We don’t have a crystal ball, but we do know this:

Jobs related to the career and technical education (CTE) field are booming. The reason for this is simple: it’s all about economics. There is high demand and significant earning potential for CTE jobs, yet many of those jobs go unfilled. Study after study shows this situation will only worsen unless more people are trained in these careers.

We invite you to use this engaging career exploration curriculum that is designed in a fun and interactive way.
Thank You to Our Sponsor

Sponsorship of *SkillsUSA Middle School Career Cluster Lesson Plans* is a special project of the SkillsUSA Foundation. The generous commitment made to SkillsUSA and to developing student leaders makes this program possible.

Hypertherm has generously sponsored the resources for the Middle School Integration Guide and Career Cluster Lesson Plans as a special project of the SkillsUSA Foundation. Hypertherm believes all students deserve access to a quality education that will allow them to reach their greatest potential, help them become good community citizens and prepare them for the workforce.
Prior to the session, assemble puff vehicle material sets for each group of three students.

**ANTICIPATORY SET: 4 minutes**
Post this question and have students respond on paper:

“What are some of the newest innovations in automobiles?”

Allow one minute for work. Have students share their responses. Create a list on the writing surface. Discuss student answers. Be sure to include: pedestrian detection, automatic high-beam control, parental and teen driver technology, GPS tracking, backup cameras, in-car internet, fuel efficiency, connect apps, lane departure warning, rear cross-traffic alert, and automatic emergency braking.

“Many careers are involved in the development of new technology, production of autos and some even require the use of specialized vehicles. Which of those careers are part of our career and technical education area?”

Have a few students share responses with the class. Discuss the relationship between your career and technical education area and both the technology and auto industries.

**CONTENT ACTIVITY: 33 minutes**
Divide students into groups of three. Give instructions for the activity.

“Today, we will explore the use of wind as an energy source. Wind can be harnessed to create electricity. It can also be used to propel planes, balloons and sailboats. Inside the walls of our classroom, we don’t have wind, but we can create ‘puff’ energy. When you blow a puff of air, you create moving air or wind. When wind pushes against an object, it can make the object move, if the energy created is greater than the friction or drag of the object against a surface.”

“As a group, create a vehicle powered by your own puff of air. Use only the supplies provided. You have 15 minutes to construct, and then we will test the vehicles to see whose goes the furthest using a single puff of air. What questions do you have?”

Distribute student materials. Monitor students’ work and provide updates of time remaining. After 15 minutes, bring students back together. Have each group test its vehicle in front of the class. Place vehicles behind the starting line, and have one person provide the puff of wind. Monitor the group as it measures the distance traveled. Record results on the writing surface. Congratulate all students on their creations and use of creativity and engineering skills. Celebrate the top team. Capture a photo of each team or the entire class together. Facilitate a discussion by asking questions including:

“Which design features were the most successful?”
“What forces slow down the vehicle?”
“What if you changed the size of the vehicle?”
“If you could add one more item to the vehicle, what would you add and why?”
“Why is renewable energy technology important?”

**SUPPLIES NEEDED**
- Paper, one piece per student
- Writing utensil, one per student
- Puff vehicle materials:
  - Plastic drinking straws, three per group
  - Round hard candy with a hole in the center (such as Life Savers or breath mints), four per group
  - Paper, one piece per group
  - Paper clips, two per group
  - Scotch or masking tape, 12 inches per group
  - Scissors, one pair per group
- Flat surface on either a large table or floor
- Piece of tape to mark the starting line
- Measuring tape
- Writing surface
REFLECTION AND REVIEW: **7 minutes**

Put students into two groups. Have the first group form a circle facing outward. Then have the second group form a circle facing inward so that each student is facing one partner. Give instructions for the review activity.

“We will conclude with a quick reflection and review. I will ask a question. You and your partner have a total of 45 seconds to answer and discuss with each other. I’ll call on a few of you to share. Then the outside circle will rotate and we will discuss another question.”

Use these questions:

“What did you enjoy about today’s activity?”
“What skills did you use today?”
“How did we use STEM (science, technology, engineering and mathematics)?”
“What if you had been asked to create the vehicles but never test them?”
“How do you apply the skills you learn in this classroom at home? In school?”
“What skills are needed to be successful in your future career?”

After students discuss the first question, ask a few students to share their answer with the class. Then have the outside circle rotate one person to the right. Ask the next question. Repeat the process for all questions.

