Washington Township School District

The mission of the Washington Township Public Schools *is to provide a safe, positive, and progressive educational environment that provides opportunity for all students to attain the knowledge and skills specified in the NJ Learning Standards at all grade levels, so as to ensure their full participation in an ever-changing world as responsible, self-directed and civic-minded citizens.*

Course Title:	**Electrical Technology**
Grade Level(s):	10-12

Duration:	*Full Year:*	**X**	*Semester:*		*Marking Period:*	

Course Description:

This course employs a three- pronged approach to learning: Lecture, demonstration, and experimentation to ensure thorough understanding of the principles being explained in each topic area covered. Experiments with detailed instruction help the learning process of those principles in the fields of electricity and electronics. These applications bring the concepts into focus for the students enrolled. Many of the topics relate electricity and electronics to state-of-the-art technology. Practical applications of the developed principals and skills by constructing inexpensive, professional-appearing projects. These projects have proven appeal and also demonstrate the concrete knowledge that is being developed throughout the units of study. Students who successfully complete the electricity and electronics technology course should have a thorough understanding of the concepts of electricity and electronics. This knowledge gained will be able to be applied to other more advanced studies in this field. This course brightens the outlook for students entering the electronics industry in the future and translates into opportunities for specialized education and a lifetime of challenging and rewarding employment. **A strong math background is recommended. Successful completion of 80% in Algebra I is highly encouraged.**

Grading Procedures:

Assignments will consist of:

- Rubric based Major & Minor Projects
- Lab work with partner
- Quizzes
- Tests
- Classwork
- Rubric based Participation

Final Grades will be based on District Policy

Primary Resources:

- Electricity & Electronics 10th Edition. Gerrish, Dugger, Roberts The Goodheart-Wilcox Company 2009
- Modern Residential Wiring 10th Edition. Holzman. The Goodheart-Wilcox Company 2015

Washington Township Principles for Effective Teaching and Learning

- Implementing a standards-based curriculum
- Facilitating a learner-centered environment
- Using academic target language and providing comprehensible instruction
- Adapting and using age-appropriate authentic materials
- Providing performance-based assessment experiences
- Infusing 21st century skills for College and Career Readiness in a global society

Designed by:	Matt Persichetti

Under the Direction of:	Malika Moore

Written: August 2023

Revised: _____

BOE Approval: _____

Unit Title: 1 Couse Introduction, Overview & General Safety

Unit Description:

This unit introduces students to basic safety information necessary to prevent injury in the lab throughout the year. Students will become aware of the types of injuries that might occur and ways to prevent them. Information in this unit will also include basic introductory electrical terms along with units of measure needed to communicate in a technical manner. The class will also explore various career opportunities in the field of electrical technology and their safety issues.

Unit Duration: 3 Days

Desired Results

Standard(s):

9.3.12.AC-DES.1 – 2	9.3.12.AR.B4	9.3.IT-SUP.2-3	9.3.IT-WD. 1 -4, 6, 8, 10
9.3.12.AR 1 – 5	9.3.AR-PRT. 1 – 3	9.3.ST-ET.4	
9.3.12. AR – AV.1 – 2	9.3.IT.7		

Indicators:

Students will understand:

- the necessary requirements of classroom behavior and participation as stated in course proficiencies to successfully complete the course.
- the four major areas of injury in the lab including steps to prevent injury.
- the basic introductory electrical terms along with units of measure.
- the fatal value of current to the human body.
- The necessary training and schooling to enter careers in the Electricity and Electronics Industry.
- The required specific safety steps to prevent injury when operating power equipment / machines in the lab.
- The general safety rules to be followed while working with any tools in the lab to prevent injuries or accidents.
- The safety steps to prevent burns when using tools that produce heat.
- The safety precautions in using chemicals or acids to complete classroom activities.

Essential Questions:

1. Why must safe practices be followed when studying electricity?
2. What is one of the major reasons people working in the field of electricity and electronics receive a shock or a fatal electric current while either on or off the job?
3. 3. How could you be able to identify an unsafe situation at school, or at home?
4. What are the behavioral requirements needed to maintain a safe environment in the lab?
5. What four areas of injury must be addressed throughout the year for safety?
6. What are the basic terms and units of measurement common in the study of electricity?
7. How much current could produce a fatal injury?
8. .What are some opportunities to use electrical skills in the workplace?

