LESSON 3 Robots at the Ready

OBJECTIVE

Students consider how robots can be beneficial in manufacturing and perform a cost-benefit analysis to merge business thinking with STEM.

MATERIALS

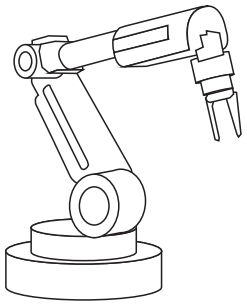
"Robot Reboot" activity sheet, Internet access

TIME

75 minutes

CONTEST PREP

This lesson gives students a chance to practice business thinking in the context of robotic manufacturing.



ACTIVITY SHEET KEY

1. There is no single correct solution. Staying in budget, a maximum efficiency score of 19 can be achieved with three robots with an efficiency score of 6 plus one robot with a score of 1.

2. Students can share research on how robot functions might be beneficial for workers. E.g., 'Robot A' lifts heavy pieces that might be dangerous for humans to lift.

3. Students can share how they consolidated budget and efficiency score with prior knowledge, research, and personal judgment when making decisions.

ARCONIC FOUNDATION

CLASS DISCUSSION

1. Show a short video of robots working on an automotive assembly line, such as bit.ly/2JNx4uW.

2. Ask your class if the arms in the video are robots or machines. What is the distinction between a robot and a machine? Prompt students that a machine performs a function and a robot is a *type* of machine that can be programmed to *autonomously* perform a variety of functions. .

3. Ask students to think about the video of the assembly line they watched. Besides performing a specific function, like driving a screw or lifting a piece into place, what are some of the reasons robots are used in manufacturing? Create a list together. Jump-start the list or complement students' ideas with the following robot functions:

   - handling repetitive tasks
   - working with small pieces or in tight spaces
   - working with large or heavy pieces
   - efficiency
   - working in unsafe or hazardous conditions for humans (such as extreme temperatures or heights)
   - ability to be programmed to perform complex functions and sequences and respond to changing conditions

ACTIVITY

Distribute the "Robot Reboot" activity sheet and explain to students that they'll be researching some of the functions robots perform in the manufacturing of vehicles. Students will work with a budget and make decisions about how to improve the efficiency of their fictional green-energy bus factory. There is no right answer as long as students can justify their choices.

Ask them to share their solutions and the rationale for their decisions. Are they able to figure out the maximum efficiency score? What factors besides efficiency are important to your students?

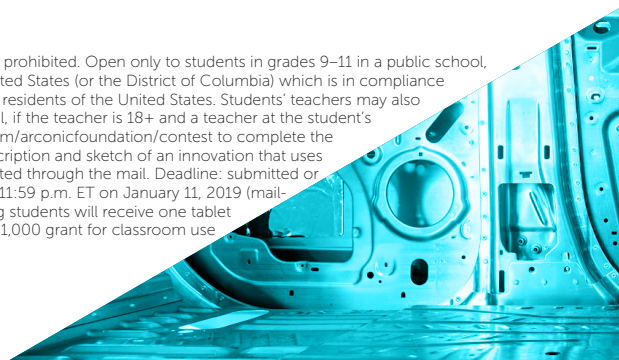
ENTER FOR A CHANCE TO WIN A $1,000 CLASSROOM GRANT!

Continue the learning with the Innovators of Tomorrow Contest. Five students in grades 9-11 will win a tablet, and their teacher will win a $1,000 classroom grant! You may wish to get students motivated by having them think about what they would do with a tablet, or what technology, supplies, or field trips they would suggest you purchase or organize if your classroom receives the $1,000 classroom grant.

Share the prep sheet with students so they can plan their entries. When students are ready, ensure they fill out and submit all three components.

It is recommended that teachers mail or upload for an entire class, but students may also submit on their own. For complete details go to **scholastic.com/arconicfoundation/contest**.

