Monster Claws

An air-powered grabbing claw.

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

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

Next Generation Science Standards (NGSS)

CODE	WHAT IT COVERS
3-PS2-1	Forces and Interactions: Cause and Effect
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **investigate how the force of pulling a piston handle causes the claw jaws to close**, testing different pull strengths to observe how the claw responds - establishing a clear cause-and-effect relationship between applied force, air pressure transfer through the tube, and the opening/closing motion of the claw.	
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 claw that will not fully open or close** by checking one variable at a time - is one piston fully closed and the other fully open? Are both tube connections snug? Are the connectors firmly pushed through? - isolating each possible failure point until the system works.	
MS-PS3-5	Energy Transfer: Construct an explanation of energy transfer
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **explain how energy transfers through their Monster Claws pneumatic system** - the mechanical energy of pulling the piston handle converts to pneumatic energy as air is compressed and pushed through the tube, then converts back to mechanical energy on the other side when the second piston extends and pulls the claw jaws closed.	
MS-ETS1-2	Evaluate competing design solutions
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **compare their Monster Claw's performance when driven by air versus colored water** during the hydraulics extension, evaluating which fluid produces stronger, more controlled gripping force - and discussing the trade-offs engineers make between the simplicity and speed of pneumatics and the consistent force of hydraulics in real-world gripper design.	

Common Core State Standards (Math and ELA)

CODE	WHAT IT COVERS
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 pulling a piston handle and the claw closing** by tracing how air travels from one cylinder, through the connecting tube, and into the other cylinder - connecting what the printed visual guide shows to the physical pneumatic system they built.	
W.3-5.2	Write informative texts to examine a topic and convey ideas clearly
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **write or dictate a short "how it works" paragraph for their Monster Claw**, identifying the piston, cylinder, and tube and explaining how a push or pull on the handle transfers air through the system to open or close the claw.	
RST.6-8.3	Follow a multistep procedure when carrying out experiments
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **follow the ten-step Monster Claws build sequence precisely** - including the critical rule that one piston has to be fully pushed in and the other fully pulled out before the tube is connected - understanding that reversing the order or skipping the balance step means the pneumatic system won't transfer air correctly.	
SL.6-8.1	Engage in collaborative discussions with diverse partners
WHERE YOU'LL SEE IT (GRADES 6-8): Learners **debate the trade-offs between pneumatics and hydraulics during the extension activity**, using their Monster Claws to compare how force transfers through air versus colored water, and arguing which approach is better for specific real-world applications like dental chairs, construction equipment, or robot grippers.	
3.MD.B.4	Generate measurement data by measuring lengths
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **measure how far the piston handle moves when they push or pull it** and compare it to how far the claw jaws open or close, generating data about the one-to-one relationship between handle motion and claw motion in their pneumatic system.	
4.OA.C.5	Generate and analyze patterns
WHERE YOU'LL SEE IT (GRADES 3-5): Learners **observe the inverse push-pull pattern of the pneumatic system** - when they pull one piston out, the claw closes; when they push the piston in, the claw opens - recognizing this as a consistent, repeating inverse relationship and predicting the claw's motion before every push or pull.	

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

WHERE YOU'LL SEE IT (GRADES 6-8): Learners **count the lever segments that make up each half of their claw** - three straight and bent levers fastened together for the long half, two for the short half - expressing this as a 3:2 ratio and reasoning about why the long half, built from more segments, sweeps through a wider arc than the short half when the claw opens and closes.

8.G.C.9	Know the formulas for the volumes of cones, cylinders, and spheres and use them to solve problems

WHERE YOU'LL SEE IT (GRADES 6-8): Learners **calculate the volume of air inside a closed cylinder** using $\pi r^2 h$ before and after the piston is pushed in, connecting the change in cylinder volume to the force and range of motion they feel in the claw - then predict how a wider or a longer cylinder would change both.

LEARNERS EXPLORE

pneumatics and air pressure; lever systems; force transfer through a closed fluid system; troubleshooting mechanical systems; pneumatics vs. hydraulics