EXTENDED LEARNING OPPORTUNITIES

- Challenge students to redesign or modify the puff vehicles for a second test. You may require students to use the same supplies, allow them to add one item or even allow them to use their own supplies. The possibilities are endless!
- Use the STEM promotion letter from Section 10 of the Middle School Chapter Integration Guide to send a letter to the students’ parents. The letter will help family members understand the value of career and technical education, and encourage positive conversations at home.
- Introduce students to SkillsUSA through the organization’s magazine. Articles highlight students and teachers, career and technical education opportunities and outstanding programs. It is available free online at: [https://www.skillsusa.org/publications-news/skillsusa-champions-magazine/](https://www.skillsusa.org/publications-news/skillsusa-champions-magazine/)
ACTIVITY 1: Architecture and Construction: Demolition Engineer 7
ACTIVITY 2: Arts, A/V Technology and Communications: Podcaster 10
ACTIVITY 3: Education and Training: Speech and Language Pathologist 14
ACTIVITY 4: Health Science: Epidemiologist 19
ACTIVITY 5: Hospitality and Tourism: Pastry Chef 24
ACTIVITY 6: Human Services: Massage Therapist 28
ACTIVITY 7: Information Technology: Computer Support Specialist 32
ACTIVITY 8: Law, Public Safety, Corrections and Security: Intelligence Research Operations Specialist 36
ACTIVITY 9: Manufacturing: Calibration Technician 40
ACTIVITY 10: Marketing: Survey Researcher 46
ACTIVITY 11: Transportation, Distribution and Logistics: Transportation Engineer 49
Focus on Quality Assurance Pathway: Calibration Technician

ANTICIPATORY SET: 3 minutes

Draw a round target containing four circles on the writing surface.

“This is a target. If we were having an archery, dart or shooting contest, where would we aim?”

Solicit student responses.

“The center, of course! (Point at the center of the target.) Let’s have a contest. We need two volunteers to compete.”

Select two volunteers. Give each volunteer one of the secret instruction cards. Have each volunteer stand behind a starting point, pretend to fly his or her arrow (the marker) toward the writing surface and mark where it lands on the target. Then repeat until each have flown three arrows. The finished target should look similar to this:

Facilitate a group discussion.

“Which arrows represent accuracy?”

- Red arrows, they are closer to the “target”

“Which arrows represent precision?”

- Black arrows, they are consistent
“Which is more important when working with instruments such as a thermometer, an IV pump or a fertilizer spreader?”

- Both. For example, it is critical an IV pump give the desired amount each and every time.

“A calibration technician maintains, tests and repairs a variety of instrumentation and equipment. He or she ensures that instruments, gauges and testing devices are calibrated correctly and give accurate readings.”

**CAREER INFORMATION: 1 minute**

Display a poster or PowerPoint slide with the career cluster definition.

“A calibration technician is one of many jobs in the Manufacturing career cluster.

“Careers in this cluster involve planning, managing and performing the processing of materials into intermediate or final products and related professional and technical support activities such as production planning and control, maintenance and manufacturing and process engineering.

“A calibration technician is considered a STEM career. STEM stands for science, technology, engineering and mathematics. STEM careers involve a combination of those four elements. A calibration technician uses science. He or she must understand, calibrate and validate instruments that measure temperature, pressure, flow, force torque, chemical analysis, optics, humidity, speed, viscosity, mechanical dimensions, vacuum, light intensity, mass, voltage, current resistance and frequency. A calibration technician must know how to use highly technological tools and test them for accuracy and precision. Often these tools are used in engineering and manufacturing. As you will see in our next activity, he or she uses math during testing of the instruments.

“Today, we will test a hand sprayer to test precision as we introduce the calibration technician career.”

**CONTENT ACTIVITY: 15 minutes**

Divide students into small groups. Each group needs one hand sprayer with two gallons of water, measuring cup, measuring tape, marking flags or tape, paper, writing utensil, calculator and Hand Sprayer Calibration worksheet.

“A hand sprayer may be used to apply herbicide to a lawn to eliminate weeds. Calibration is important so the correct amount of herbicide is applied. Too much herbicide may harm the lawn, or too little herbicide may not kill the weeds. To calibrate a small hand sprayer, we must figure out how much water we are actually spraying.

“When we begin, you will first measure an area 18½ feet by 18½ feet. This is equal to \( \frac{1}{128} \)th of an acre. Use the marking flags (or tape if on cement or parking lot) to mark the corners. The second step is spray the measured area uniformly with water, using a gentle sweeping motion with the spray wand. The third step is to measure the remaining water in the sprayer, using the measuring cup to determine how much water was used. Remember, there are 16 cups in one gallon.”

If time will allow, tell students they will refill the hand sprayer and repeat so an average of the two can be recorded.
“We will then calculate how many gallons per acre would be sprayed and use a chart to determine how much pesticide to use in the hand sprayer. The worksheet will guide you through these steps. What questions are there? (Pause) Go calibrate!”

Monitor students’ work. As groups finish, provide instructions for clean up.

**REFLECTION AND REVIEW: 4 minutes**

Wrap up with a group discussion. Solicit student responses for each question.

