

STEM ACTIVITIES

for the Classroom

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STEM ACTIVITIES FOR THE CLASSROOM

Interested in how you can help capture your students' attention in the STEM subjects of science, technology, engineering and mathematics? This guide features several STEM activities for the classroom, spanning elementary to high school. You'll receive step-by-step plans, along with downloadable worksheets and ideas to expand the lessons.

Feel free to jump to those STEM activities now, or if you're interested in more general information about STEM and STEM education, the next two sections can provide you with helpful background on this topic.

WHY IS STEM IMPORTANT?

As the Bureau of Labor Statistics (BLS) noted, [technological changes have impacted daily life](#). Years ago, you might have consulted books at a library to plan a foreign vacation. Now, you simply reach for your smartphone.

Technological advances continue to alter various facets of life, given the emergence of trends like online learning, 3D printing, and artificial intelligence. Several personal- and work-related actions involve technology, and all of these things are products of STEM fields. STEM has led to fundamental innovations that touch all people, including those who don't study STEM or work in a STEM occupation.

“Today, it would be difficult to imagine our daily lives without smartphones, applications (‘apps’), online shopping, and many other conveniences made possible by the men and women working in science, technology, engineering, and mathematics (STEM) occupations.”

- Bureau of Labor Statistics

DEMAND AND SUPPLY

STEM careers comprise a substantial portion of all occupations. Unfortunately, the pool of talent is not enough to meet projected demand for STEM careers.

From 2000 to 2013, STEM employment has increased by [more than 30 percent](#), according to the U.S. News/Raytheon STEM Index. STEM jobs rose from 12.8 million to 16.8 million in the 13-year period, based on an index that measures key factors relating to STEM jobs and education.

Those figures are staggering, but they may not tell the whole story. A separate analysis from Burning Glass Technologies found that the STEM market may be much larger. It located [5.7 million jobs openings](#) in STEM fields in 2013. That finding was due to the study's methodology. Instead of relying on forecasts from sources, researchers analyzed the text of job postings to determine whether the position was STEM-related. As a result, for example, clinical positions in health care requiring a background in biology or chemistry would be counted; they typically wouldn't have been included in most analyses.

“The market for STEM jobs is bigger, actually significantly bigger, than most other studies have reported in the past. We also found that graduates in STEM fields have much better prospects, both because they are competing for a large number of jobs...but also because they make substantially more.”

- Burning Glass Chief Executive Officer Matt Sigelman

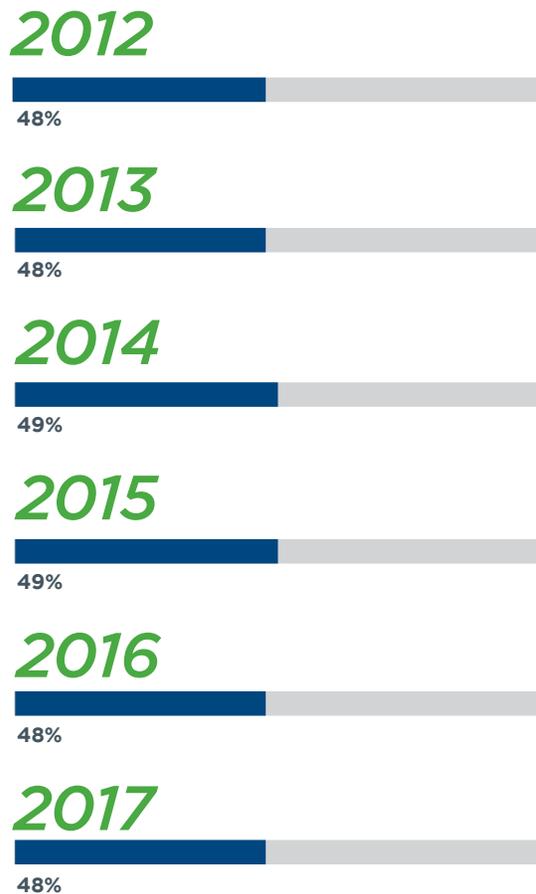
The demand is there, but what about the supply of STEM-prepared workers? U.S. News and Raytheon noted that, despite the sharp rise in STEM employment between 2000 and 2013, levels of STEM degrees granted have remained relatively flat. There were slight increases in the actual number of undergraduate and graduate STEM degrees granted, but not the total proportion of STEM degrees compared to all degrees.

