



**Career  
Essentials:  
Assessments**

# Career Essentials: Assessments

## **Teacher Preparation Guide For Use with the Career Essentials: Assessments**

*Discover, Develop and Validate Students'  
Knowledge and Skill*

***ROBOTICS ASSESSMENT***

# Introduction to the Career Essentials: Assessments

The Career Essentials: Assessments can help both students and teachers discover students' occupational strengths. By implementing the Career Essentials: Assessments, students and teachers can collaboratively develop a life-long learning plan to validate and enhance students' skills and knowledge. Assessment data results are beneficial for students, teachers and administrators in validating student learning, and improving programs and their accountability.

This teacher preparation guide is a tool developed for instructors to help students capitalize on their unique strengths, which can improve individual student performance and provide a clear way forward for student success.

The Career Essentials: Assessments Teacher Preparation Guide provides an easy-to-follow road map to implement the Career Essentials: Assessments. The guide is not meant to be curriculum nor should it replace that which already exists. It provides specific information regarding the Career Essentials: Assessments so teachers can identify existing curriculum areas that may need additional emphasis.

The guide ultimately helps teachers provide students with learning opportunities. Its goal is for students to become comfortable and successful with the Career Essentials: Assessments.

Inside the guide, teachers will find:

- Major content areas of the assessment
- A blueprint of the assessment competency areas
- A checklist of the various competency areas within the assessment
- Access to a trade- or technical-specific online 10-question demo assessment
- Resources used for the assessment development
- Access to an employability skills based, online 10-question practice assessment to help students navigate the assessment system

## Table of Contents

What are Career Essentials: Assessments?.....	4
Using the Career Essentials: Assessments .....	4
Preparing Students for the Career Essentials: Assessments .....	5
Workplace-Ready Skills .....	6
Assessment Competency Areas .....	7
Academic Core and Critical Skill Areas .....	7
Connections to National Standards .....	8
Student Tools: Access Directions for the Trade- or Technical Specific Online 10-Item Demo.....	8
Student Tools: Test-Taking Reminders .....	8
Student Testing Tips.....	8
Student Tools: Robotics Blueprint and Competency Area Knowledge Checksheets.....	9
Summary and Quick Glance Testing Reminders .....	9
Robotics Blueprint .....	10
Knowledge Checksheets.....	15
Helpful Tips and Reminders for Students.....	25
Sample Assessment Questions .....	26
Resources .....	30

### **What are Career Essentials: Assessments?**

Career Essentials: Assessments are online assessments that evaluate technical and employability skills and knowledge. They are the way ahead for the next generation of our American workforce, and they help candidates validate their technical skills and knowledge to potential employers. They also help local instructors demonstrate the value of their programs, while supporting local industries with a pool of potential employees that has been tested by a system they can trust.

Each assessment was developed by a panel of industry, high school and college/postsecondary subject matter experts (SMEs) using national technical standards. Career Essentials: Assessments were created by industry to ensure relevance to entry-level skills, meet Perkins IV accountability requirements and provide certificates to students who achieve industry-defined scores. They ensure your students are workforce ready.

Career Essentials: Assessments incorporate photographs, videos, animations and illustrations to ensure clarity for each technical question. Drag-and-drop and multiple-choice questions appeal to visual and kinesthetic learners and test content knowledge rather than test-taking abilities. Even simple multiple-choice questions are brought to life through pictures and animations.

Assessments are available in more than 40 trade, industrial and technical areas. A rigorous and educationally sound process captures critical competencies, standards and criteria as defined by industry.

Academic core and critical skill areas also exist in each assessment. State-level academic curriculum specialists identified connections to national academic standards.

Each one-hour assessment includes 50 questions. Under the supervision of a proctor, the integrity of each test is ensured by offering multiple unique versions of the assessment, which

**For complete information regarding the Career Essentials: Assessments and to see all assessment areas, please visit the website at:**

***[www.careeressentials.org/assessments](http://www.careeressentials.org/assessments)*** .

measure the same core and critical competencies. Even within the same version, questions and answers are displayed in varying orders to prevent test takers from copying others. The Career Essentials: Assessments are designed to be user-friendly and intuitive for students.

### **Using the Career Essentials: Assessments**

Every classroom is unique. You can use the Career Essentials: Assessments in a way that best suits your program and students. The following directions are SkillsUSA's suggested and preferred method to implement the assessments so that your students gain the most from the results.

The most important step in the Career Essentials: Assessments process is to select the correct assessment for your students. You are key to the selection process. Without your involvement, the wrong assessment may be selected. Assessment titles do not provide enough information for proper selection. Review the various assessment categories that best correspond to your program.

Next, look at each of the assessment titles within the category and the corresponding blueprint. The blueprint will tell you which competencies and subjects are addressed in the assessment.

Cross-walk the various blueprints with your classroom curriculum. The assessment blueprint will show what's emphasized and how competencies are weighed. Please remember the Career Essentials: Assessments are based on national industry standards, so the assessment may not perfectly align with the existing curriculum. Content may need to be added or emphasized to better prepare students for the Career Essentials: Assessments.

Once you have selected the assessment that best fits your program, administer that Career Essentials: Assessments at the beginning of your students' final program year. This could be considered a pre-test.

