

Unit 3: Circuits and Programming (5 weeks)

Content Area: **Technology**
Course(s):
Time Period: **Full Year**
Length: **Full Year**
Status: **Published**

UNIT RATIONALE

The final unit in the 8th grade Technology Education curriculum focuses on something ubiquitous in modern society: electronics. Students are inundated with electronic technology everywhere they go and with everything they do. They are the “digital natives.” Being born into the digital world, however, does not innately give a student *understanding* of it. Through Circuits and Programming, students gain a greater understanding of how electronics work, what programming is, and gain valuable logic skills through coding and troubleshooting.

ESSENTIAL QUESTIONS

How do electronics work?

What are the essential components of an electrical circuit?

Why are software and electrical engineering tied closely together when developing new technologies?

What is an Arduino and what can you do with one?

STANDARDS

NEW JERSEY STUDENT LEARNING STANDARDS: 21st CENTURY

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready

individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

CRP.K-12.CRP6.1

Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

CRP.K-12.CRP8.1

Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

CRP.K-12.CRP11.1

Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.

CRP.K-12.CRP12.1

Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

NEW JERSEY STUDENT LEARNING STANDARDS: CONTENT AREA

New Jersey (NJSL) - Grades 6-8 - Computer Science and Design Thinking (2020)

8.1.8.CS.2:

Design a system that combines hardware and software components to process data.

8.1.8.CS.3:

Justify design decisions and explain potential system trade-offs.

8.1.8.CS.4:

Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.

8.1.8.AP.2:

Create clearly named variables that represent different data types and perform operations on their values.

8.1.8.AP.3:

Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.

8.1.8.AP.4:

Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.

8.2.8.ED.1:

Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.

8.2.8.ED.2:

Identify the steps in the design process that could be used to solve a problem.

8.2.8.ED.3:

Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).

8.2.8.NT.3:

Examine a system, consider how each part relates to other parts, and redesign it for another purpose.

CS.6-8.8.1.8.AP.2	Create clearly named variables that represent different data types and perform operations on their values.
CS.6-8.8.1.8.AP.3	Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.
CS.6-8.8.1.8.AP.4	Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.
CS.6-8.8.1.8.CS.2	Design a system that combines hardware and software components to process data.
CS.6-8.8.1.8.CS.3	Justify design decisions and explain potential system trade-offs.
CS.6-8.8.1.8.CS.4	Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.
CS.6-8.8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
CS.6-8.8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
CS.6-8.8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
CS.6-8.8.2.8.NT.3	Examine a system, consider how each part relates to other parts, and redesign it for another purpose.

NEW JERSEY STUDENT LEARNING STANDARDS: CAREER READINESS, LIFE LITERACIES AND KEY SKILLS

TECH.9.4.8.CI.4	Explore the role of creativity and innovation in career pathways and industries.
TECH.9.4.8.TL.2	Gather data and digitally represent information to communicate a real-world problem (e.g., MS-ESS3-4, 6.1.8.EconET.1, 6.1.8.CivicsPR.4).
TECH.9.4.8.IML.1	Critically curate multiple resources to assess the credibility of sources when searching for information.
TECH.9.4.8.IML.7	Use information from a variety of sources, contexts, disciplines, and cultures for a specific purpose (e.g., 1.2.8.C2a, 1.4.8.CR2a, 2.1.8.CHSS/IV.8.AI.1, W.5.8, 6.1.8.GeoSV.3.a, 6.1.8.CivicsDP.4.b, 7.1.NH. IPRET.8).

NEW JERSEY STUDENT LEARNING STANDARDS: COMPUTER SCIENCE AND DESIGN THINKING

CS.6-8.8.1.8.AP.2	Create clearly named variables that represent different data types and perform operations on their values.
CS.6-8.8.1.8.AP.3	Design and iteratively develop programs that combine control structures, including nested

	loops and compound conditionals.
CS.6-8.8.1.8.AP.4	Decompose problems and sub-problems into parts to facilitate the design, implementation, and review of programs.
CS.6-8.8.1.8.CS.2	Design a system that combines hardware and software components to process data.
CS.6-8.8.1.8.CS.3	Justify design decisions and explain potential system trade-offs.
CS.6-8.8.1.8.CS.4	Systematically apply troubleshooting strategies to identify and resolve hardware and software problems in computing systems.
CS.6-8.8.2.8.ED.1	Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
CS.6-8.8.2.8.ED.2	Identify the steps in the design process that could be used to solve a problem.
CS.6-8.8.2.8.ED.3	Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
CS.6-8.8.2.8.NT.3	Examine a system, consider how each part relates to other parts, and redesign it for another purpose.