More recent data isn't encouraging. According to ACT, the organization that administers the standardized test used for college admissions in the United States, STEM interest and

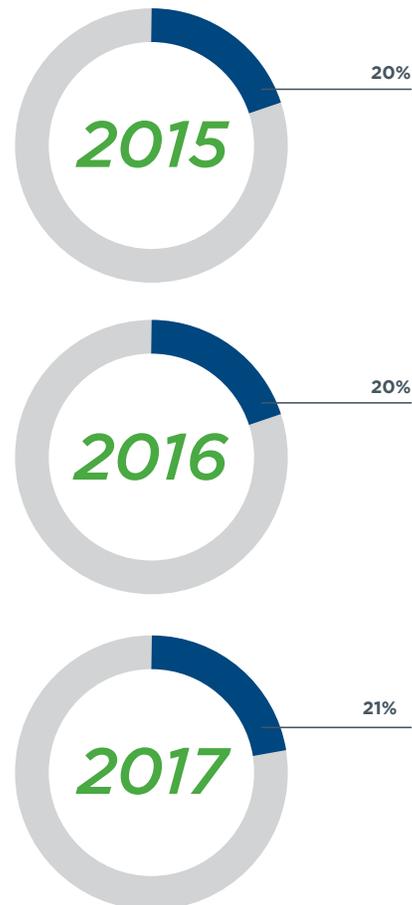
achievement for high school graduates has not changed much between 2012 and 2017. STEM interest for younger students may be even worse, based on research published by Junior Achievement. The organization found that from 2017 to 2018, interest in STEM careers has decreased among boys and stayed the same among girls ages 13 to 17.

STEM Interest and Achievement Among ACT-Tested High School Graduates

Percentages of ACT-tested high school graduates interested in STEM, 2012-2017



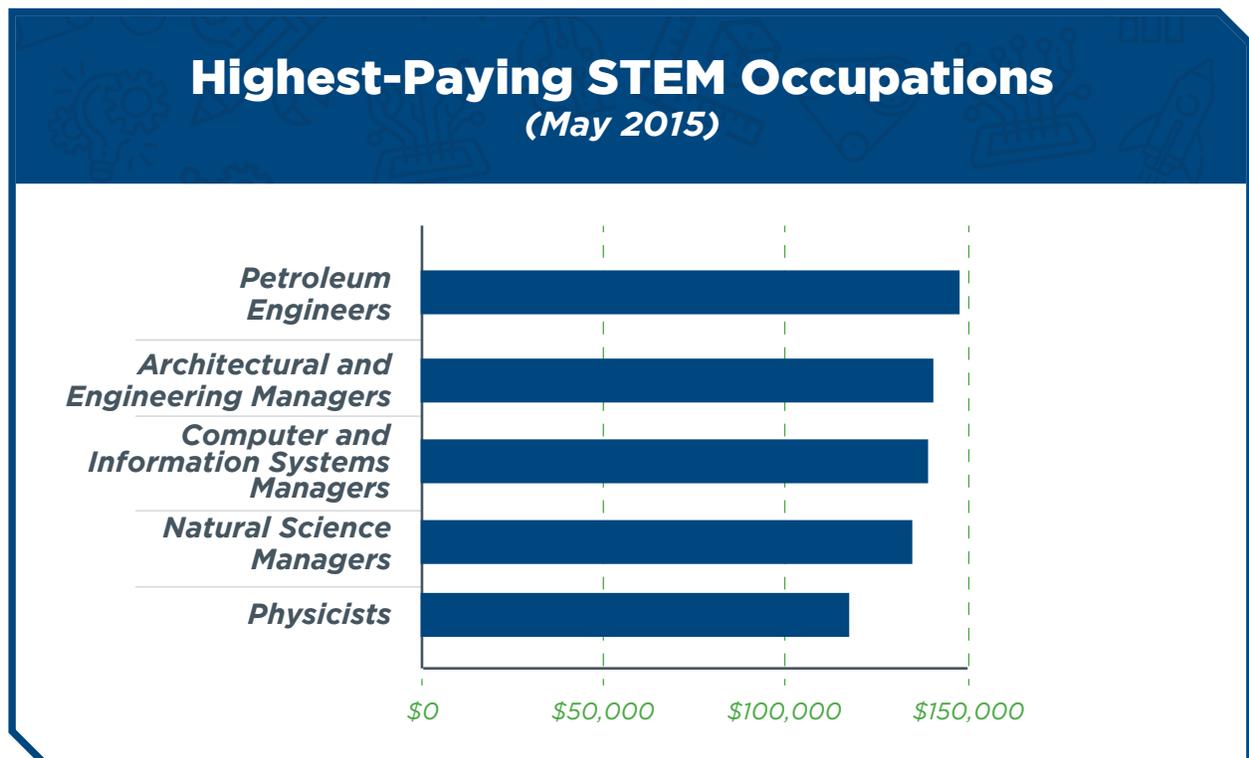
Percentages of ACT-tested high school graduates meeting the ACT STEM Benchmark, 2015-2017