Assessment results are available as soon as your student completes the assessment. The report provides you with a gap analysis to identify your students' learning needs according to each competency area within the assessment. Dynamic reports compare your students' performance to the current state and national averages. Reports also enable you to track a student's progress on an individual basis. The assessment pre-testing results provide you with a benchmark for your students and identify student learning gaps. This data may help you adjust your own curriculum and identify areas that may need more or less emphasis. The data can be shared with students so everyone can focus on learning areas that need improvement during the school year.

Then, at the end of the school year or program semester, administer your specific Career Essentials: Assessments a second time as a post-test.

Use post-test data to improve or adjust curriculum once again for your next program year. This way, curriculum adjustments are made using the student testing data rather than arbitrarily making adjustments.

This pre- and post-test process is a "win-win" situation for the teacher and especially the student! To ensure a quality process, SkillsUSA is ready to help at any time.

### **Preparing Students for the Career Essentials: Assessments**

Provide each student with a copy of their trade- or technical-specific Career Essentials: Assessments Blueprint. Do this at the beginning of your course. Review and discuss the blueprint with your class, providing insight on the assessment weighting and what is emphasized.

Have students discuss how they can assist each other to prepare for the assessment.

Place the Career Essentials: Assessments Blueprint on the classroom wall. The blueprint will help students focus on the appropriate course content areas that align with the assessment. It will also help everyone to be aware of the program's goals and expectations.

### **The Career Essentials: Assessments at a Glance**

- **Select the correct assessment title. *Do not* have someone select the assessment for you, as there may be several titles that may relate to your program**
- **Review the assessment blueprint that best aligns with your existing curriculum**
- **Identify gaps in your curriculum, and use additional resources to enhance or align the curriculum**
- **Share the assessment blueprint with the students so everyone is aware of the expectation**
- **Have your students take the assessment at the beginning of their final program year as a pre-test**
- **Use pre-test data to identify learning gaps or strengths of individual students or the class**
- **Remediate the students using the data analysis from pre-test to enhance, emphasize and adjust learning objectives**
- **Have your students take the assessment a second time (as a post-test) at the end of the program year to determine learning gains/gaps**
- **Use post-test data to improve or adjust curriculum for your next program year**

Administer the Career Essentials: Assessments as a pre-test to identify student gaps. If possible, pre-test your students at the beginning of their final program year to identify learning gaps both individually and as a class. The data will provide an excellent “road map” to prepare students to take the assessment again (post-test) at the end of the program. Using the data, tailor the instruction to better prepare your students.

Use the Career Essentials: Assessments competency areas checksheets included in this guide to encourage class discussion and help students identify strengths and weaknesses.

Use the pre-test data to ascertain problematic learning areas. Have students identify discussion topics based on the various competency areas and their pre-test data results. Exercises, demonstrations and even questions can be developed by the students using their textbooks or other resources listed in this guide.

Assign homework that aligns to the assessment blueprint. Focus on a competency area within the assessment. Using the checksheets in this guide, have students develop questions and potential answers using the resources identified when developing the assessment. Use the questions for class discussion or “quiz bowl” activities.

Have students take the Career Essentials: Assessments trade- or technical-specific online 10-question demo assessment. This could be a homework assignment or done in class 30 days prior to taking the assessment the second time (as a post-test). This not only will provide students with specific sample questions and potential answers, but it will also allow students to experience the online system again and become more familiar with the types of questions they may encounter when taking the actual assessment.

Following the demo assessment, discuss the experience students had. What question(s) did

they not understand? Did they have difficulty navigating the online system? This experience will help students be more comfortable and confident when taking the final assessment.

Discuss as a class or individually with students which question(s) were difficult. Facilitate a discussion to glean more information regarding why certain answers were wrong. Offer techniques students can use to better determine correct answers.

### **Workplace-Ready Skills**

Through the Career Essentials: Assessments, you have the option for your students take an Employability Assessment. This assessment tests a student’s workplace-ready skills such as communication, teamwork, time management and more. It can be used for any student in any occupational area as a practice test or a separate assessment.

If you use the Employability Assessment as a practice test have students take it in class. Not only can the Employability Assessment help students become familiar with the navigational tools of the assessment system, but it can also measure and make your students aware of another important skill set. It may also help them become comfortable in the testing environment.

See the Career Essentials: Assessments website for more information: [www.careeressentials.org/assessments](http://www.careeressentials.org/assessments)

The Employability Assessment is *not* intended to familiarize students with the Robotics assessment content.

**Please note: For all Career Essentials: Assessments to be valid, instructors cannot be present in the room where their students will be taking the test. A proctor is required. Proctors can be other instructors, a school administrator or school counselor.**

**Assessment Competency Areas**

Career Essentials: Assessments Robotics Assessment covers 10 major technical competency areas (unit areas). In the online assessment, these 10 competencies are tested with 50 interactive, multiple-choice items. Each competency area has a different number of items. The chart lists the major technical competency areas and the percentage of the assessment in each one.