“How many gallons per acre did you spray?”
- Answers will vary

“In the case of the hand sprayer and this application, which is more important: accuracy or precision? Why?”
- Precision. Individual sprayer consistency is important. We tested to find out what each sprayer put out, and then we know how much herbicide to apply.

Regardless of how many gallons per acre were applied, the same amount of herbicide was applied. For example, 20 gallons multiplied by 5 teaspoons is a total of 100. On the opposite end of the spectrum, 100 gallons multiplied by 1 teaspoon is 100. Some instruments require accuracy such as an IV pump.

“A high school diploma is required. Postsecondary programs, special certification and on-the-job training may be obtained.

“The average salary for a calibration technician is $42,000. An experienced technician may be paid $60,000.

“What specific tasks and jobs might a calibration technician complete?”
- Calibrate instruments
- Troubleshoot, install and repair mechanical components
- Set up laboratory and testing equipment
- Order parts for a repair
- Develop calibration testing procedures
- Identify and correct measurement errors
- Compile, measure and record data
- Work with acoustical, chemical, electrical, fluid, mechanical, optical or thermodynamic instruments

“What part of a calibration technician’s job would be enjoyable?”
- Answers will vary

“Which career cluster did we explore today?”
- Manufacturing

“What does STEM stand for?”
- Science, technology, engineering and mathematics
**CLOSING: One minute**
Fill in the blanks with types of career and technical education courses offered in your school.

“If you are interested in becoming a calibration technician or any other STEM profession, you should take advanced math, science and computer science classes. Some examples of career and technical education classes to consider are:

___________________________________________________________________

These classes provide technical, academic and employability skills, preparing you for the future. Career and technical education helps you take what is learned in the classroom and apply this knowledge to an actual job or career.”

**EXTENDED LEARNING OPPORTUNITY**
Compare accuracy of several fitness bands, smart watches and smartphone apps. Give each student or pair of students a tool. Have students walk a set course that has been accurately measured. Record all distances from the handheld devices. Discuss what might affect accuracy of these devices.

**FOR MORE INFORMATION**
https://careertech.org/manufacturing
https://www.skillsusa.org/programs/career-clusters/
**Target Activity**

**Volunteer 1**

Thanks for volunteering! These are your SECRET instructions. Please put all of your arrows side by side in the outer ring.

![Diagram showing arrows in the outer ring](image1)

**Target Activity**

**Volunteer 2**

Thanks for volunteering! These are your SECRET instructions. Please put all of your arrows in the first ring (outside the center) spaced around the ring.

![Diagram showing arrows in the first ring](image2)
**Hand Sprayer Calibration**

Names: ______________________________         ____________________________

1. Measure an area 18½ feet by 18½ feet. Mark the corners with marking flags or tape. This is equal to 1/128th of an acre.

2. Uniformly spray the area with a gentle sweeping motion.

3. Measure the water remaining in the hand sprayer.

____________________________ cups remaining

4. Calculate: ____________________ cups sprayed

   1 cup = 8 ounces

   Convert: ____________________ fluid ounces sprayed

   EQUALS gallons of water sprayed per acre

5. If time allows, repeat and calculate the average:

6. Use the chart to determine the amount of herbicide required:

<table>
<thead>
<tr>
<th>Gallons per Acre</th>
<th>Recommended Herbicide Rate per Acre of 1 pint per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>5 tsp./gal</td>
</tr>
<tr>
<td>30</td>
<td>3 tsp./gal</td>
</tr>
<tr>
<td>40</td>
<td>2 1/3 tsp./gal</td>
</tr>
<tr>
<td>50</td>
<td>2 tsp./gal</td>
</tr>
<tr>
<td>60</td>
<td>1 2/3 tsp./gal</td>
</tr>
<tr>
<td>70</td>
<td>1 1/3 tsp./gal</td>
</tr>
<tr>
<td>80</td>
<td>1 1/4 tsp./gal</td>
</tr>
<tr>
<td>90</td>
<td>1 tsp./gal</td>
</tr>
<tr>
<td>100</td>
<td>1 tsp./gal</td>
</tr>
</tbody>
</table>

Amount of herbicide to apply: ______________________________
Focus on Transportation Systems/Infrastructure Planning, Management and Regulation Pathway: Transportation Engineer

ANTICIPATORY SET: 3 minutes
Each student needs one piece of paper. Give instructions for the activity.

“Think about all of the ways we move from one place to the next. You have 45 seconds to brainstorm modes of transportation. What questions are there? (Pause) Get moving!”

Monitor students’ work. After 45 seconds, bring students back together. Have students share responses. Capture a list of transportation modes on the writing surface.

“How do you normally get to school? Raise your hand if you ride a bus. (Pause) Raise your hand if you ride in a car or truck. (Pause) Bicycle. (Pause) Who walks? (Pause) How else do you get to school?”

