ROI

INDIANA UPLANDS | PROUD PARTNER

Grade 3-5 STEM Challenge

Fix the Machine

Inspired by Nick, a Maintenance Technician in the Indiana Uplands.

Published by Regional Opportunity Initiatives

GRADE 3-5 STEM CHALLENGE

Fix the Machine

Inspired by Nick, a Maintenance Technician in the Indiana Uplands.

Students will work together to solve a puzzle challenge while learning about processes and algorithms.

LESSON TIMELINE

DAY 1 45 Minutes

- Show the inspiration video, "Nick - Maintenance Technician"
- Explore a problem and identify possible strategies

DAY 2 60 Minutes

- Follow an algorithm
- Implement and test solutions

Recommended Supplies

For each group:

- Magic Square number cards
- Breakdown! Fix the Machine work mat
- Scissors

CAREER CONNECTION AND LESSON OVERVIEW

Nick is a Maintenance Technician with MasterBrand Cabinets in Ferdinand, Indiana. Nick's job is not only to repair machinery when it breaks down but also to routinely inspect and maintain the equipment before there is a problem. Communication skills and teamwork are essential in his position. When equipment breaks down, Nick works with the machine operator and other team members to diagnose the problem and get the machine back up and running as soon as possible. Maintenance Technicians like Nick may use electrical schematics, mechanical blueprints, and their in-depth knowledge of the equipment to find and fix the problem.

In today's activity, students will use their deductive reasoning skills to fix a broken mathematical "machine." Like Nick, they will need to be methodical in how they look for a solution to the puzzle.

IN THIS CHALLENGE, STUDENTS WILL:

- Solve an algorithmic puzzle to illustrate how a maintenance technician solves problems.
- Design an algorithm for others to solve the problem.

Standards

Science & Engineering Process Standards

SEPS.5 Using mathematics and computational thinking
SEPS.8 Obtaining, evaluating, and communicating information

Employability Skills Standards

3-5.WE.4 Complete tasks or activities with prompting and guidance from adult educators.
3-5.WE.5 Demonstrate perseverance to complete tasks and activities.
3-5.LS.2 Communicate with others by applying a variety of speaking skills.
3-5.LS.3 Communicate with others using a variety of technology.
3-5.LS.4 Relate personal interests, abilities, and leisure time activities to possible occupational choices without stereotyping.
3-5.LS.13 Utilize effective questioning and brainstorming techniques.

Mathematics Process Standards

PS.1 Make sense of problems and persevere in solving them
PS.8 Look for and express regularity in repeated reasoning

Computer Science Standards

3-5.DI.1 Understand and use the basic steps in algorithmic problem solving.
3-5.DI.2 Develop a simple understanding of an algorithm using computer-free exercises.
3-5.DI.5 Understand the connection between computer science and other fields. Computer Science Standards
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3-5.DI.2 Develop a simple understanding of an algorithm using computer-free exercises.
3-5.DI.5 Understand the connection between computer science and other fields.

English/Language Arts

3.RV.1 Build and use accurately conversational, general academic, and content specific words and phrases.
4.RV.1 Build and use accurately general academic and content specific words and phrases.
5.RV.1 Build and use accurately general academic and content specific words and phrases.

Planning and Implementation

FIX THE MACHINE

Essential Vocabulary

- ADVANCED MANUFACTURING: Using advanced technology to make things. People with careers in advanced manufacturing use their skills in computer programming and robotics to create products safely and efficiently.
- ALGORITHM: A step by step process to complete a task.
- CONDITIONAL: A conditional is an action that occurs when something specific happens (for example, IF/ELSE statements).

In this challenge, students will:

- In this challenge, students will:
- View the video “Nick- Maintenance Technician," found at https://regionalopportunityinc.org/nick/
- Solve an algorithmic math puzzle to illustrate how a maintenance technician solves problems through troubleshooting and process of elimination
- Design an algorithm for others to use to solve the problem

Before Class:

- Read the lesson plan to become familiar with the activity.
- Gather necessary materials. Be sure that you have enough materials and space for each student to work on their "magic squares."