**Technical Competency Areas for Robotics**

Competency	Percentage of Area Assessment
Demonstrate knowledge of general safety rules and practices	4%
Demonstrate knowledge of safety rules and practices when working with electrical equipment	6%
Demonstrate knowledge of safety rules and practices specific to a robotic work cell as defined in the Automation Safety Requirements of the ANSI/RIA R15.006 1999 Standards	10%
Demonstrate an understanding of basic robotic systems	18%
Demonstrate an understanding of the function of and need for robot accessories	8%
Demonstrate an understanding of the use of a teach pendant	10%
Connect a robot such that it can communicate with its environment	14%
Design the layout of a work cell, ensuring that the cell operation is optimized with regards to its objectives	8%
Work with positions in a robotic work cell	12%
Program a robotic work cell	10%

**Academic Core and Critical Skill Areas**

Academic core and critical skill areas also ex-

ist in each assessment. The SkillsUSA national technical committee identified that the following academic skills are embedded in the Robotics training program and assessment:

**Math Skills**

- Use fractions to solve practical problems
- Use proportions and ratios to solve practical problems
- Simplify numerical expressions
- Use scientific notation
- Solve practical problems involving percentages
- Solve single variable algebraic expressions
- Solve multiple variable algebraic expressions
- Measure angles
- Apply transformations (rotate or turn, reflect or flip, translate or slide and dilate or scale) to geometric figures
- Construct three-dimensional models
- Make comparisons, predictions and inferences using graphs and charts
- Organize and describe data using matrixes
- Solve problems using proportions, formulas and functions
- Use measures of interior and exterior angles of polygons to solve problems
- Find arc length and the area of a sector

**Science Skills**

- Plan and conduct a scientific investigation
- Use knowledge of potential and kinetic energy
- Use knowledge of mechanical, chemical and electrical energy
- Use knowledge of heat, light and sound energy
- Use knowledge of temperature scales, heat and heat transfer
- Use knowledge of sound and technological applications of sound waves
- Use knowledge of the nature and technological applications of light
- Use knowledge of speed, velocity and acceleration
- Use knowledge of Newton’s laws of motion
- Use knowledge of work, force, mechanical

advantage, efficiency and power

- Use knowledge of simple machines, compound machines, powered vehicles, rockets and restraining devices
- Use knowledge of principles of electricity and magnetism
- Use knowledge of static electricity, current electricity and circuits
- Use knowledge of magnetic fields and electromagnets
- Use knowledge of motors and generators

### Language Arts Skills

- Provide information in conversations and in group discussions
- Provide information in oral presentations
- Demonstrate use of verbal communication skills, such as word choice, pitch, feeling, tone and voice
- Demonstrate use of nonverbal communication skills, such as eye contact, posture and gestures using interviewing techniques to gain information
- Analyze mass media messages
- Demonstrate comprehension of a variety of informational texts
- Use text structures to aid comprehension
- Identify words and phrases that signal an author's organizational pattern to aid comprehension
- Understand source, viewpoint and purpose of texts
- Organize and synthesize information for use in written and oral presentations
- Demonstrate knowledge of appropriate reference materials
- Use print, electronic databases and online resources to access information in books and articles
- Demonstrate narrative writing
- Demonstrate informational writing
- Edit writing for correct grammar, capitalization, punctuation, spelling, sentence structure and paragraphing

### Connections to National Standards

State-level academic curriculum specialists identified the following connections to national

academic standards.

### Math Standards

- Numbers and operations
- Algebra
- Measurement
- Problem solving
- Reasoning and proof
- Communication
- Connections
- Representation

*Source: NCTM Principles and Standards for School Mathematics. To view high school standards, visit: [www.nctm.org/standards/content.aspx?id=16909](http://www.nctm.org/standards/content.aspx?id=16909).*

### Science Standards

- Understands the sources and properties of energy
- Understands forces and motion
- Understands the nature of scientific inquiry

*Source: McREL compendium of national science standards. To view and search the compendium, visit: [www2.mcrel.org/compendium/](http://www2.mcrel.org/compendium/)*

### Language Arts Standards

- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion and the exchange of information)

*Source: IRA/NCTE Standards for the English Language Arts. To view the standards, visit: [www.readwritethink.org/standards/index.html](http://www.readwritethink.org/standards/index.html).*

**Student Tools:**

**Access Directions for the Trade- or Technical-Specific Online 10-Item Demo Assessment**

Have your students copy and paste this link [www.careeressentials.org/assessments/demo-our-assessments/](http://www.careeressentials.org/assessments/demo-our-assessments/) into their browser. The sample programmatic questions will give you and your students an idea of the types of questions on the assessment and how the questions are generally written.

**Student Tools:**

**Test-Taking Reminders**

Encourage your students to have good study habits. Below are basic reminders to better prepare students for life-long learning and workplace success. You may want to have this discussion at the beginning of the year to encourage students to incorporate these strategies.

- Develop a regular study schedule
- Identify a specific location to study
- Always take notes while studying in class or on your own
- Take short breaks during your study session
- Perform “mini-testing” to make sure you understand and comprehend the program concepts
- Join small study groups to help focus on the program content
- If you need special assistance in testing, tell your teacher or counselor so they can make accommodations.

**Student Testing Tips**

The most important tip for your students is to be prepared mentally and physically for the testing session. Make sure to tell them to get plenty of rest and eat healthy. Suggest they wear comfortable and appropriate clothing to the testing session. If they are able to bring items

to the testing session, such as a non-programmable calculator, make sure they have the items ready the night before. Have students check our website at [www.careeressentials.org/wp-content/uploads/2017/07/Permitted-Testing-Tools-Aids.pdf](http://www.careeressentials.org/wp-content/uploads/2017/07/Permitted-Testing-Tools-Aids.pdf) for permitted tools or job aids that can be used during testing. The more organized they are before the testing period, the more relaxed they will be during the actual testing session.