Adapted from act.org

LUCRATIVE CAREER OPPORTUNITIES

The BLS analyzed STEM occupations and found that they had a national average wage of \$87,570, which nearly doubled the wage for all non-STEM occupations of \$45,700. The trend of high-paying STEM careers continued for the vast majority of occupations. Out of 100 STEM occupations, 93 had “wages significantly above the national average wage for all occupations of \$48,320,” the BLS said.



DEMOGRAPHIC TRENDS

There are [several concerning demographic trends](#) surrounding the population of STEM college majors and professionals compared to the U.S. population, according to research compiled in Science Education.



Those types of issues impact economic competitiveness and individuals who have limited opportunities. STEM allows students to be [better prepared for the future and can access attractive career opportunities](#), according to a statement released by the International Council of Associations for Science Education, Science Education International noted. The statement was addressed to everyone involved in research, policy development, and the teaching of STEM disciplines.

“Access to high quality education is a fundamental right for all. In times of global vulnerability, issues such as sustainability, health, peace, poverty alleviation, gender equity, and biodiversity conservation need to be at the forefront of thinking, planning and actions related to strengthening STEM education. While the relative balance and emphases of these disciplines varies around the world, it is the interrelatedness and combination of these that will propel progress.”

- Statement from the International Council of Associations for Science Education, 2013 World Conference

TIPS FOR ENGAGING STUDENTS IN STEM EDUCATION

How can you help your students develop a genuine interest in STEM? Here are [a few tips](#) from Marcia Reed, a former award-winning principal and current volunteer at a STEM-based organization.

- **Integrate an exclusive STEM program:** After-school and extracurricular programs including STEM activities can be helpful in encouraging students in those important subjects. However, a dedicated in-the-classroom STEM program can be especially effective. If your school doesn't have one, explore getting one of those programs started to make STEM more of a focus.
- **Demonstrate real-world connections:** How is STEM practical to students? How do STEM activities actually relate to life after school? Even if students aren't interested in a STEM-based career, you can still help them understand these connections and develop a natural curiosity about the topic. One way to do this, according to Reed, is through field trips, which help open "students' eyes to new ideas, new horizons, new surroundings, and new information."
- **Engage with families:** Students can become encouraged and empowered in STEM when families understand its benefits. Help families make the connection, which leads to involvement in students' lives. One way to do this is to host thematic STEM nights, featuring fun activities like computer labs and hands-on experiments for all ages.

One of the most direct ways to engage students is to introduce STEM activities for the classroom. At any grade level, you can promote interest in STEM subjects and work on valuable skills through a wide range of lessons. The following sections of the guide cover several STEM activities for elementary, middle, and high school.

BALANCING APPLE

(Grades 1-2)

OBJECTIVE: *Students will explore fundamental concepts of balance and gravity.*

MATERIALS

- Cardstock or paper plates
(if you only have regular paper, trace apples onto paper plates)
- Colored pencils or crayons
- Clothespins
- Printable template

INSTRUCTIONS

Feel free to introduce this lesson with the book *Ten Apples Up On Top* by Dr. Seuss. The story involves animals trying to balance apples, which is the inspiration for this activity.

You can have students perform this activity individually or divide them into groups. Demonstrate how you can balance a paper apple and then prompt them to follow your lead.

1. Hand out the paper apples to students. They can cut their apple out and color it.
2. Attach two clothespins to the bottom of each apple. The best spot is at the bottom of either side of the blossom point; tell students that or have them experiment with the best locations to place their clothespins.
3. Have students try to balance their apples with one finger at the bottom.
4. Discuss with students what's taking place. Where is the best spot to hold the apple and why? Why do other ways to hold the apple result in the apple falling?

