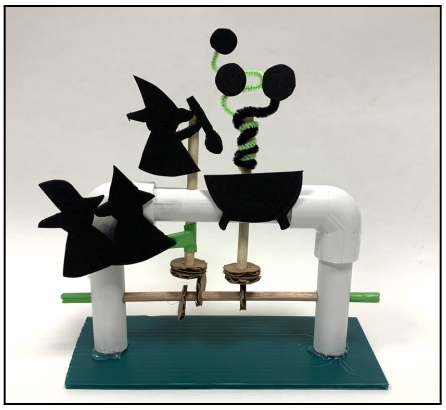
# Automata with PVC Pipe Base

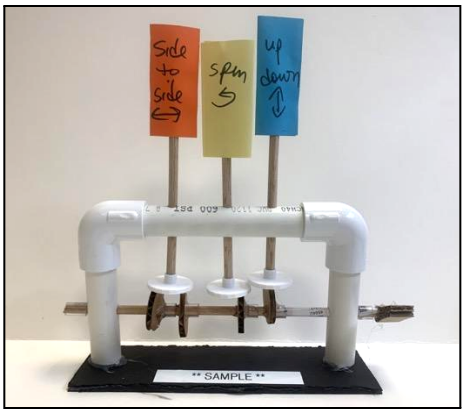
**Shared by**: Edgerton Center K-12 Maker Team

| **Specialized tools and materials used:** | **Experience level required:** |
|---|---|
| Drill | Beginner/intermediate |
| Craft materials (card stock, foam sheets, markers, hot glue, craft tape, hole punch, scissors or cutting tool) | Beginner/intermediate |
| Wood dowels, ¼" diameter | Beginner |
| PVC pipe and joints, size ½" | Beginner |

**Grade Level and Subject** (of this example): 9th Grade Literature

**Topic/Content Standards** (for this example): Mechanical design, abstract modeling






**Summary of Project:**

Students will design and create machines with moving objects/characters that symbolize abstract concepts and represent dynamic situations. These machines, called automata or cam toys, consist of hand-powered mechanisms that create cyclical motions to animate a scene (see simple and complex examples). 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.

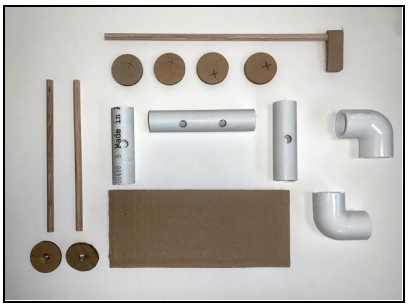
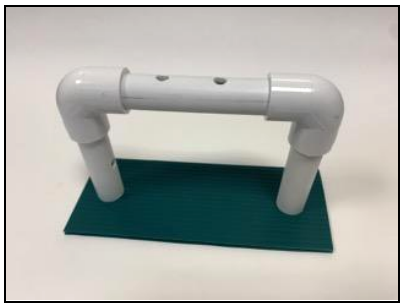
This design uses inexpensive PVC pipe and fittings and is a modern take on a classic craft machine. Traditional automata bases are made with wood pieces or cardboard, both of which require clean cuts and 90° corners. The use of PVC pipes and 90° angle fittings eliminates the need for clean perpendicular cuts, the use of wood cutting tools, and the

production of sawdust. Ratcheting PVC pipe cutters do not require much strength and create clean cuts. The cut ends will not be exactly perpendicular, but the ones that go in the fittings don't matter, and the ones that get glued to the base can be adjusted with hot glue.

Students will begin by researching the motions and mechanisms that are easily implemented in a cam toy, then 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, or represent abstract concepts, like a balance of power, ecological interactions, or societal changes. The appearance and motions of the characters and objects must communicate the intended concept. When they are ready to fabricate their models, they can do so with a combination of craft materials and PVC pipes.

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

Encourage students to test each other's automata, and see if they can figure out what they mean before the concept is explained.

**Suggested resources**

- Example automata in action: Sample 1, Sample 2
- Step by step guide with photos and mechanical cam toys Instructable

**Possible Content explorations**

- **Science:** Chemical reactions, phases of matter, pollination/plant growth, cell processes, effects of climate change/rising sea level
- **Social Studies:** Change in power balance before/after conflict/event, social structures, reactions to social stresses like taxes/cultural oppression/work conditions, stewardship examples
- **ELA:** Scenes or animated characters from a story/novel/play/history
- **World Languages:** Cultural norms in world cultures, myths and legends