Day 1

Introduction (20 minutes)

Introduce students to the maintenance technician career path in the field of advanced manufacturing to the students. Advanced manufacturing is uses advanced technology, like robots and other programmable machines, to make products. People with careers in advanced manufacturing use their skills in computer programming and robotics to create products safely and efficiently.

> "The person in the video we will watch today is a maintenance technician at MasterBrand Cabinets on Ferdinand, Indiana."

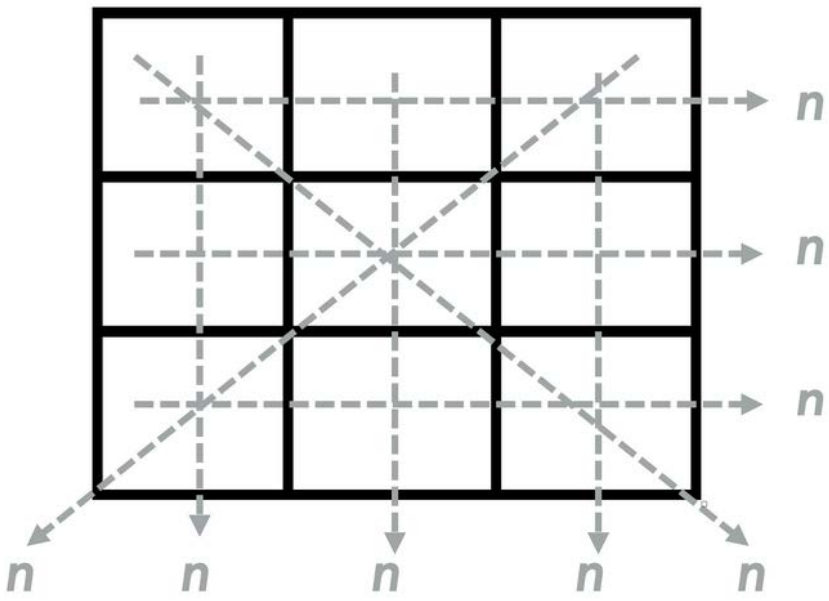
Either project the Maintenance Technician career profile or give a copy to each student. Here they can read more about being a maintenance technician.
Show the video “Nick- Maintenance Technician” (3:19).

Problem Statement and Exploration (25 Minutes)

In the video, students will see that a large part of Nick's daily job is to solve problems in manufacturing when there is a breakdown. For this activity, students will work in groups of 2-3. Provide each group with the Magic Square Number Cards, Breakdown-Fix The Machine Breakdown Mat, the Problem/Solution Log, and scissors.

Explain that the "math machine" has broken down and that they will have to solve the puzzle in order to fix it. To solve the puzzle, students will place the number cards on the grid so that, when added, the numbers in each row, column and in every diagonal have the same sum. (see figure).

Give students 5 minutes to work on finding a placement of number tiles on the "machine" where all columns, rows, and diagonals add up to the same number. Prompt groups to stop and record their attempts to solve the problem, either in words or pictures, and explain their strategy on the PROBLEM/SOLUTION LOG.



Examination

Share with the students that when approaching a problem, a maintenance technician does not begin randomly looking for solutions. They have information available, from the machine operator and instruction manuals, to help point them in the right direction.

After their first day of trial and error, many groups will have discovered that each row needs to add up to 15. If they do not arrive at this conclusion on their own, provide guidance and possible solutions ("Let's try some numbers-- does 17 work with the numbers you have?") to lead them to testable solutions.

