Wind-Up Vehicles

Spring-powered cars learners design and reinvent.

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

These are the standards listed in the Wind-Up Vehicles 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 winding the motor creates a push that rolls the vehicle forward**, investigating how the strength of the wind (more clicks vs. fewer clicks) changes the distance the vehicle travels and the speed at which it moves - a direct observation of force-and-motion cause and effect.	
K-2-ETS1-2	Engineering Design: Develop a simple sketch, drawing, or physical model
WHERE YOU'LL SEE IT (GRADES K-2): Learners **iterate through multiple vehicle configurations in Step 10**, physically modeling each change - swapping wheels, adjusting the wedge position, trimming axle length - and testing whether each modification improves how the vehicle rolls, learning that engineering is a cycle of build-test-change.	
3-PS2-1	Forces and Interactions
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **investigate how the force released by a tightened spring causes the Wind-Up Vehicle to roll**, testing different wind counts and different wheel sizes to observe how the same stored energy produces different motion outcomes depending on the vehicle's design - establishing a clear cause-and-effect relationship between force input and motion output.	
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 vehicle that won't roll** by isolating variables one at a time - checking whether collars are dragging on the ground, whether the straw is seated in the wedge, whether the axle is too long - identifying each failure point, fixing one thing, and re-testing before changing anything else.	
MS-PS3-5	Energy Transfer: Construct an explanation of energy transfer
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **trace the energy path through their Wind-Up Vehicle**: hand-applied mechanical energy converts into elastic potential energy as the spring winds tight; elastic potential energy converts back into rotational kinetic energy when the spring releases; rotational kinetic energy transfers through the axles into the wheels as translational motion, until friction with the floor dissipates it as heat.	
MS-ETS1-3	Analyze data from tests to determine similarities and differences among competing solutions
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **compare their basic build against their iterated design** (or against a classmate's radically different configuration), measuring travel distance, stability, and speed for each and using the quantitative results to decide which design choices matter most when the goal is "farthest per wind" versus "fastest over a fixed distance."	

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 **refer to the printed instruction sheet in their Wind-Up Vehicles kit** to identify which piece is the motor holder and which are the wedges, collars, stoppers, and wheels - combining the labeled diagram with the physical foam pieces to understand the assembly before starting the build.	
SL.K-2.1	Participate in collaborative conversations
WHERE YOU'LL SEE IT (GRADES K-2): Learners **describe their troubleshooting process to a partner** during Step 9, using vocabulary like "motor," "axle," and "wedge" to explain why their vehicle rolls backwards or won't roll at all - then listen to their partner's fix and try it on their own build.	
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 tightening the wind-up spring and the vehicle rolling forward**, tracing how stored potential energy in a wound spring releases as rotation that spins the straw axles and drives the foam wheels across the floor.	
W.3-5.2	Write informative/explanatory texts to examine a topic
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **write a short build log describing how they modified their vehicle for the wheel-diameter experiment** - noting which wheels they tested, how far the vehicle rolled each time, and what they concluded about the relationship between wheel size and travel distance.	

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 10-step Wind-Up Vehicles build sequence precisely**, understanding that the order matters - the straws must be seated in the wedge pinchers before the collar slides forward to lock them, and the scraps from Step 5 must be saved because they become the second axle in Step 7.	
SL.6-8.1	Engage in collaborative discussions with diverse partners
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **negotiate the rules of the cross-kit combination challenge** - debating whether vehicles should lock rigidly or flex at the joints, whose motor drives first, and what it means for the giant rolling machine to "work" - building scientific argumentation skills as they test their collaborative build.	
2.MD.A.1	Measure the length of an object
WHERE YOU'LL SEE IT (GRADES K-2): Learners **measure how far their Wind-Up Vehicle travels on a single wind** using a ruler or tape along the floor, comparing their result to a classmate's and identifying which build traveled farther - connecting physical length measurement to the spring's energy output.	
K.G.A.1	Describe objects using names of shapes and relative positions
WHERE YOU'LL SEE IT (GRADES K-2): Learners **identify the wheel as a circle and the wedge as an L-shape** and describe spatial relationships during assembly - "the collar slides in front of the wedge," "the straw goes through the hole," "the stopper sits outside the wheel" - using positional language throughout the build.	
3.MD.B.4	Generate measurement data by measuring lengths
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **test their vehicle with all three wheel-pair diameters and measure travel distance for each**, generating a small data set and displaying it on a line plot - comparing how small, medium, and large wheels translate the same amount of spring energy into different amounts of rolling distance.	
4.MD.A.2	Use the four operations to solve word problems involving distances
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **calculate the difference in travel distance between their vehicle's small-wheel and large-wheel tests**, using subtraction to quantify the improvement and multiplication to predict how far the vehicle would travel over multiple winds at the best-performing wheel size.	
6.RP.A.3	Use ratio and rate reasoning to solve real-world problems
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **calculate travel distance per wind** by dividing the total distance their vehicle rolled by the number of clicks they wound into the spring - comparing rates between their own runs at different wheel sizes and building an intuition for how stored energy converts to motion.	
7.SP.B.4	Use measures of center to draw informal comparative inferences about two populations
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **compare the average travel distance of small-wheel vs. large-wheel configurations** across multiple trials, calculating the mean for each group and using those measures to argue which wheel choice is better for distance vs. speed - using real experimental data from their own builds.	

LEARNERS EXPLORE

elastic potential energy; energy transfer (spring to motion); axle and wheel mechanics; iterative open-ended design; troubleshooting drivetrains