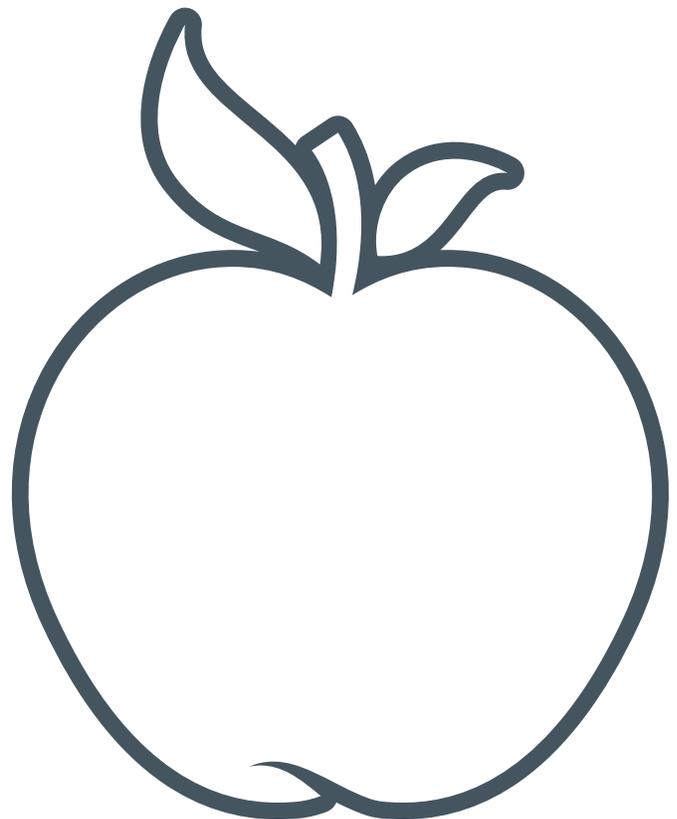
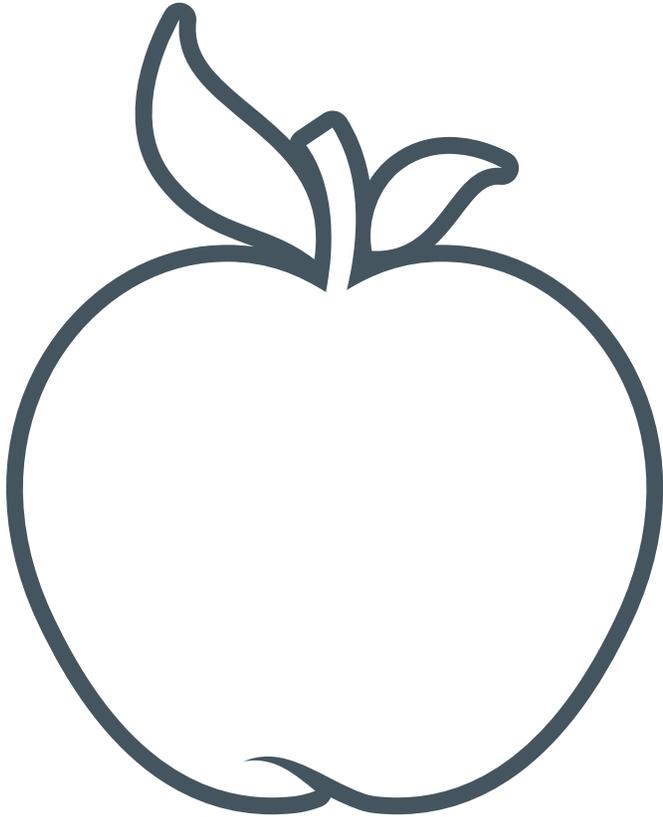
EXPANDING THE ACTIVITY

- See how many apples a student can balance at one time.
- Can a student hop around the room while balancing an apple?
- Add more weight to some part of the apple, such as by creating a paper bug and taping it to the apple. How does this alter where to place the clothespins and hold the apple? Why?

Activity provided by [Little Bins Little Hands](#)

BALANCING APPLE

Printable Template



Print on cardstock. Color and cut.