Day 2

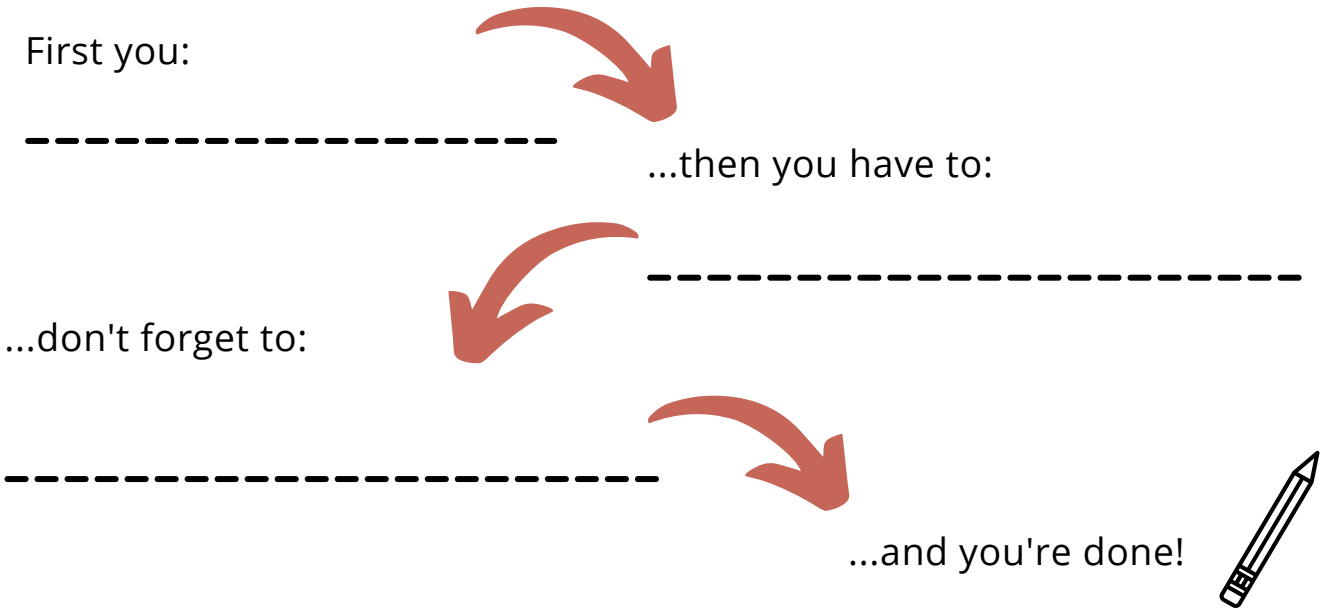
Design, Implement, and Test (40 Minutes)

Reframe the challenge from Day 1 and refocus the student's attention back to the number machine problem.

> "This problem illustrates a step-by-step process to solve a problem. Now that we know the common sum for each row, column, and diagonal is 15, we can use that information to help solve the puzzle."

Introduce the word "algorithm" to the class. An algorithm is a step-by-step process to complete a task. Computers use algorithms to complete tasks. Kids can use algorithms too!

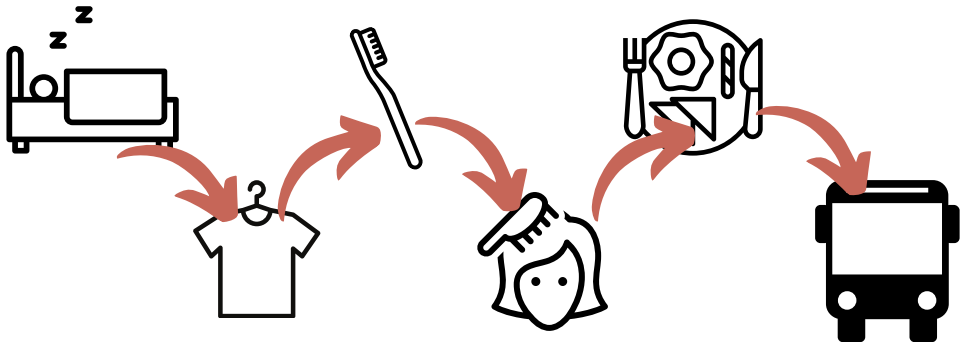
In addition to having background information available to them, maintenance technicians also follow specific steps or checklists to find problems in a machine. Have students start by determining the algorithm (series of steps) needed to sharpen a pencil



Have students spend 5 minutes coming up with an algorithm for their morning routine and record them on their Problem/Solution Log.