PRE-ASSESSMENTS

How do electronics work? Class discussion and initial KWL charts

INSTRUCTIONAL PLAN

MODULE 1

Activity 1 - Introduction to Electronics

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning about basic electronics terms so that I can understand how energy flows within a circuit.</p> <p>I am learning about the basic parts of an electronic circuit so that I can describe how they interact with each other to make use of electricity.</p> <p>I am learning about multimeters so that I can measure voltage and current in an electrical circuit.</p>
<p>Student Learning Strategies</p>	<p>KWL Charts Peer learning Self-reflection Class discussion Visual models</p>

	<p>Teacher and peer modeling/demonstration Hands-on learning Vocabulary</p>
<p>Success Criteria</p>	<p>I can use basic electronics terms and understand how to describe how energy flows within a circuit.</p> <p>I can identify the basic parts of an electronic circuit and describe how they interact with each other.</p> <p>I can use a multimeter to measure voltage and current in an electrical circuit.</p>
<p>Formative Assessment (drives instructional decisions)</p>	<p>KWL Charts</p> <p>Participation in class discussions and circuit building activities.</p>
<p>Activities and Resources</p>	<p>Pose “How do electronics work?” question in Google Classroom as a think-pair-share. Once students have had a chance to answer, they should turn to a neighbor and discuss their answers. After, have a whole-class discussion - geared towards circuits and electricity.</p> <p>Ask students to begin a whole-class KWL chart with the topic “Electronics.” Students write down three things they Know and three they Want to learn about electronics. Discuss student contributions to the chart with the class. If any Knows are incorrect, lead students to the correct answers. If students have answers to any Want to learn posts, encourage them to give their answer. Before moving on, let students know that we’ll be adding to these throughout the unit to help us remember where we started and how far we’ve come.</p> <p>Introduce electronics vocabulary: electricity, circuit, power load, ground, voltage, current. Vocab should be introduced one-at-a-time while demonstrating and allowing students to practice with small electronics kits. Relate to the water analogy.</p> <p>Hand out small electronics kits containing: 3.3V button cell battery, 4 LEDs of different colors, several pairs of alligator clips, 2 different 1/4W resistors, 5V capacitors, multimeter. Demonstrate how to create some simple circuits with the batteries and LEDs, highlighting the vocabulary individually during each new concept.</p>

	<p>Instruct students on the use of multimeters to measure voltage and current of these simple circuits; and see how different LEDs give different values - Why do you think that is? Each needs a different current and/or voltage to light up.</p> <p>Before moving on, ask students to write down something they've Learned or something else they Want to learn for our class KWL chart. Review additions with the class.</p>
Suggested Modifications	

MODULE 2

Activity 2 - Ohm's Law

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning about basic electronics terms so that I can understand how energy flows within a circuit.</p> <p>I am learning about the basic parts of an electronic circuit so that I can describe how they interact with each other to make use of electricity.</p> <p>I am learning about multimeters so that I can measure voltage and current in an electrical circuit.</p> <p>I am learning about Ohm's Law so that I can calculate the voltage, current, or resistance of a circuit when I know the other two.</p>
<p>Student Learning Strategies</p>	<p>KWL Charts Peer learning Self-reflection Class discussion Visual models Teacher and peer modeling/demonstration Hands-on learning Vocabulary</p>
<p>Success Criteria</p>	<p>I can use basic electronics terms and understand how to describe how energy flows within a circuit.</p>