MARBLE MAZE

(Grades 3-4)

OBJECTIVE: *Students will engineer structures to develop spatial relationships, planning skills, and problem-solving skills.*

MATERIALS

- Shoebox or file box lid
- Drinking straws
- Paper
- Glue dots or tape
- Scissors
- Marbles

INSTRUCTIONS

This activity helps students work through design challenges and observe how small differences in mazes impact the movement of a marble.

1. After giving each student a box lid, scissors, drinking straws, and glue dots, have students construct a maze using the straws. Encourage them to add other features, like tunnels and ramps.
2. When students are finished, they can swap mazes with each other.
3. Ask students which mazes were the easiest and hardest to complete. Discuss why.

EXPANDING THE ACTIVITY

- Have students record the time it takes to complete mazes. Work on mathematics skills by calculating the average time for each maze.
- Do another version of the maze by propping up the box on an incline (the blog [Frugal Fun For Boys and Girls](#) expands on this version of the activity). This time, the design is from the top down, and the marble will fall to the bottom. Challenge students to create a maze that takes the longest time for the marble to reach the bottom

Activity provided by [We Have Kids](#)

BRIDGING THE GAP

(Grades 5-6)

OBJECTIVE: *Students will design and build a bridge that is able to hold a cup of marbles without breaking.*

MATERIALS

- Paper
- Pencil
- Plastic straws
- Scotch tape
- Ruler
- Scissors
- 100 marbles
- Cup

INSTRUCTIONS

This STEM activity is a great way to help students understand how bridges can handle a considerable amount of weight. Before or after students build a bridge, you can have them watch a video about how bridges accomplish that feat.

1. Set up two desks, chairs, or tables 10 inches apart.
2. Have students create a bridge that links the two objects together, using the provided materials. The goal is to make a bridge that will hold a cup filled with 100 marbles.

EXPANDING THE ACTIVITY

- Have students predict how many more marbles the bridge will hold. What's the maximum weight load? You could give students another attempt at improving the bridge to see how much it has improved.
- Instead of one cup of marbles, have the students determine how much weight the bridge can hold when two or three cups are placed in different spots. Where is the bridge the strongest?

Activity provided by [STEM Playground](#)

DARTBOARDS

(Grades Middle School)

OBJECTIVE: Students will recognize patterns in numbers and gain practice in multiplication strategies.

MATERIALS

- Downloadable worksheet

INSTRUCTIONS

Start by introducing the game of darts. Then move onto the lesson. You can pass out the worksheet for students to work on them immediately, or you can draw the two dartboards on a chalkboard or whiteboard and walk students through the questions.

Here is the information that students have on the worksheet, and the following section provides the answers to the questions.

ANSWERS

1. Students can calculate the totals by using all combinations of each number. The key is recognizing that all three totals can be the same, two can be the same and all numbers might be different. As a result, there are 10 totals.

$$\begin{array}{lll} 2+2+2=6 & 9+9+2=20 & 5+5+9=19 \\ 2+2+5=9 & 2+5+9=16 & 9+9+5=23 \\ 5+5+2=12 & 5+5+5=15 & 9+9+9=27 \\ & 2+2+9=13 & \end{array}$$

This gives ten totals: 6, 9, 12, 13, 15, 16, 19, 20, 23, 27

2. A key to this problem is that the smallest number will be a multiple of three, because that's the smallest number on the dartboard hit with three darts. So, the smallest value is 3 (9 divided by 3). Likewise, the largest number is divisible by three. So the largest value on the dartboard is 10 (30 divided by 3). Finding the middle number is done by looking at the next smallest value, in the list of totals provided in the question (11). That number is formed by adding two of the smallest numbers from the dartboard to the middle number of the board. That means the middle value is 5 ($3 \times 2 + x = 11$).

DARTBOARDS *(Continued)*

EXPANDING THE ACTIVITY

- If students had a similar dartboard but not the same numbers, like Cindy and John had, how many possible totals could they get with three darts?
 - There are 10 totals. Values can be three of the same ($3a$, $3b$, $3c$), two of the same ($2a + b$, $2a + c$, $2b + a$, $2b + c$, $2c + a$, $2c + b$) or all different ($a + b + c$).

Activity provided by [nzmaths](#)



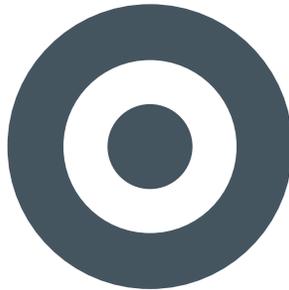
DARTBOARDS

Two people have three darts and a dartboard with three rings.