Example:

1. Get up
2. Get dressed
3. Brush teeth
4. Comb hair
5. Eat breakfast
6. Leave for school



The other kinds of statements that help people diagnose and troubleshoot problems are conditional statements. An If/Else statement is an example of a conditional statement. Conditionals are actions that occur when a specific thing happens.

Example: IF you eat your dinner, you get dessert. ELSE you get no dessert.

Explain that each group will be writing an algorithm so that someone trying to solve the same problem could follow it and solve the problem more easily. Students should identify one person in the group to record the steps the group takes to solve the number square problem. Students should continue to work toward a solution where the sum of each row, column, and diagonal equals 15.

As students begin to create algorithms, prompt them to record the steps they took to do so. If students are struggling to come to a solution, you can provide an additional piece of information (the middle number of the square is 5).

Communicate (20 Minutes)

Students will fill out the COMMUNICATE section of the Problem/Solution Log. Have each group of students share the algorithm they created to fix the machine with the class or another group.

Career Exploration and Extension

Prompt students to think about and research what a career as a maintenance technician might entail.

- What does a maintenance technician do all day? What does Nick do?
- What kind of training would a student need to become a maintenance technician?
- What kind of education is needed to ensure that complicated machinery and robots stay functional? Where could a student be trained locally for this career? What types of classes are important?

Name: _____

Fix the Machine

Problem/Solution Log

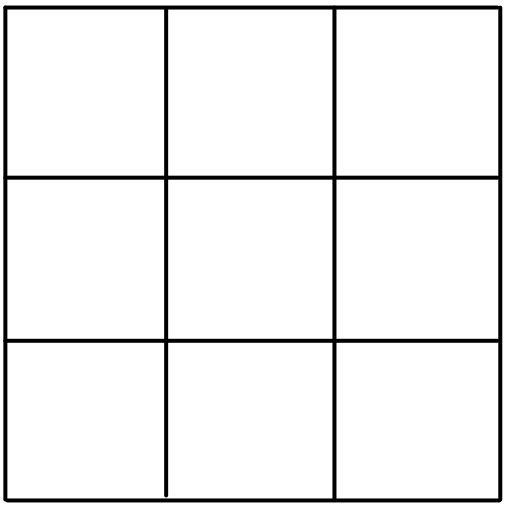
Problem Statement

What is the problem we are going to solve?

The "number machine" has had a breakdown! You need to solve the puzzle to get the machine working again. Place the number cards in the machine so that each row, column, and diagonal have the same sum (add up to the same number).

Exploration

Record the first try at creating a solution.



Explain the strategy you used to solve this.

Did your first solution work? What did you find?

Name: _____

Examination

Follow the formula for a helpful tip!

Have you figured out the sum that each row, column, and diagonal will add up to? (circle one)

Yes, it's _____ No, not yet.

To figure out the common sum, find the sum of all 9 numbers on the cards.

The sum is _____

Divide that number by the total number of rows in the square: _____

Design, Implement, Test

Create an algorithm for solving the problem.
Use this algorithm to test possible solutions!

Write out your morning routine algorithm.

Name: _____

Design an algorithm to "fix" the number machine. What steps did you take?

COMMUNICATE

Share your prototype with the class or another group.

What was the most difficult part of this challenge?

What was the most successful part of this challenge for your group?