	<p>I can identify the basic parts of an electronic circuit and describe how they interact with each other.</p> <p>I can use a multimeter to measure voltage and current in an electrical circuit.</p> <p>I can understand the interrelationship of voltage, current, and resistance.</p>
<p>Formative Assessment (drives instructional decisions)</p>	<p>KWL Charts</p> <p>Participation in class discussions and circuit building activities.</p> <p>Correct usage of Ohm's Law to calculate values.</p>
<p>Activities and Resources</p>	<p>Review the previous day's vocabulary with students.</p> <p>Highlight any previously added W or Ls from the KWL chart that we'll be covering today.</p> <p>Introduce new vocabulary to students (Conductor, insulator, resistance, Ohm's Law, Polarity, LED, Capacitance), one word at a time, defining each and giving practical examples and demonstrations utilizing the small electronics kits for exploration. Relate terms to the water analogy. When discussing Ohm's Law, introduce its importance by discussing electrification and human resistance. Give students the equations to calculate each, and have them work out the voltage, current, and resistance present when using different components on a circuit, like LEDs and resistors.</p> <p>Before moving on, ask students to write down something they've Learned or something else they Want to learn for our class KWL chart. Review additions with the class.</p>
<p>Suggested Modifications</p>	

MODULE 3

Activity 3 - Breadboards and Circuit Prototyping

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning about basic electronics terms so that I can understand how energy flows within a circuit.</p> <p>I am learning about the basic parts of an electronic circuit so that I can describe how they interact with each other to make use of electricity.</p> <p>I am learning about multimeters so that I can measure voltage and current in an electrical circuit.</p> <p>I am learning about Ohm's Law so that I can calculate the voltage, current, or resistance of a circuit when I know the other two.</p>
<p>Student Learning Strategies</p>	<p>KWL Charts Peer learning Self-reflection Class discussion Visual models Teacher and peer modeling/demonstration Hands-on learning Vocabulary</p>
<p>Success Criteria</p>	<p>I can use basic electronics terms and understand how to describe how energy flows within a circuit.</p> <p>I can identify the basic parts of an electronic circuit and describe how they interact with each other.</p> <p>I can use a multimeter to measure voltage and current in an electrical circuit.</p> <p>I can understand the interrelationship of voltage, current, and resistance.</p>
<p>Formative Assessment (drives instructional decisions)</p>	<p>KWL Charts</p> <p>Participation in class discussions and circuit building activities.</p>
<p>Activities and Resources</p>	<p>Review vocabulary from the previous day.</p> <p>Highlight any previously added W or Ls from the KWL chart that we'll be covering today.</p> <p>Today will be the last bit of new circuits vocab. Electronics all stems from building functional circuits, so students will</p>

	<p>now learn about different types of circuits and how they can be prototyped a little easier.</p> <p>Introduce new vocabulary to students (Breadboard, open circuit, closed circuit, short circuit, parallel circuit, series circuit, switch), one word at a time, defining each and giving practical examples and demonstrations utilizing the small electronics kits for exploration. Begin with what breadboards are and how to use them. In addition to the other components in the kits, students should be given jumper wires, breadboards, and momentary push button switches. As each new circuit is introduced, demonstrate and have students build and test them using the breadboards.</p> <p>Before moving on, ask students to write down something they've Learned or something else they Want to learn for our class KWL chart. Review additions with the class.</p>
<p>Suggested Modifications</p>	

MODULE 4

Activity 4 - Introduction to Arduino - Blinking LED

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning about Arduinos so that I can build working prototype electronic circuits that interface hardware and software.</p> <p>I am learning about troubleshooting so that I can review possible problems in a circuit or code, test possible solutions, and fix them.</p>
<p>Student Learning Strategies</p>	<p>KWL Charts Peer learning Self-reflection Class discussion Visual models Hands-on learning Step-by-step tutorial</p>
<p>Success Criteria</p>	<p>I can build working prototype electronic circuits.</p>

	<p>I can identify what an Arduino board is and how it functions to interface hardware and software.</p> <p>I can work with a partner and use a troubleshooting process to fix a problem in a circuit or Arduino code.</p>
<p>Formative Assessment (drives instructional decisions)</p>	<p>KWL Charts</p> <p>Participation in class discussions and circuit building and programming activities.</p> <p>Successful completion of Blinking LED circuits and programs.</p> <p>Reflection questions</p>
<p>Activities and Resources</p>	<p>Have a question ready in Google Classroom for initial discussion - "What is an Arduino, and what can we do with it." If students have trouble coming up with any answers, show them actual Arduino boards and allow them to research online for a few minutes.</p> <p>Pair up students and hand out small electronics kits, breadboards, jumper wires, and Arduino boards. Properly introduce the board with the Arduino Overview handout and an Arduino pin diagram. Students should follow along with instruction by identifying the pins on their Arduino boards with what is being shown and described to the class.</p> <p>Get students set up within TinkerCAD circuits - they should definitely be familiar with TinkerCAD for 3D design, so continue using its familiar layout with Circuits. For this introduction and first circuit, have students create a new circuits project, and walk through the options available on the project screen.</p> <p>After students have been familiarized with the project screen, hand out and begin a walkthrough of making a LED blink using an Arduino (Arduino Activity 2). Students will follow along as we build the circuit and code it, as a class. Stop frequently to verify understanding and to ask the reflection questions leading students to describe why we're building the circuit the way we are and what the Arduino code means.</p> <p>When the circuit is complete and the Arduino coded in</p>

