Center K-12 Maker Team

Specialized tools and materials used:	Experience level required:
Tinkercad 3D modeling software	Beginner/intermediate
3D Printer and filament	Beginner/intermediate
Craft materials (card stock, foam sheets, markers, hot glue)	Beginner
Flexible PVC tubing, ¼" inside diameter	Beginner
Wood dowels, ¼" diameter (optional, to reduce 3D printing time)	Beginner

Grade Level and Subject (of this example): 7th Grade Science

Topic/Content Standards (for this example): Mechanical design, engineering design, abstract modeling, Earth science



Summary of Project:

In this activity, students will design and create machines with moving objects/characters that symbolize abstract concepts and represent dynamic situations, utilizing Tinkercad for fabrication on a 3D printer or laser cutter.

These machines, called automata or cam toys, consist of hand-powered mechanisms that create cyclical motions to animate a scene. Cams are rotating shapes that push on or rub against mechanical elements to create other motions. One rotating shaft can power many



cams, and each can create a different motion in its associated mechanical element. Students decide which of these motions is best for the specific concepts they want to represent.

Models may be directly representative of academic content, such as a depiction of a sound wave, or a model of a cell. Abstract concepts, like a balance of power, ecological interactions, or societal changes, are also well-suited to modeling. The appearance and motions of the characters and objects must communicate the intended concept.

Instructors should create a series of requirements and parameters for students to meet, such as creating multiple characters or objects, including more than one form of motion (spin, side-to-side, up-down), and varying the range of motion (speed, height, frequency).

Students will begin by researching the motions and mechanisms that are easily implemented in a cam toy. They can then brainstorm ideas on how to represent the topic they are assigned using the mechanical motions commonly done in automata. Students may do this work by hand on paper, by creating models with crafting materials, or by exploring Tinkercad. When they are ready to fabricate their models, they can do so with a combination of craft materials and 3D printing.

Once completed, these models provide an excellent opportunity for students to share their creations and get feedback from peers. Encourage students to test each other's automata, and see if they can figure out what they mean before the concept is explained.

This project may be completed individually or in groups of 2-3 students. Depending on students' experience with mechanical design and 3D printing software, this project should take approximately 2-3 hours.

Suggested resources

- Mechanical cam toys [Instructable](#)
- [Tinkercad designs](#): Cam toy base, rotating shaft, cam designs
- Cam toy [dimensions diagram](#)
- Edgerton Center 3D printing [resources](#)

Possible Content explorations

- **Science:** Chemical reactions, phases of matter, pollination/plant growth, cell processes, effects of climate change/rising sea level
- **Math:** Mathematical relationships
- **Social Studies:** Change in power balance before/after conflict/event, American westward expansion, Medieval life and social structures, understanding of race in the US, women's roles in society, reactions to social stresses such as taxes/tariffs/cultural oppression/work conditions, citizenship and stewardship examples
- **ELA:** Scenes or animated characters from a story/novel/play/history
- **World Languages:** Cultural norms in world cultures, myths and legends