Encourage your students to be relaxed and positive. If they begin to panic during the testing, suggest they take some deep breaths to relax and think positive thoughts.

Do not rush through the questions. Instruct your students to read the question and potential answers thoroughly. Tell them to make sure they know exactly what the question is asking before answering. Let them know that if they are unsure, they can mark the question and return to it.

Use process of elimination. If your students are not sure of the correct answer, tell them to study the potential answers and eliminate the ones that they know are not correct.

If all else fails, tell students to *guess*. After they have exhausted all options, tell them to take their best guess at the correct answer. If they have studied the content area, they may intuitively know the correct answer. The Career Essentials: Assessments system does not penalize students for guessing and they may guess correctly!

**Student Tools:**

**Robotics Blueprint and Competency Area Knowledge Checksheets**

The next section provides the assessment blueprint and detailed topics within each competency area covered within the Robotics assessment. Photocopy and share the following blueprints and checksheets with your students so they can better prepare for each of the competency areas within the Robotics assessment.

## Robotics and Automation Blueprint

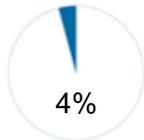
This Blueprint contains the subject matter content of this Career Essentials Assessment.

**Note:** To fully prepare for **Robotics and Automation** SkillsUSA Championships contest, refer to the current year's SkillsUSA Championships Technical Standard, now included with your SkillsUSA Professional Membership. If you need help in accessing this benefit, contact the SkillsUSA Membership Office at 1-800-355-8422.

### Standards and Competencies

Competencies are weighted throughout the assessment. The percent shown is the weight of the competency. There are 50 questions per assessment.

#### Demonstrate knowledge of general safety rules and practices.



- ∞ Keep your work area clean and safe.
- ∞ Describe response procedures for different emergency situations.
  - Demonstrate basic first aid.
- ∞ Utilize appropriate safety apparel for the task being performed.
  - Wear appropriate safety goggles, hard hats, work boots, etc., for a given situation.
- ∞ Identify and demonstrate safe use of hand tools.

#### Demonstrate knowledge of safety rules and practices when working with electrical equipment.



- ∞ Exercise caution when working near energized lines.
  - Demonstrate proper use of lockout/tagout.
- ∞ Understand and demonstrate proper usage of circuit protection devices, such as fuses, circuit breakers, and ground fault circuit interrupters.
  - Understand the importance of grounding.

#### Demonstrate knowledge of safety rules and practices specific to a robotic workcell as defined in the Automation Safety Requirements of the ANSI/RIA R15.06 1999 Standards.



- ∞ Demonstrate proper use of emergency stop buttons.
- ∞ Follow safety rules during installation and layout of a robotic workcell.
- ∞ Prevent accidents in the robotic workcell.
  - Prevent impact or collision accidents, such as unpredicted movements, component malfunctions, or unpredicted program changes related to the robot's arm or peripheral equipment.
  - Prevent crushing and trapping accidents.
  - Prevent mechanical part accidents, such as the breakdown of the robot's drive components, tooling or end-effector, peripheral equipment, or its power source.
- ∞ Demonstrate proper teach pendant safety.
  - Demonstrate understanding of working in Teach mode.
  - Demonstrate proper usage of the Deadman switch.

#### Demonstrate an understanding of basic robotic systems.



- ∞ Identify the components of a robotic system, including the manipulator, end effector, teach pendant and controller.
- ∞ Identify the joints of a robotic arm.
- ∞ Define different methods to power a robot joint, such as hydraulic, AC or DC power.
- ∞ Define work envelope.
- ∞ Define the term "degree of freedom" and explain how it affects types of joints.
- ∞ Demonstrate the use of gears in robots.
  - Demonstrate the use of harmonic drives in robots.
- ∞ Demonstrate the use of incremental and absolute encoders.

- ∞ Demonstrate the use of closed loop control in robotic systems.
- ∞ Explain how Proportional Integral Derivative (PID) control is used in robotic systems.
- ∞ Demonstrate an understanding of when, why and how a robot should be homed.
- ∞ Explain how robot positions are defined.
  - Define the term Tool Center Point (TCP) and its importance to robotic positioning.
  - Define and differentiate between joint coordinate systems and Cartesian coordinate systems.
- ∞ Define a pick and place operation.

**Demonstrate an understanding of the function of and need for robot accessories.**



- ∞ Identify accessories that can extend the robot work envelope, such as a slidebase.
- ∞ Identify different types of end of arm effectors and their usage.
- ∞ Identify robot accessory devices that are used to transport materials, such as conveyors, rotary tables, XY tables, etc.

**Demonstrate an understanding of the use of a teach pendant.**



- ∞ Identify and differentiate between the available modes of operation, such as Teach and Auto.
- ∞ Identify factors that must be considered before moving a robot manually.
- ∞ Operate the open/close gripper function.
- ∞ Determine and select the movement type appropriate to an operation.
- ∞ Determine and select the appropriate speed for moving a robot.
- ∞ Determine and select the appropriate joint or axis upon which to move the robot.
- ∞ Record a position.
- ∞ Move the robot to a predefined position.