	<p>TinkerCAD, students should start the simulation to test their work. If all is well, students should be instructed to build the same circuit in the real world, and test it (on pre-programmed Arduinos).</p> <p>Before moving on, ask students to write down something they've Learned or something else they Want to learn for our class KWL chart. Review additions with the class.</p>
Suggested Modifications	

MODULE 5

Activity 5 - Variables and Fading a LED

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning about Arduinos so that I can build working prototype electronic circuits that interface hardware and software.</p> <p>I am learning about troubleshooting so that I can review possible problems in a circuit or code, test possible solutions, and fix them.</p> <p>I am learning about constants and variables so that I can represent and reference values in a program more easily.</p>
<p>Student Learning Strategies</p>	<p>KWL Charts Peer learning Self-reflection Class discussion Visual models Hands-on learning Step-by-step tutorial</p>
<p>Success Criteria</p>	<p>I can build working prototype electronic circuits.</p> <p>I can identify what an Arduino board is and how it functions to interface hardware and software.</p> <p>I can work with a partner and use a troubleshooting process to fix a problem in a circuit or Arduino code.</p> <p>I can define a constant as a representation of data that</p>

	<p>does not change in a program.</p> <p>I can define a variable as a representation of data that can change in a program.</p>
Formative Assessment (drives instructional decisions)	<p>KWL Charts</p> <p>Participation in class discussions and circuit building and programming activities.</p> <p>Successful completion of fading LED circuits and programs.</p> <p>Reflection questions</p>
Activities and Resources	<p>Review the answers from the reflection questions of the previous activity (Arduino Activity 2). Discuss information regarding the Arduino code and parameters used so far in activities, and allow students to add to the KWL chart.</p> <p>Highlight any previously added W or Ls from the KWL chart that we'll be covering today.</p> <p>As we add more and more <i>stuff</i> to a circuit and to a program, it gets increasingly more difficult to know exactly what we're talking about when we just use numbers to represent things. To fix this, programmers use <i>variables</i> and <i>constants</i> to represent numbers, letters, words, and more when coding.</p> <p>Give examples of how this can be used to make coding easier, and to accept user input.</p> <p>Introduce the next activity: making a LED fade (Arduino Activity 3). Encourage students to attempt this activity in pairs, and filter around the room helping where needed. Students should be able to complete the entire activity in TinkerCAD, but will have to build and upload the code to their physical Arduinos themselves.</p> <p>Before moving on, ask students to write down something they've Learned or something else they Want to learn for our class KWL chart. Review additions with the class.</p>
Suggested Modifications	

MODULE 6

Activity 6 - The Arduino Cloud

Student Learning Intentions (SLI) WALT: (We are learning to...)	<p>I am learning about Arduinos so that I can build working prototype electronic circuits that interface hardware and software.</p> <p>I am learning about troubleshooting so that I can review possible problems in a circuit or code, test possible solutions, and fix them.</p>
Student Learning Strategies	<p>KWL Charts Peer learning Self-reflection Class discussion Visual models Hands-on learning</p>
Success Criteria	<p>I can identify what an Arduino board is and how it function to interface hardware and software.</p> <p>I can navigate the Arduino IDE to create a program and upload it to an Arduino to run.</p> <p>I can work with a partner and use a troubleshooting process to fix a problem in a circuit or Arduino code.</p>
Formative Assessment (drives instructional decisions)	<p>KWL Charts</p> <p>Participation in class discussions and circuit building and programming activities.</p> <p>Successful completion of fading LED circuits and programs.</p> <p>Reflection questions</p>
Activities and Resources	<p>Highlight any previously added W or Ls from the KWL chart that we'll be covering today.</p> <p>Introduce today's task - building, coding, and troubleshooting circuits <i>without</i> TinkerCAD. We've built fading LED programs that won't run on our Arduinos without actually uploading the code. To do this, share a link to the Arduino Cloud, so students can create accounts</p>

