Strawbots

A motorized wiggling machine made of straws.

GRADES 2 THROUGH 8 | AGES 7 TO 14 | ABOUT 45 MIN

These are the standards listed in the Strawbots 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 **observe how the motor's spinning offset weight creates an unbalanced force** that pushes and pulls the Strawbot in unpredictable directions, feeling the vibration in the straw structure and discovering firsthand that unbalanced forces - not balanced ones - are what cause the Strawbot to move across the table.	
K-2-ETS1-2	Engineering Design: Develop a simple sketch, drawing, or physical model
WHERE YOU'LL SEE IT (GRADES K-2): Learners **design and iterate on their straw structure** by changing leg angles, switching from a triangle to a square base, and adjusting where the foam weight sits on the motor gear - testing each modification to see how it changes the Strawbot's movement pattern and direction.	
3-PS2-1	Forces and Interactions: Cause and Effect
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **investigate how the unbalanced foam weight on the motor causes vibration** and how changing the weight's position on the gear changes the movement pattern - testing different placements to observe that a weight farther from center creates stronger vibration and more dramatic Strawbot movement.	
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 Strawbot that won't move** by testing one change at a time - first checking whether the motor wires contact the battery terminals, then whether the foam weight is secured to the gear, then adjusting leg angle or base shape - isolating one variable per test to identify what improves movement.	
MS-PS3-5	Energy Transfer: Construct an explanation of energy transfer
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **trace the energy conversion chain in their Strawbot** - chemical energy stored in the AA battery converts to electrical energy flowing through the motor wires, then to mechanical energy as the motor spins, then to kinetic energy as the offset foam weight creates vibration that transfers through the straw structure and moves the entire Strawbot across the surface.	
MS-ETS1-2	Engineering Design: Evaluate competing design solutions
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **compare triangle versus square base configurations** and different leg arrangements across their group's Strawbots, evaluating which design trade-offs - three legs versus four, short legs versus long, weight near center versus edge - produce the best balance of stability and movement, and presenting evidence for why one design outperforms another.	

Common Core State Standards (Math and ELA)

CODE	WHAT IT COVERS
SL.K-2.1	Participate in collaborative conversations
WHERE YOU'LL SEE IT (GRADES K-2): Learners **describe to a partner what happens when they connect the circuit** by inserting the motor wires under the rubber band on the battery terminals, using vocabulary like "circuit," "vibration," and "motor" to explain what they see spinning, hear buzzing, and feel vibrating during the testing phase.	
RI.K-2.7	Use illustrations and words in a text to describe key ideas
WHERE YOU'LL SEE IT (GRADES K-2): Learners **refer to the visual instruction sheet and diagrams** in their Strawbots kit to identify which component is the motor, which is the AA battery, and how the foam harness and rubber band connect them to the straw structure - using both pictures and labels to understand the circuit before assembling it.	
RI.3-5.3	Explain relationships between concepts in a text
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **explain the cause-and-effect relationship between connecting the circuit and the Strawbot vibrating** by tracing how electricity flows from the battery through the motor wires, spins the offset foam weight, and creates the mechanical vibration that makes the entire straw structure shake and move across the table.	
W.3-5.2	Write informative/explanatory texts
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **document their Strawbot design changes in journals**, writing what they modified - leg angle, base shape, or weight placement - and explaining why each change affected the Strawbot's movement pattern, speed, or stability during the iteration phase.	

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 Strawbots build sequence precisely**, understanding that the order matters - testing the circuit first by connecting the motor wires to the battery before building the straw structure, because verifying the motor spins and the foam weight vibrates before assembly prevents rebuilding later.	
SL.6-8.1	Engage in collaborative discussions with diverse partners
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **compare different Strawbot designs across their group**, debating whether a triangle base or square base produces better movement and discussing which structural choices - leg length, weight placement, connector angles - create the most stable and interesting motion patterns.	
K.G.A.1	Describe objects using names of shapes and relative positions
WHERE YOU'LL SEE IT (GRADES K-2): Learners **identify triangles and squares in their Strawbot's straw structure** and describe spatial relationships during assembly - "the motor sits on top of the straw," "the legs connect below the base," and "the battery is between two connectors" - using positional language like above, below, and between.	
K.MD.A.1	Describe measurable attributes of objects
WHERE YOU'LL SEE IT (GRADES K-2): Learners **compare the lengths of straws used for legs versus the base** and observe how longer or shorter legs affect the Strawbot's height, balance, and movement pattern - describing the relationship between leg length and how smoothly the Strawbot travels across the surface.	
3.MD.B.4	Generate measurement data by measuring lengths
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **measure straw lengths and leg angles on their Strawbot** and compare how different measurements affect balance and motion, generating data about the relationship between leg length, angle of attachment, and the distance the Strawbot travels in a set time.	
4.G.A.1	Draw and identify geometric shapes based on attributes
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **recognize triangles and squares as structural bases for their Strawbot** and discuss which geometric shape provides better stability - observing that a triangular base with three legs distributes vibration differently than a square base with four legs, and testing which configuration moves more effectively.	
6.RP.A.1	Understand ratio concepts and use ratio reasoning
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **count their kit's parts and express them as a ratio** - 12 straws to 12 connectors, or 1:1 - and use that ratio to reason about how many connectors they would need if they wanted to build a six-legged Strawbot instead of the standard design.	
6.EE.C.9	Use variables to represent two quantities that change in relationship to one another
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **name leg length as the independent variable and travel distance as the dependent one**, then test several leg lengths, record the pairs in a table, and describe the relationship in words and as an equation - finding out whether longer legs really do carry the Strawbot farther, and where the pattern breaks down.	

LEARNERS EXPLORE

closing an electric circuit; unbalanced forces and vibration; energy transfer (electrical to mechanical to kinetic); structural stability (triangle vs. square bases); iterative troubleshooting