1. Here is Cindy's dartboard. Given the numbers on the board, what totals can result if all of her darts land?



2. Here is John's dartboard. Not all numbers on his board are the same as on Cindy's.



John can only make the following totals: 9, 11, 13, 15, 16, 18, 20, 23, 25, 30. Given that information, what numbers are on John's dartboard?

BOMBS AWAY

(Grades High School)

OBJECTIVE: *Students will learn about physics and practice mathematics skills.*

MATERIALS

For Building Each Catapult

- 8 popsicle sticks
- 5 rubber bands
- Glue
- Plastic bottle cap
- Soft projectile (*cotton ball, marshmallow, crumpled paper*)

For Competition and Scoring

- 1 small bin per team
- 1 ruler per team

INSTRUCTIONS

Discuss ancient and medieval catapults, which spanned several types of devices including the ballista and trebuchet. How were those devices able to launch 200-to-300-pound stones up to a thousand feet? Feel free to take a look at some [trebuchet physics](#) with your class for a mathematical explanation of how it works.

The primary part of the activity is building a simple catapult and then seeing which team can launch projectiles the greatest distance. There are plenty of ways to add complexity to the activity.

1. Separate students into groups and then hand out the required materials for each team to build a catapult.

BUILDING THE CATAPULT

2. Have students stack six popsicle sticks on top of each other.
3. Then they will wrap a rubber band around both ends of the stack.

Continued on next page.

BOMBS AWAY *(Continued)*

4. Next, students will anchor the launching stick to the stack of popsicle sticks. This is done by taking one stick and attaching it perpendicular to the stack, around the middle, so that a cross shape is obtained. Tip: Have one or two rubber bands crossed in an “X” over the sticks.
5. Now students can add the base. Attach a stick to one end of the launching stick by using a rubber band. The launching stick and the base should form a “V” shape, lying on its side with the stack of sticks in the middle.
6. Have students put their catapult on its base. They can locate the end of the launching stick that sticks up, and then glue the bottle cap so there is a small cup to hold the projectile.
7. Wait until the glue dries.

TESTING AND CALCULATING

8. Have each team launch their catapult at the target, marking the projectile’s distance each time. Teams can come up with statistics for their launches, such as median, mean, standard deviation, and more.
9. How far away from the target can each team’s catapult be placed while still allowing the projectile to hit the target? See which team is able to fire a projectile the farthest distance while reaching the target.
10. Optionally, integrate some of the following ideas to expand the activity. There are plenty of ways to reinforce physics- and mathematics-based aspects of the project.

EXPANDING THE ACTIVITY

- Use several different soft projectiles and compare the results. Which projectiles traveled the farthest distance? Is there an optimal weight for a projectile?
- Examine how the angle of the catapult, before letting go, is involved in the distance a projectile travels. For instance, how does a 30- versus 45-degree angle impact results? Students can use a scatter plot or some other type of chart to analyze the results.

*Activity provided by [STEM Playground](#)
Catapult building instructions provided by [Scientific American](#)*

BONUS STEM ACTIVITIES

(Grades High School)

Here are two other STEM activities for high school classrooms.

- Combine Earth science and geometry with NASA's "[Math Rocks: A Lesson in Asteroid Dynamics](#)." Students will learn about asteroids and meteors, and have the opportunity to calculate the distance, volume, density, and more of an asteroid tracked by NASA.
- Examine how rockets work with the American Association for the Advancement of Science's "[Rocket Launch](#)" activity. Students will analyze how the design of a model rocket impacts flight.

ENCOURAGING YOUR STUDENTS IN STEM

Need more activities and ideas of how to engage your students in STEM?

An [online master's in mathematics education](#) can deepen your understanding of mathematical concepts and their usage throughout the K–12 spectrum. You'll develop the mathematics content and pedagogy needed to excite and instill a passion for mathematics in the next generation of learners.

Mathematics is a major focus in education. School systems nationwide are looking to bolster their students' academic achievement level in STEM subjects like mathematics and science. As educational spending and incentives in the near future increase, so too will the career possibilities in mathematics. Furthering your education in mathematics instruction can help you reach your goals.

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