**Connect a robot such that it can communicate with its environment.**



- ∞ Connect a robot controller to a PC, and verify its connection.
- ∞ Define serial communication and its use in a robot workcell.
- ∞ Understand and use digital inputs and outputs.
  - Identify and define the function of a digital input.
  - Identify and define the function of a digital output.
  - Calculate the load an output can support.
  - Define the terms sink and source.
  - Connect an external device to an output, such as a warning light, solenoid, relay or pneumatic actuator, and control it.
  - Connect an external device to an input, such as a contact or inductive proximity sensor, and monitor it.
  - Connect an external device to an output through an external relay, and control it.
- ∞ Explain the function of a mechanical relay.

**Design the layout of a workcell, ensuring that the cell operation is optimized with regards to its objectives.**



- ∞ Place devices in a workcell based on required functionality.
- ∞ Consider critical factors when designing the workcell, such as wiring, air, power, facilities and safety.
- ∞ Adhere to a design specification when physically setting up a workcell.
- ∞ Test the physical layout of the workcell as defined in the design specification, using the robot and peripheral devices.

**Work with positions in a robotic workcell.**



- ∞ Define different position types, such as joint, Cartesian and tool.
- ∞ Define and differentiate between different types of movement from one position to another - joint, linear and circular.
- ∞ Demonstrate an understanding of how, when and why to adjust speed when moving a robot.
- ∞ Teach a robot with a 2-finger gripper to grasp a part, taking into consideration the part's geometry.
- ∞ Demonstrate an understanding of absolute robot positions and when they should be used when planning the position scheme in a workcell.
- ∞ Demonstrate an understanding of relative robot positions and when they should be used when planning the position scheme in a workcell.
- ∞ Demonstrate an understanding of the use of intermediate and approach positions.
- ∞ Set a position scheme for the cell that achieves all objectives, and explain your considerations.
  - Document workcell positions.
  - Precisely record on and above positions for a part in a fixture.
  - Record and/or teach the positions defined in the position scheme.
  - Move the robot to each of the positions defined according to the sequence in the workcell layout, to ensure that all positions are precise and adequately meet the cell objectives.

**Program a robotic workcell.**



- ∞ Develop a flowchart that outlines a robotic program based on cell requirements.
- ∞ Develop a robotic program based on cell requirements.
- ∞ Use correct syntax of a given robotic programming language.
  - Define the relationship between the positions defined and their implementation in a program.
  - Use variables and constants in a robotic program.
  - Use comments/remarks in a robotic program.
  - Use counters and accumulators in a robotic program.
  - Use arithmetic operations and functions in a robotic program.
  - Use conditional statements and branches in a robotic program.
  - Program interfacing with input and output devices.
- ∞ Create a robotic program that communicates with an external device.
- ∞ Execute a dry-run of a robotic program.
- ∞ Debug a simple robotic program.
- ∞ Modify an existing robotic program.
- ∞ Run a robotic program.

**Demonstrate professional development skills in a simulated customer service or employment situation. Examples may include:**

- ∞ Job interview
- ∞ Customer service scenario
- ∞ Communications
- ∞ Decision making, problem solving and/or critical thinking

## Committee Identified Academic Skills

The SkillsUSA national technical committee has identified that the following academic skills are embedded in the robotics and automation technology training program and assessment:

### Math Skills

- Use fractions to solve practical problems
- Use proportions and ratios to solve practical problems
- Simplify numerical expressions
- Use scientific notation
- Solve practical problems involving percentages
- Solve single variable algebraic expressions
- Solve multiple variable algebraic expressions
- Measure angles
- Apply transformations (rotate or turn, reflect or flip, translate or slide and dilate or scale) to geometric figures
- Construct three-dimensional models
- Make comparisons, predictions and inferences using graphs and charts
- Organize and describe data using matrixes
- Solve problems using proportions, formulas and functions
- Use measures of interior and exterior angles of polygons to solve problems
- Find arc length and the area of a sector

### Science Skills

- Plan and conduct a scientific investigation
- Use knowledge of potential and kinetic energy
- Use knowledge of mechanical, chemical and electrical energy
- Use knowledge of heat, light and sound energy
- Use knowledge of temperature scales, heat and heat transfer
- Use knowledge of sound and technological applications of sound waves
- Use knowledge of the nature and technological applications of light
- Use knowledge of speed, velocity and acceleration
- Use knowledge of Newton's laws of motion
- Use knowledge of work, force, mechanical advantage, efficiency and power
- Use knowledge of simple machines, compound machines, powered vehicles, rockets and restraining devices
- Use knowledge of principles of electricity and magnetism
- Use knowledge of static electricity, current electricity and circuits
- Use knowledge of magnetic fields and electromagnets
- Use knowledge of motors and generators

### Language Arts Skills

- Provide information in conversations and in group discussions
- Provide information in oral presentations
- Demonstrate use of verbal communication skills, such as word choice, pitch, feeling, tone and voice
- Demonstrate use of nonverbal communication skills, such as eye contact, posture and gestures using interviewing techniques to gain information
- Analyze mass media messages
- Demonstrate comprehension of a variety of informational texts
- Use text structures to aid comprehension
- Identify words and phrases that signal an author's organizational pattern to aid comprehension
- Understand source, viewpoint and purpose of texts
- Organize and synthesize information for use in written and oral presentations
- Demonstrate knowledge of appropriate reference materials
- Use print, electronic databases and online resources to access information in books and articles

- Demonstrate narrative writing
- Demonstrate informational writing
- Edit writing for correct grammar, capitalization, punctuation, spelling, sentence structure and paragraphing

### **Connections to National Standards**

State-level academic curriculum specialists identified the following connections to national academic standards.