	<p>and join the online class.</p> <p>Once students have connected, walk through the Arduino Cloud dashboard; creating, accessing, and editing sketches; and how to hook up and upload their written code to their Arduino for testing.</p> <p>Students can copy their code from TinkerCAD and paste it into a new sketch in the Arduino Cloud to upload and test their physical LED fade circuits. When done, students should answer the reflection questions in Arduino Activity 3 and try some of the extensions.</p> <p>As an extension to this assignment, show students how to use analogWrite commands with a multicolor LED to cycle through its different colors.</p> <p>Before moving on, ask students to write down something they've Learned or something else they Want to learn for our class KWL chart. Review additions with the class.</p>
<p>Suggested Modifications</p>	

MODULE 7

Activity 7 - Piezo Buzzers

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning about Arduinos so that I can build working prototype electronic circuits that interface hardware and software.</p> <p>I am learning about troubleshooting so that I can review possible problems in a circuit or code, test possible solutions, and fix them.</p> <p>I am learning about piezo buzzers so that I can add sound to a prototype electronic circuit.</p>
<p>Student Learning Strategies</p>	<p>KWL Charts Peer learning Self-reflection Class discussion Visual models</p>

	<p>Hands-on learning Step-by-step tutorial</p>
<p>Success Criteria</p>	<p>I can identify what an Arduino board is and how it functions to interface hardware and software.</p> <p>I can navigate the Arduino IDE to create a program and upload it to an Arduino to run.</p> <p>I can work with a partner and use a troubleshooting process to fix a problem in a circuit or Arduino code.</p> <p>I can use a piezo buzzer in a working electronic circuit and code an Arduino to make different sounds.</p>
<p>Formative Assessment (drives instructional decisions)</p>	<p>KWL Charts</p> <p>Participation in class discussions and circuit building and programming activities.</p> <p>Successful completion of piezo buzzer circuits and programs.</p>
<p>Activities and Resources</p>	<p>Highlight any previously added W or Ls from the KWL chart that we'll be covering today.</p> <p>Introduce a new type of output to students - Piezo Buzzers. These are small speakers that use pulses of electricity to oscillate a magnet. Those oscillations move a film or cone to vibrate the air and produce sound. Demonstrate how speakers work by showing a model.</p> <p>To get the tiny piezo buzzers to work, we'll use a sort of <code>analogWrite()</code> command made especially for speakers - <code>tone()</code> and <code>noTone()</code>. Instead of the pin and a value from 0-255, we use the pin and the sound frequency in Hz (number of oscillations per second).</p> <p>Introduce arduino.cc as a reference page for all Arduino coding questions, as well as this quick guide.</p> <p>Have students construct circuits using the buzzers and walk through the code, explaining the importance of all the commands. Students can reference the build here.</p> <p>After students have successfully built and tested their circuits and code, suggest they browse around online for</p>

	<p>recreations of some of their favorite songs along with the search terms “Arduino” and “buzzer.” Students will learn through this activity how to find examples of code they can reference for future projects.</p> <p>Before moving on, ask students to write down something they’ve Learned or something else they Want to learn for our class KWL chart. Review additions with the class.</p>
<p>Suggested Modifications</p>	

MODULE 8

Activity 8 - Wiring and Coding a Switch

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning about Arduinos so that I can build working prototype electronic circuits that interface hardware and software.</p> <p>I am learning about troubleshooting so that I can review possible problems in a circuit or code, test possible solutions, and fix them.</p> <p>I am learning about switches in electronic circuits so that can collect and use input data.</p> <p>I am learning about constants and variables so that I can represent and reference values in a program more easily.</p>
<p>Student Learning Strategies</p>	<ul style="list-style-type: none"> KWL Charts Peer learning Self-reflection Class discussion Visual models Hands-on learning Step-by-step tutorial
<p>Success Criteria</p>	<p>I can identify what an Arduino board is and how it functions to interface hardware and software.</p> <p>I can navigate the Arduino IDE to create a program and upload it to an Arduino to run.</p>