Solicit student responses.

“Most of us rely on streets and highways to get from place to place. A transportation engineer plans, designs, operates and maintains everyday systems such as streets and highways. He or she may also plan large projects such as airports, ship ports, mass transit systems and harbors.”

CAREER INFORMATION: 1 minute
Display a poster or PowerPoint slide with the career cluster definition.

“A transportation engineer is one of many jobs in the Transportation, Distribution and Logistics career cluster.

Careers in this cluster involve planning, managing and movement of people, materials and goods by road, pipeline, air, rail and water and related professional support services such as transportation infrastructure planning and management, logistics services, mobile equipment and facility maintenance.

“A transportation engineer is considered a STEM career. STEM stands for science, technology, engineering and mathematics. STEM careers involve a combination of those four elements. A transportation engineer uses technology and a variety of computer programs including computer aided design (CAD) software and analytical or scientific software. He or she applies engineering techniques, procedures and equipment to design plans, blueprints, drawings and models. Basic math, algebra, geometry calculus and statistics are used in design and construction.

“Today, we will design and test a road for a marble to introduce the transportation engineer career.”

CONTENT ACTIVITY: 10 minutes
Assemble all materials in one location. Give instructions for the activity.

“Each of you will build a track for a marble. You will use two halves of foam pipe and masking tape. Start your track at the top of a high place by taping one end of the tubing to the top of a ledge, table or other high spot. Then challenge yourself by using different props like chairs or books to make hills and curves in the road. Steady your track
Monitor students’ work. Challenge students to add hills, turns, loop-de-loops and more. After seven minutes, bring students back together. Provide instructions for cleanup.

**REFLECTION AND REVIEW: 5 minutes**

Wrap up with a group discussion. Solicit student responses for each question.

“**What was challenging about building your road?**”
- Answers will vary

“**What designs worked well?**”
- Answers will vary

“**When designing actual roads for transportation, what must be considered?**”
- Safety
- Cost
- Location
- Amount of land needed
- Effect on community and businesses
- Environmental impacts

“Transportation engineers, as well as all civil engineers, need a bachelor’s degree. A graduate degree and licensure is needed for promotion to senior positions. Coursework will include math, statistics, engineering mechanics and fluid dynamics.

“The average salary for a transportation engineer is $80,770.

“What specific tasks and jobs might a transportation engineer complete?”
- Design and prepare plans for transportation systems at airports, commuter trains, highways, streets, bridges, drainage structures and roadway lighting
- Supervise the maintenance or repair of transportation systems
- Analyze environmental impact statements for transportation projects
- Check construction plans, design calculations and cost estimates to ensure completeness, accuracy and conformity to engineering standards
- Confer with contractors, utility companies and government agencies to discuss plans, specifications and work schedule
- Direct the surveying, staking and laying-out of projects
- Estimate project costs
- Inspect completed transportation projects to ensure safety or compliance with applicable standards and regulations
- Investigate or test specific construction project materials to determine compliance with specifications and standards
- Investigate traffic problems and recommend methods to improve traffic flow and safety
• Model transportation scenarios to evaluate the impact of activities such as a new
development or identify possible solutions to transportation problems
• Participate in contract bidding, negotiation and administration
• Prepare final project layout drawings that include details such as stress
calculations
• Prepare project budgets, schedules or specifications for labor and materials
• Develop, or assist in the development of, transportation-related computer
software or computer processes
• Evaluate traffic control devices or lighting systems to determine need for
modification or expansion
• Prepare administrative, technical or statistical reports on traffic-operation matters,
such as accidents, safety measures, and pedestrian volume
• Prepare data, maps or other information at construction-related public hearings
and meetings

“What part of a transportation engineer’s job would be enjoyable?”
• Answers will vary

“What which career cluster did we explore today?”
• Transportation, Distribution and Logistics

“What does STEM stand for?”
• Science, technology, engineering and mathematics

CLOSING: 1 minute
Fill in the blanks with types of career and technical education courses offered in your school.

“If you are interested in becoming a transportation engineer or any other STEM
profession, you should take advanced math, science and computer science classes. Some
examples of career and technical education classes to consider are:
________________________________________________________________.
These classes provide technical, academic and employability skills, preparing you for the
future. Career and technical education helps you take what is learned in the classroom
and apply this knowledge to an actual job or career.”

EXTENDED LEARNING OPPORTUNITY
Follow the Future City Competition format to have students design a virtual city using
SimCity software. Planning for transportation is part of city planning. Students imagine,
research, design and build cities of the future. Students may present their solutions through
an essay, scale model, project plan or presentation. More information can be found at:
http://futurecity.org

FOR MORE INFORMATION
https://careertech.org/transportation
https://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm
https://www.skillsusa.org/programs/career-clusters/
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