#### **Math Standards**

- Numbers and operations
- Algebra
- Measurement
- Problem solving
- Reasoning and proof
- Communication
- Connections
- Representation

**Source:** NCTM Principles and Standards for School Mathematics. To view high school standards, visit: <http://www.nctm.org/standards/content.aspx?id=16909>.

#### **Science Standards**

- Understands the sources and properties of energy
- Understands forces and motion
- Understands the nature of scientific inquiry

**Source:** McREL compendium of national science standards. To view and search the compendium, visit: [www.mcrel.org/standards-benchmarks/](http://www.mcrel.org/standards-benchmarks/).

#### **Language Arts Standards**

- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion and the exchange of information)

**Source:** IRA/NCTE Standards for the English Language Arts. To view the standards, visit: [www.readwritethink.org/standards/index.html](http://www.readwritethink.org/standards/index.html).



Review Dates:

## Competency Area 1: Demonstrate Knowledge of General Safety Rules and Practices

### Knowledge Check

How well do you know how to:	Very Well	Somewhat Well	Not Well
1. Keep your work area clean and safe?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Describe response procedures for different emergency situations?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Demonstrate basic first aid?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Utilize appropriate safety apparel for the task being performed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Wear appropriate safety goggles, hard hats, work boots, etc., for a given situation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Identify and demonstrate safe use of hand tools?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Areas I Need To Review:



## Robotics and Automation Blueprint

This Blueprint contains the subject matter content of this Career Essentials Assessment.

**Note:** To fully prepare for **Robotics and Automation** SkillsUSA Championships contest, refer to the current year's SkillsUSA Championships Technical Standard, now included with your SkillsUSA Professional Membership. If you need help in accessing this benefit, contact the SkillsUSA Membership Office at 1-800-355-8422.

### Standards and Competencies

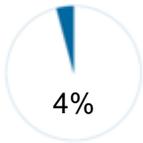
Competencies are weighted throughout the assessment. The percent shown is the weight of the competency. There are 50 questions per assessment.

Very Well

Somewhat Well

Not Well

#### Demonstrate knowledge of general safety rules and practices.



- |  |                          |                          |                          |
|--|--------------------------|--------------------------|--------------------------|
| ∞ Keep your work area clean and safe.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ∞ Describe response procedures for different emergency situations.                     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ○ Demonstrate basic first aid.   |                          |                          |                          |
| ∞ Utilize appropriate safety apparel for the task being performed.                     |                          |                          |                          |
| ○ Wear appropriate safety goggles, hard hats, work boots, etc., for a given situation. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ∞ Identify and demonstrate safe use of hand tools.                                     |                          |                          |                          |

#### Demonstrate knowledge of safety rules and practices when working with electrical equipment.



- |  |                          |                          |                          |
|--|--------------------------|--------------------------|--------------------------|
| ∞ Exercise caution when working near energized lines.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| ○ Demonstrate proper use of lockout/tagout.  |                          |                          |                          |
| ∞ Understand and demonstrate proper usage of circuit protection devices, such as fuses, circuit breakers, and ground fault circuit interrupters. |                          |                          |                          |
| ○ Understand the importance of grounding.  |                          |                          |                          |

#### Demonstrate knowledge of safety rules and practices specific to a robotic workcell as defined in the Automation Safety Requirements of the ANSI/RIA R15.06 1999 Standards.



- |  |  |  |  |
|--|--|--|--|
| ∞ Demonstrate proper use of emergency stop buttons.  |  |  |  |
| ∞ Follow safety rules during installation and layout of a robotic workcell.  |  |  |  |
| ∞ Prevent accidents in the robotic workcell.   |  |  |  |
| ○ Prevent impact or collision accidents, such as unpredicted movements, component malfunctions, or unpredicted program changes related to the robot's arm or peripheral equipment. |  |  |  |
| ○ Prevent crushing and trapping accidents.   |  |  |  |
| ○ Prevent mechanical part accidents, such as the breakdown of the robot's drive components, tooling or end-effector, peripheral equipment, or its power source.                    |  |  |  |



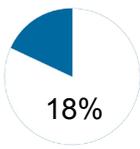
**Review Dates:**

**Competency Area 3: Demonstrate Knowledge of Safety Rules and Practices  
Specific to a Robotic Work Cell as Defined in the Automation Safety  
Requirements of the ANSI/RIA R15.06 1999 Standards**