	<p>I can work with a partner and use a troubleshooting process to fix a problem in a circuit or Arduino code.</p> <p>I can use a switch in a working electronic circuit and code an Arduino to take different actions based on input.</p> <p>I can define a variable as a representation of data that can change in a program.</p>
<p>Formative Assessment (drives instructional decisions)</p>	<p>KWL Charts</p> <p>Participation in class discussions and circuit building and programming activities.</p> <p>Successful completion of switch circuits and programs.</p>
<p>Activities and Resources</p>	<p>Highlight any previously added W or Ls from the KWL chart that we'll be covering today.</p> <p>Review the use of variables and constants when writing code. For today's activity, we will need to accept user input, so we will need to store that input in the program for future use within a variable.</p> <p>Instruct students to access information on wiring and coding a switch, and walk through the entire build and coding process. Use the Arduino reference page to help explain if//else statements, and why they (along with digitalRead) are necessary to accept and use input data.</p> <p>Before moving on, ask students to write down something they've Learned or something else they Want to learn for our class KWL chart. Review additions with the class.</p>
<p>Suggested Modifications</p>	

MODULE 9

Activity 9 - Project: Build a Digital Piano

<p>Student Learning Intentions (SLI) WALT: (We are learning to...)</p>	<p>I am learning about Arduinos so that I can build working prototype electronic circuits that interface hardware and software.</p>
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	<p>I am learning about troubleshooting so that I can review possible problems in a circuit or code, test possible solutions, and fix them.</p> <p>I am learning about piezo buzzers so that I can add sound to a prototype electronic circuit.</p> <p>I am learning about switches in electronic circuits so that I can collect and use input data.</p> <p>I am learning about pseudocode so that I can describe in basic English the steps I want to program a computer to carry out.</p> <p>I am learning to use the engineering design process to plan and produce a product that solves a problem.</p>
<p>Student Learning Strategies</p>	<p>KWL Charts Peer learning Self-reflection Class discussion Visual models Hands-on project work</p>
<p>Success Criteria</p>	<p>I can identify what an Arduino board is and how it functions to interface hardware and software. I can navigate the Arduino IDE to create a program and upload it to an Arduino to run.</p> <p>I can work with a partner and use a troubleshooting process to fix a problem in a circuit or Arduino code.</p> <p>I can use a piezo buzzer in a working electronic circuit and code an Arduino to make different sounds.</p> <p>I can use a switch in a working electronic circuit and code an Arduino to take different actions based on input.</p> <p>I can write pseudocode to describe what a program will do in plain English.</p> <p>I can use the engineering design process to understand a problem and develop a solution that meets specified constraints and requirements.</p>

Formative Assessment (drives instructional decisions)

KWL Charts

Participation in class discussions.

Successful completion pseudocode, circuit, and program for a digital piano.

KWL Reflection

Activities and Resources

Introduce the concept of pseudocode to students. Pseudocode is a way of writing out, in English exactly what you'll eventually be telling a computer program to do through coding. Give an example that utilizes *if*, *else if*, and *else*; and one that uses *do* and *while*. Show that writing out English instructions first can make it very easy to code properly later on.

For the culminating project, students will use all they've learned up to this point to create a digital piano using buzzer(s), switches, and their Arduinos. To complete the project, students will:

- Use the engineering design process as a guide.
- Write pseudocode describing what the program will need to do.
- Design and build a prototype circuit that acts as a digital piano.
- Code an Arduino to play notes in accordance with specific buttons being pressed.

Students will follow their Engineering Design Process journal to put their pseudocode (PLAN), a short video of their piano circuit, and their Arduino code (CREATE - based on the code and circuit working as intended based on the pseudocode) together, suggest possible improvements, and reflect on what they made.

After the project, ask students to review their and the class' entries to the KWL chart and reflect on their achievement within the course. Students should write a

paragraph describing what they learned, in what way they believed they learned best, if learning about electronics was beneficial to them, and if they think they might pursue any electronics in the future.

Suggested Modifications

SUGGESTED MODIFICATIONS

Suggested Modifications (ELL, Sp. Ed, Gifted, At-risk of Failure)

English Language Learners

Native language support: The teacher provides auditory or written content to students in their native language.