Name: _____

Fix the Machine

Magic Square Number Cards

1	2	3
4	5	6
7	8	9

Name: _____

Fix the Machine

Breakdown Mat

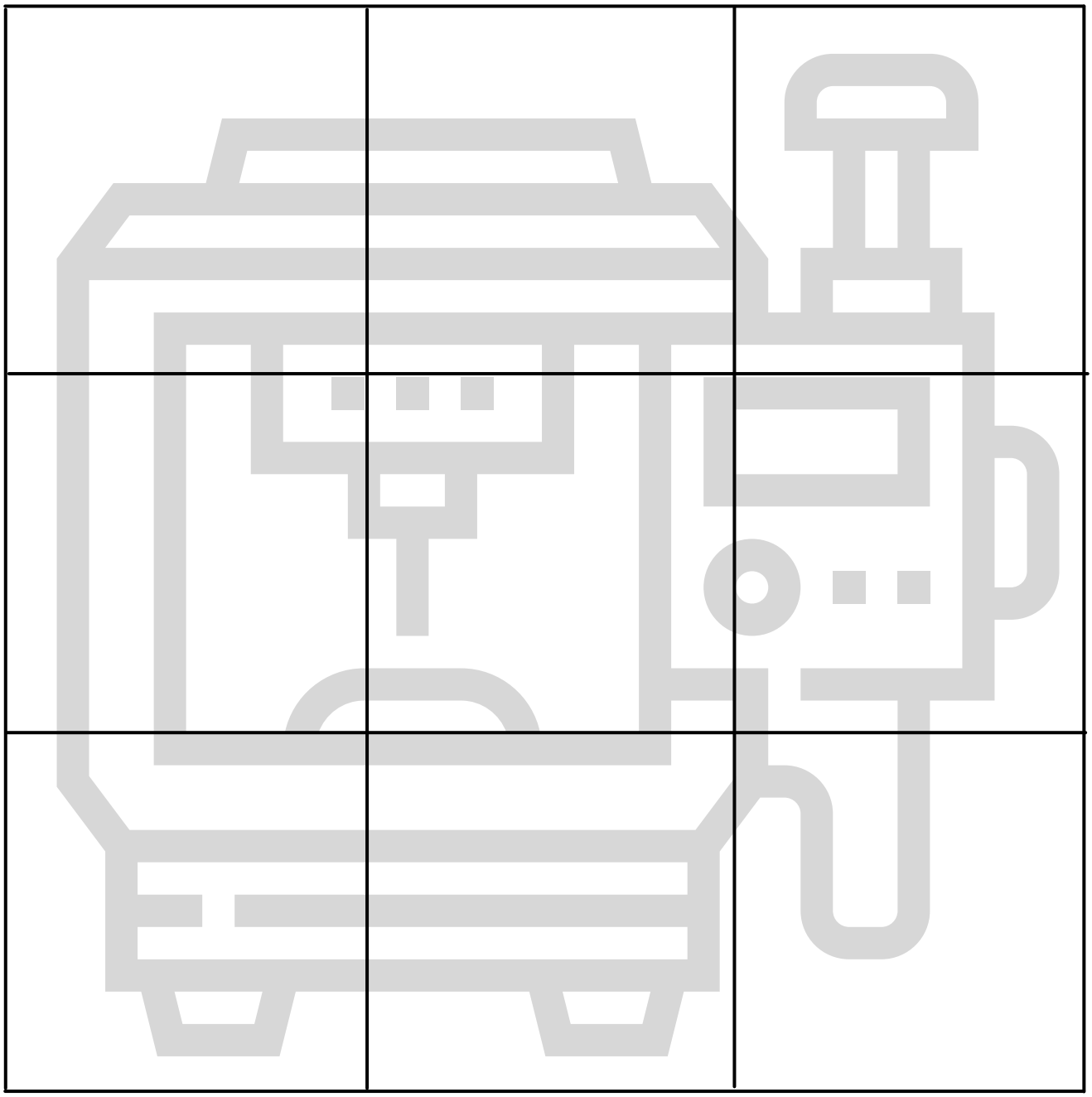


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IMAGE AND CONTENT CREDITS

Images

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Stock image assets courtesy of Canva.com

Still video images from "Nick - Maintenance Technician," available at https://regionalopportunityinc.org/nick

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