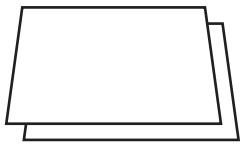
NO PURCHASE NECESSARY TO ENTER OR WIN. Void where prohibited. Open only to students in grades 9–11 in a public school, an accredited private school, or a home school in the 50 United States (or the District of Columbia) which is in compliance with the laws and regulations of its state/district and who are residents of the United States. Students' teachers may also submit entries on their students' behalf both online or by mail, if the teacher is 18+ and a teacher at the student's school. To enter, an eligible student must go to scholastic.com/arconicfoundation/contest to complete the online entry form, as well as create and upload a written description and sketch of an innovation that uses advanced manufacturing; or complete entries can be submitted through the mail. Deadline: submitted or postmarked between 12:01 a.m. ET on October 1, 2018, and 11:59 p.m. ET on January 11, 2019 (mail-in entries must be received by 1/23/19). Prize: Five (5) winning students will receive one tablet (ARV: $79.99). Each winning student's teacher will receive a $1,000 grant for classroom use (five grants in total). See Official Rules.



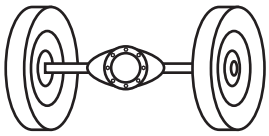
Name: _____

Robot Reboot

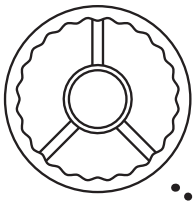
CALLING ALL ENGINEERS! A contract has been awarded for a fleet of green-transit buses in Eco City. Below is the flow of work at the Green Mobile Bus Factory as well as a selection of robots that can increase efficiency and/or improve safety. Your job is to research the robots and decide which ones are worth purchasing for Eco City. Assign up to three robots per area by writing their letter codes into each stage of the workflow. You may choose as many robots as you like, including buying multiples of the same robot, as long as you stay within your **$470,000** budget. Go!



Press Shop The panels of the bus are made here. Doors, sides, roof, and hood are stamped, cut or printed.

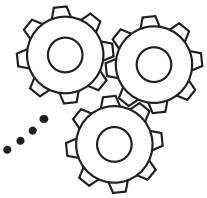


Axle Assembly The wheels are bolted and attached to the axles here. Shocks are also installed.

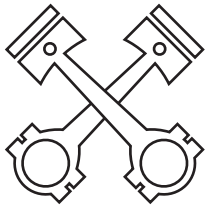


Chassis Assembly and Weld Shop
Wheels, brakes, steering, and suspension come together with the base of the bus. Welding and bolting attach key components.

Transmission Shop
Gears and shafts of the bus's gearbox are made here, plus machining of gears and box assembly.

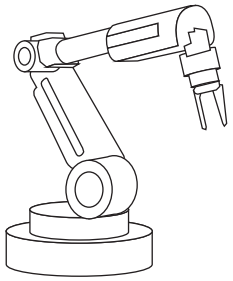


Engine Shop The bus's engine block is cast and engine parts are assembled here.



Paint Shop
Panels, frames, and parts of the bus are painted, coated, and sealed here.

Body Assembly The body of the bus is welded and bolted together here.



Warehouse
Parts manufactured externally, like seats, windshields, and brake pads, are delivered and stored here.

Weld Shop
Panels and parts are welded or bolted to the bus frame here.

FINAL ASSEMBLY
Instrumentation, wiring, pedals, interior and seats are installed here.

CHOOSE FROM ROBOTS THAT CAN BE PROGRAMMED TO...

A Lift heavy pieces **Cost:** $40,000 **Efficiency Score:** 1	**B** Assemble smaller components like gear and motor parts **Cost:** $150,000 **Efficiency Score:** 6	**C** Laser-cut, stamp or 3D-print parts/panels **Cost:** $120,000 **Efficiency Score:** 5
D Weld parts together **Cost:** $100,000 **Efficiency Score:** 3	**E** Mold parts or pour molten metal **Cost:** $50,000 **Efficiency Score:** 1	**F** Apply paint and sealant **Cost:** $110,000 **Efficiency Score:** 4
G Install parts **Cost:** $60,000 **Efficiency Score:** 2	**H** Pick and deliver parts from the warehouse **Cost:** $70,000 **Efficiency Score:** 2	**I** Work in tandem with a person **Cost:** $140,000 **Efficiency Score:** 6

Write your answers on separate paper.

1 How were you able to improve the efficiency of the factory? Add the efficiency scores of each of your robots. What is your total efficiency score? (Higher is better.)

2 Explain how the robots in your factory relieve humans of repetitive or tedious tasks, eliminate strain on the human body, remove humans from dangerous working conditions or perform tasks that might be difficult for humans.

3 How did you make decisions about which robots to include and where to place them? Which decisions were difficult? Why?