Adjusted Speech: The teacher changes speech patterns to increase student comprehension. This could include facing students, paraphrasing, clearly indicating the most important ideas, and speaking more slowly.

Visuals: The teacher uses graphics, pictures, visuals, and manipulatives. This helps ELL students better understand and comprehend the subjects at hand.

Front-Loading Vocabulary: The teacher front loads vocabulary. This means providing students with a list of important vocabulary words they will need to know for a book, lesson, etc. prior to the lesson being taught. Including pictures to go with the vocabulary words is also very beneficial for the students.

Special Education Students

Chunking: The teacher presents information in a way that makes it easy for students to understand and remember. Chunking is based on the presumption that our working memory is easily overloaded by excessive detail. The best way to deliver information is to organize it into meaningful units. Because students with special needs get overloaded easily, chunking is an effective strategy to use with them.

Checking for Understanding: It is important to constantly check for understanding, especially for students who have accommodations. Teachers want to make sure students understand the concepts being covered in a way that makes sense to them.

Extra time: The teacher provides students with special needs extra time to complete work or answer questions. It is important to give students enough time to process their thoughts.

Oral Reading: The teacher will read work orally to students. Class work such as tests and literature circles may need to be read aloud to the student.

Timers: The teacher will use timers as an instructional tool. The use of timers is beneficial for students who have trouble completing tasks. Timers can be helpful so the student is aware of how much time they have to complete an assignment.

Students with 504 Plans

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Gifted & Talented Strategies

Extensions/Enrichments: Teachers will provide gifted and talented students with extension/enrichment projects. Students will be challenged to further their understanding, to apply acquired knowledge, and/or to produce something in reference to acquired knowledge.

Modify/Change Activities: Teachers will monitor and modify activities to accommodate those students who need to be challenged further. Additional reading, problem-solving, writing, or project work is necessary for those students who are ready to move on at a rate more accelerated than their peers. In this way, G & T students are provided the same opportunity for support as special needs students.

Students at Risk of School Failure

Directions or Instructions: Make sure directions and/or instructions are given in limited numbers. Give directions/instructions verbally and in simple written format. Ask students to repeat the instructions or directions to ensure understanding occurs. Check back with the student to ensure he/she hasn't forgotten.

Peer Support: Peers can help build confidence in other students by assisting in peer learning. Many teachers use the 'ask 3 before me' approach. This is fine, however, a student at risk may have to have a specific student or two to ask. Set this up for the student so he/she knows who to ask for clarification before going to you.

Alternate or Modified Assignments: Always ask yourself, "How can I modify this assignment to ensure the students at risk are able to complete it?" Sometimes you'll simplify the task, reduce the length of the assignment or allow for a different mode of delivery. For instance, many students may hand something in, the at-risk student may jot notes and give you the information verbally. Or, it just may be that you will need to assign an alternate assignment.

Increase One to One Time: When other students are working, always touch base with your students at risk and find out if they're on track or needing some additional support. A few minutes here and there will go a long way to intervene as the need presents itself.

Contracts: It helps to have a working contract between you and your students at risk. This helps prioritize the tasks that need to be done and ensure completion happens. Each day write down what needs to be completed, as the tasks are done, provide a checkmark or happy face. The goal of using contracts is to eventually have the student come to you for completion sign-offs.

Hands On: As much as possible, think in concrete terms and provide hands-on tasks. This means a child doing math may require a calculator or counters. The child may need to tape record comprehension activities instead of writing them. A child may have to listen to a story being read instead of reading it him/herself.

Tests/Assessments: Tests can be done orally if need be. Break tests down in smaller increments by having a portion of the test in the morning, another portion after lunch and the final part the next day.

Seating: Seat students near a helping peer or with quick access to the teacher. Those with hearing or sight issues need to be close to the instruction which often means near the front.

REFLECTIONS

INTERDISCIPLINARY CONNECTIONS: NEW JERSEY STUDENT LEARNING STANDARDS FOR ELA, SOCIAL STUDIES, SCIENCE AND/OR MATHEMATICS

- LA.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- LA.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
- LA.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, voice, and style are appropriate to task, purpose, and audience.
- LA.WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research.