Scene Machines

Hand-cranked automata that animate a scene.

GRADES 2 THROUGH 8 | AGES 7 TO 14 | ABOUT 60 MIN

These are the standards listed in the Scene Machines educator guide. Under each one is where you will see it in the activity.

Next Generation Science Standards (NGSS)

CODE	WHAT IT COVERS
K-PS2-1	Motion and Stability: Forces and Interactions
	WHERE YOU'LL SEE IT (GRADES K-2): Learners **apply a push and a turn to the cam axle and observe how the follower rotates in response** - feeling firsthand that a force applied at one point in a mechanical system causes motion somewhere else, and noticing that the size of their turn determines how far the follower moves.
K-2-ETS1-2	Engineering Design: Develop a simple sketch, drawing, or physical model
	WHERE YOU'LL SEE IT (GRADES K-2): Learners **sketch a one-sentence scene on the Brainstorm Sheet before they build**, drawing where the moving element will go on the frame and labeling which mechanism will drive it - then building a low-fi paper-and-tape prototype of that sketch to test whether the mechanism animates the story the way they imagined.
3-PS2-1	Forces and Interactions: Cause and Effect
	WHERE YOU'LL SEE IT (GRADES 3-5): Learners **investigate how the direction and position of the cam cause the follower to rotate one way or the other** - sliding the cam from the left of the follower to the right of the follower, then turning the cam axle, and observing that the follower's direction of rotation reverses. A direct, observable cause-and-effect relationship in a mechanical system.
3-5-ETS1-3	Plan and carry out fair tests to identify failure points
	WHERE YOU'LL SEE IT (GRADES 3-5): Learners **systematically troubleshoot a stuck round-and-round mechanism** by isolating one variable at a time: first checking whether the cam and follower are in contact, then whether the stoppers need to slide, then whether the follower axle is sticking out too far and blocking the cam - a textbook failure-point test they can repeat on the up-and-down and side-to-side unlocks.
MS-PS3-5	Construct an argument that a change in kinetic energy means energy was transferred
	WHERE YOU'LL SEE IT (GRADES 6-8): Learners **argue that the follower's motion is evidence of energy transferred from the cam** - before the crank turns, the follower is still and its kinetic energy is zero; after, it is rotating. The turning hand applies force to the cam, the cam pushes the follower at the point of contact, and the follower's gain in kinetic energy is exactly the energy the learner put in.
MS-ETS1-3	Analyze data from tests to identify similarities and differences among several design solutions
	WHERE YOU'LL SEE IT (GRADES 6-8): Learners **compare the three mechanism unlocks - round-and-round, up-and-down via offset cam, and side-to-side via linkage** - evaluating which mechanism best animates each scene element, documenting trade-offs between mechanical simplicity (round-and-round) and expressive motion (side-to-side linkage), and justifying their choice using observations from their prototype test runs.

Common Core State Standards (Math and ELA)

CODE	WHAT IT COVERS
RI.K-2.7	Use illustrations and words in a text to describe key ideas
	WHERE YOU'LL SEE IT (GRADES K-2): Learners **use the visual instruction sheet and the Planning Sheet to identify the parts of their Scene Machine** - the cam, the follower, the guide tube, the axle - matching the labeled illustrations to the real foam and cardboard pieces as they fold and build the automata frame.
SL.K-2.1	Participate in collaborative conversations
	WHERE YOU'LL SEE IT (GRADES K-2): Learners **describe their Scene Machine's story to a partner in one sentence**, using automata vocabulary like "cam," "follower," and "axle" to explain how the mechanism animates the element their story is about - rehearsing the narrative that made them pick a round-and-round motion in the first place.
RI.3-5.3	Explain relationships between a series of concepts in a text
	WHERE YOU'LL SEE IT (GRADES 3-5): Learners **explain the cause-and-effect relationship between turning the cam axle and the follower's rotation**, tracing how the cam on one axle makes contact with the follower on the other - then predicting what happens when the cam is slid to the opposite side of the follower.
W.3-5.3	Write narratives to develop real or imagined experiences
	WHERE YOU'LL SEE IT (GRADES 3-5): Learners **use the Scene Machine Planning Sheet to title their automata and write the one-sentence story it tells**, then develop that story into a brief narrative that describes what moves, why it moves, and how the scene changes when the cam turns during the final gallery-walk presentation.

CODE	WHAT IT COVERS
RST.6-8.3	Follow a multistep procedure when carrying out experiments
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **follow the nine-step Scene Machines build sequence in order** - frame fold, guide tube, axles, cam, rotation test, brainstorm, prototype, finalize, iterate - recognizing that skipping the prototype stage is the single most common reason a final scene's mechanism fails when art supplies are already glued on.	
SL.6-8.1	Engage in collaborative discussions with diverse partners
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **compare round-and-round, up-and-down, and side-to-side mechanisms** during the unlock phase, arguing which mechanism would best animate a particular story element and citing evidence from their prototype test runs to support the engineering decision.	
2.MD.A.1	Measure the length of an object by selecting and using appropriate tools
WHERE YOU'LL SEE IT (GRADES K-2): Learners **use their own pinky finger as a measuring tool** to determine the length of the jumbo straw that becomes the guide tube - a real-world moment where an informal unit of length is exactly the right tool for the job, and where measurement directly controls whether the mechanism works.	
K.G.A.1	Describe objects using shape names and relative positions
WHERE YOU'LL SEE IT (GRADES K-2): Learners **describe the foam parts using shape vocabulary** - the large disc and medium disc (circles), the small stoppers, the rectangular cardboard frame - and use positional language to explain "the follower sits on top of the cam" and "the stoppers go on the outside of the frame" during assembly.	
4.MD.C.5	Recognize angles and understand concepts of angle measurement
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **observe how the cam rotates through a full 360-degree turn** and how the follower rotates in response - tracking the angle of rotation of each axle and noticing how the arrow they drew on the cardboard test disc sweeps through a complete circle every time the cam axle makes one revolution.	
4.OA.C.5	Generate and analyze patterns
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **predict the repeating pattern of the round-and-round mechanism** - when the cam axle turns forward, the follower axle turns in a predictable direction, and every subsequent revolution produces the same result - recognizing this consistent cyclical pattern as the defining feature of a rotational mechanism.	
7.G.B.4	Know the formulas for the area and circumference of a circle
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **measure the circumference of the large and medium discs** and reason about how circumference relates to the mechanical output of their automata - a larger cam disc sweeps a longer path per rotation, producing a wider up-and-down movement when used with the offset hole in the advanced mechanism.	
7.RP.A.2	Recognize and represent proportional relationships between quantities
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **investigate the proportional relationship between cam-axle rotations and follower-axle rotations** - one full turn of the cam axle produces one full turn of the follower axle in a standard round-and-round - and discuss how changing cam size would change this proportion in a redesigned mechanism.	

LEARNERS EXPLORE

automata mechanisms (cams and followers); rotational motion; visual storytelling; the engineering design process; iterative mechanism design