Electric Vehicles

A motorized car with a real gear train.

GRADES 3 THROUGH 8 | AGES 8 TO 14 | ABOUT 60 MIN

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

Next Generation Science Standards (NGSS)

CODE	WHAT IT COVERS
4-PS3-2	Energy Transfer: Make observations about energy transfer
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **observe how energy from the AA battery transfers through the wires into the DC motor and then through the gear train into the wheels**, tracing the path of electric current from source to work output and confirming the transfer by disconnecting the battery and watching the motor stop.	
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 Electric Vehicle** by isolating one variable at a time - wiggle the axle to test friction, nudge the foam bearing to test gear alignment, check the battery band to test circuit closure - finding the exact failure point instead of guessing.	
MS-PS3-5	Construct an explanation of energy transfer
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **explain how the chemical energy in the AA battery is converted into electrical energy in the wires, then into mechanical energy in the motor, and finally into kinetic energy in the rolling vehicle** - identifying each transformation along the way and predicting what happens to each form of energy when the circuit is broken.	
MS-ETS1-3	Analyze data to compare design solutions
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **compare their Iterate-step redesigns against classmates' in a timed race**, analyzing which design choices (wheel size, weight distribution, number of wheels, body shape) produced the fastest or most reliable vehicle and using that data to refine a second-round design.	

Common Core State Standards (Math and ELA)

CODE	WHAT IT COVERS
RI.3-5.7	Interpret information presented visually
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **read the slide deck and the printed visual guide to identify which side of the platform the plastic wheel connects to**, interpreting the diagrams and photos to place the bearings, gears, and axle in the correct positions before the motor is powered.	
SL.3-5.1	Engage effectively in collaborative discussions
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **answer prompts like "what do you think each component is called?" with their neighbors**, discussing the difference between bearings and bushings and agreeing on a troubleshooting strategy when a classmate's gear wheel will not mesh with the motor gear.	
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 Electric Vehicles build sequence precisely**, recognizing that the order matters - the gear wheel must be pressed onto the axle before the axle is inserted into the motor clip, and the battery must be connected last so the motor only starts spinning at the intended moment.	
SL.6-8.1	Engage in collaborative discussions with diverse partners
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **debate what changed when the wires were swapped on the battery** during the polarity test, comparing observations with classmates and building a shared explanation of how the direction of current flow controls the direction of the motor.	
4.G.A.2	Classify two-dimensional figures based on their lines and angles
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **classify the foam parts by their attributes** before placing them - sorting the circular wheels and bushings from the rectangular bearing, and identifying which pieces have parallel sides and which have none - so the right piece goes in the right spot on the first axle assembly.	
4.G.A.1	Draw and identify lines and angles, and classify shapes
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **identify the three-sided rectangular tab that must sit on the correct side of the platform** and classify the foam wheels and bushings by their circular or rectangular cross-sections as they reason about which piece fits where on the first axle assembly.	

CODE	WHAT IT COVERS
6.RP.A.1	Understand ratio concepts and use ratio reasoning

WHERE YOU'LL SEE IT (GRADES 6-8): Learners **observe the gear-ratio relationship between the motor gear and the axle gear wheel** - noting how many times the motor gear must spin before the larger axle gear completes one full rotation - and discuss how changing the gear ratio would change the vehicle's speed.

7.RP.A.2	Recognize and represent proportional relationships

WHERE YOU'LL SEE IT (GRADES 6-8): Learners **decide whether battery charge and vehicle speed are in a proportional relationship** by racing the same vehicle with a fresh battery and then a partly-drained one, timing each run over the same distance and testing whether cutting the charge roughly in half also cuts the speed roughly in half - concluding, from their own timed data, at what point the relationship holds and where it breaks down.

LEARNERS EXPLORE

closing an electric circuit; gear trains and torque transfer; electrical polarity; iterative vehicle design; cause and effect in mechanical systems