**Knowledge Check**

How well do you know how to:	Very Well	Somewhat Well	Not Well
1. Demonstrate proper use of emergency stop buttons?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Follow safety rules during installation and layout of a robotic work cell?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Prevent accidents in the robotic work cell?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Prevent impact or collision accidents, such as unpredicted movements, component malfunctions, or unpredicted program changes related to the robot's arm or peripheral equipment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Prevent crushing and trapping accidents?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Prevent mechanical part accidents, such as the breakdown of the robot's drive components, tooling or end-effector, peripheral equipment, or its power source?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Demonstrate proper teach pendant safety?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Demonstrate understanding of working in Teach mode?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Demonstrate proper usage of the Deadman switch?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Areas I Need To Review:



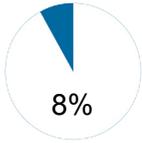
**Review Dates:**

**Competency Area 4: Demonstrate an Understanding of Basic Robotic Systems**

**Knowledge Check**

How well do you know how to:	Very Well	Somewhat Well	Not Well
1. Identify the components of a robotic system, including the manipulator, end effector, teach pendant and controller?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Identify the joints of a robotic arm?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Define different methods to power a robot joint, such as hydraulic, AC or DC power?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Define work envelope?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Define the term “degree of freedom” and explain how it affects types of joints?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Demonstrate the use of gears in robots?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Demonstrate the use of harmonic drives in robots?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Demonstrate the use of incremental and absolute encoders?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Demonstrate the use of closed loop control in robotic systems?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Explain how Proportional Integral Derivative (PID) control is used in robotic systems?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Demonstrate an understanding of when, why and how a robot should be homed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Explain how robot positions are defined?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Define the term Tool Center Point (TCP) and its importance to robotic positioning?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Define and differentiate between joint coordinate systems and Cartesian coordinate systems?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Define a pick and place operation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Areas I Need To Review:



**Review Dates:**

## **Competency Area 5: Demonstrate an Understanding of the Function of and Need for Robot Accessories**

### **Knowledge Check**

How well do you know how to:

1. Identify accessories that can extend the robot work envelope, such as a slide base?
2. Identify different types of end of arm effectors and their usage?
3. Identify robot accessory devices that are used to transport materials, such as conveyors, rotary tables, XY tables, etc.?

Very Well

Somewhat Well

Not Well

Areas I Need To Review:



**Review Dates:**

## **Competency Area 6: Demonstrate an Understanding of the Use of a Teach Pendant**

### **Knowledge Check**

How well do you know how to:	Very Well	Somewhat Well	Not Well
1. Identify and differentiate between the available modes of operation, such as Teach and Auto?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Identify factors that must be considered before moving a robot manually?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Operate the open/close gripper function?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Determine and select the movement type appropriate to an operation?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Determine and select the appropriate speed for moving a robot?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Determine and select the appropriate joint or axis upon which to move the robot?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Record a position?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Move the robot to a predefined position?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Areas I Need To Review:



**Review Dates:**

## Competency Area 7: Connect a Robot Such That It Can Communicate With Its Environment

### Knowledge Check

How well do you know how to:	Very Well	Somewhat Well	Not Well
1. Connect a robot controller to a PC, and verify its connection?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Define serial communication and its use in a robot work cell?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Understand and use digital inputs and outputs?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Identify and define the function of a digital input?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Identify and define the function of a digital output?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Calculate the load an output can support?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Define the terms sink and source?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Connect an external device to an output, such as a warning light, solenoid, relay or pneumatic actuator, and control it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Connect an external device to an input, such as a contact or inductive proximity sensor, and monitor it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Connect an external device to an output through an external relay, and control it?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Explain the function of a mechanical relay?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Areas I Need To Review:



**Review Dates:**

**Competency Area 8: Design the Layout of a Work Cell, Ensuring that the Cell Operation is Optimized with Regards to its Objectives**

**Knowledge Check**

How well do you know how to:

1. Place devices in a work cell based on required functionality?

Very Well

Somewhat Well

Not Well




2. Consider critical factors when designing the work cell, such as wiring, air, power, facilities and safety?




3. Adhere to a design specification when physically setting up a work cell?




4. Test the physical layout of the work cell as defined in the design specification, using the robot and peripheral devices?




Areas I Need To Review:



Review Dates:

## Competency Area 9: Work with Positions in a Robotic Work Cell

### Knowledge Check

How well do you know how to:	Very Well	Somewhat Well	Not Well
1. Define different position types, such as joint, Cartesian and tool?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Define and differentiate between different types of movement from one position to another – joint, linear and circular?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Demonstrate an understanding of how, when and why to adjust speed when moving a robot?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Teach a robot with a 2-finger gripper to grasp a part, taking into consideration the part's geometry?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Demonstrate an understanding of absolute robot positions and when they should be used when planning the position scheme in a work cell?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Demonstrate an understanding of relative robot positions and when they should be used when planning the position scheme in a work cell?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Demonstrate an understanding of the use of intermediate and approach positions?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Set a position scheme for the cell that achieves all objectives, and explain your considerations?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Document work cell positions?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Precisely record on and above positions for a part in a fixture?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Record and/or teach the positions defined in the position scheme?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Move the robot to each of the positions defined according to the sequence in the work cell layout, to ensure that all positions are precise and adequately meet the cell objectives?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Areas I Need To Review:



**Review Dates:**

## Competency Area 10: Program a Robotic Work Cell

### Knowledge Check

How well do you know how to:	Very Well	Somewhat Well	Not Well
1. Develop a flowchart that outlines a robotic program based on cell requirements?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Develop a robotic program based on cell requirements?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Use correct syntax of a given robotic programming language?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Define the relationship between the positions defined and their implementation in a program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Use variables and constants in a robotic program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Use comments/remarks in a robotic program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Use counters and accumulators in a robotic program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Use arithmetic operations and functions in a robotic program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Use conditional statements and branches in a robotic program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Program interfacing with input and output devices?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Create a robotic program that communicates with an external device?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Execute a dry-run of a robotic program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Debug a simple robotic program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Modify an existing robotic program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Run a robotic program?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Areas I Need To Review:

# Helpful Tips and Reminders for Students

## Access Directions to the Trade- or Technical-Specific Online 10-question Demo Assessment

Access the Web link [www.careeressentials.org/assessments/demo-our-assessments/](http://www.careeressentials.org/assessments/demo-our-assessments/) with your browser. The sample programmatic questions will help give you an idea of the types of questions on the assessment and how they are generally written.

## Test-Taking Reminders

Implementing good study habits is essential for any test or class. Below are basic reminders to better prepare you for life-long learning and workplace success. Incorporate these strategies into your everyday habits.

- Develop a regular study schedule
- Identify a specific location to study
- Always take notes while studying in class or on your own
- Take short breaks during your study session
- Perform “mini-testing” to make sure you understand and comprehend the program concepts
- Join small study groups to help focus on the program content
- If you need special assistance in testing, tell your teacher or counselor so he or she can make accommodations

## Student Testing Tips

The most important tip for you is to be prepared mentally and physically for the testing session. Make sure to get plenty of rest and eat healthy. Wear comfortable and appropriate clothing to the testing session. Find out if you can bring items to the testing session, such as a non-programmable calculator, and make sure you have the items ready the night before. Check the website at [www.careeressentials.org/wp-content/uploads/2017/07/Permitted-Testing-Tools-Aids.pdf](http://www.careeressentials.org/wp-content/uploads/2017/07/Permitted-Testing-Tools-Aids.pdf) for permitted tools or job aids that can be used during testing. The more organized you are before the testing period, the more relaxed you will be during the actual testing session.

Be relaxed and positive. If you begin to panic during the testing, take some deep breaths to relax, and think positive thoughts.

Do not rush through the questions. Read the question and potential answers thoroughly. Make sure you know exactly what the question is asking before answering. If you are unsure, note the question and return to it. Use process of elimination. If you are not sure of the correct answer, study the potential answers and eliminate the ones that you know are not correct.

If all else fails – *guess*. After you have exhausted all options, take your best guess at the correct answer. If you have studied the content area, you may intuitively know the correct answer. The Career Essentials: Assessments does not penalize you for guessing, and you may guess correctly!

# Sample Assessment Questions

## Robotics Demo Test Questions

### Question 1

What is the advantage of a circuit breaker over a fuse?

Choose one answer.

- A) A circuit breaker can simply be reset, while a fuse must be replaced.
- B) A circuit breaker works fast, and a fuse is slow.
- C) A circuit breaker works on AC or DC, while a fuse works on DC only.
- D) A circuit breaker is less expensive than a fuse.

Correct Answer: A

### Question 2

Which of the following standards governs safety requirements for industrial robots and robot systems?

Choose one answer.

- A) ANSI/RIA R15.06 1999
- B) ANSI/RIA R15.06 2008
- C) 49 C.F.R. PART 215
- D) OSHA RS2008

Correct Answer: A

### Question 3

Which of the following is a way to connect a robot controller to a PC?

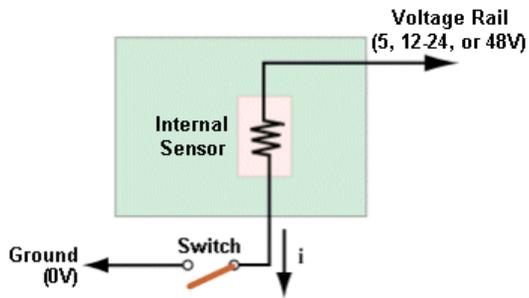
Choose one answer.

- A) I/O (Inputs/Outputs)
- B) Ethernet
- C) Universal Serial Bus
- D) UDP (User Datagram Protocol)

Correct Answer: C

## Question 4

What type of circuit is depicted in the schematic shown?



Choose one answer.

- A) Input circuit (source)
- B) Input circuit (sink)
- C) Output circuit (source)
- D) Output circuit (sink)

Correct Answer: B

## Question 5

To which of the following devices can the robot controller send an output signal?



A) A lamp



B) A microswitch



C) A servo gripper



D) Gravity Parts Feeder

Correct Answer: A

## Question 6

What type of end of arm effector is depicted in the image shown?



Choose one answer.

- A) Vacuum gripper
- B) Two-finger gripper
- C) Three-finger gripper
- D) Multi-finger gripper

Correct Answer: C

3/15/14

# Resources

## **Additional Resources**

Below are resources that will be helpful in preparing for the Assessments which were created based on industry standards nationwide. Use the Career Essentials: Assessments Blueprint as a guideline for competencies tested. Use the resources below to find curriculum or additional study guides for industry standards.

## **Robotics Resources:**

[www.careeressentials.org/assessments/assessment-resources/](http://www.careeressentials.org/assessments/assessment-resources/)