Assessment Evidence

Performance Tasks:

*Safety First lab

Safety Quiz

*Safety test

Other Evidence:

Benchmarks:

1. Participation and certain behavior aspects are important to successfully complete the course.

2. There are four major areas of injury in the lab and there are necessary steps to prevent injury.

3. Basic introductory electrical terms, along with units of measure, are important communication skills.

4. A value of current of 0.1 amps can be fatal to the human body.

Learning Plan

Learning Activities:

*Reading assignments
*Discussion / notes of all classroom rules and regulations
*Discussion of course proficiencies.
*Review discussion on harmful effects of current on human body
*Review methods of preventing injury in the lab
*Review safety procedures for experiments, soldering project construction, and machines.
*Emergency Shut-off Procedure
*Fire Drill Procedure
*Video presentation on safety in the home and at the workplace
*Complete Safety labs and related homework assignments
*Discussion on types of careers available in the Electricity and Electronics Industry
*Video presentation
*Course proficiencies handout
*Safety handouts
*Video presentation

Resources:

1. (Lecture/Discussion
2. Machine guarding
3. Lockout devices
4. Personal Protection
5. Materials Handling
6. Tools and Equipment Handling
7. Material Safety Data Sheets
8. Handout- Fire Extinguisher Classifications
9. Handout: Sample Material Safety Data Sheet
10. Orally review Fire/Emergency Evacuation Drill
11. Discuss Federal Laws for Safety

Unit Modifications for Special Population Students	
Advanced Learners	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.
Struggling Learners	• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.
English Language Learners	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and

	participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections				
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Integration of 21st Century Skills
Indicators: 9.3.12.AC-DES.1 – 2 9.3.12.AR 1 – 5 9.3.12. AR – AV.1 – 2 9.3.12.AR.B4 9.3.AR-PRT. 1 – 3 9.3.12.AR-VIS.1 – 3 9.3.IT.7 9.3.IT-SUP.2-3 9.3.IT-WD. 1 -4, 6, 8, 10

Unit Title: 2 Soldering – Safety & Techniques

Unit Description:

This unit will describe how to properly solder wire, wire connections, and printed circuit board components following all established safety and procedure steps. Students will become familiar with basic electronic components and their operation in electronic circuits. The students will demonstrate their ability to connect wires & properly fasten components to a printed circuit board using solder techniques.

Unit Duration: 3 weeks

Desired Results

Standard(s):
9.3.12.AR 4
9.3.12.AR.B4
9.3.IT-SUP.2-3
9.3.ST-ET.4

Indicators:

Understandings:
Students will understand that…

- the basic steps and proper soldering techniques to connect electrical components to a PC board.
- the need for heat sinks when soldering semi-conductor components.

Essential Questions:

1. What is the purpose of soldering electrical connections?
2. What tools are required to complete these connections?
3. How can soldering be done safely?

Assessment Evidence

Performance Tasks'

- Pass General Safety soldering quiz
- Demonstrate the ability to strip & splice wires
- Demonstrate the ability to Solder wire connections together.
- Demonstrate the ability to use a heat shrink.
- Solder components to a printed circuit board.

Other Evidence:

Benchmarks:

1. Soldering procedures are important for electronic component assembly.
2. Proper soldering techniques are a must for successful circuit operation.
3. Certain types of components require special soldering methods.
4. Technicians are required to follow proper soldering techniques on PC boards.

Learning Plan

Learning Activities:

*Notes/discussion on:
- Safety procedures
- All soldering steps
- Clean-up procedures
- Job responsibilities

*Tinning stranded wire
*Soldering solid wire for splice application
*Notes/discussion on PC board development and soldering procedures
*PC components soldering
*Discussion on heat sensitive components / heat sinks
*Bench activities to familiarize students with new components

Resources:

- Safety Demonstrations & Videos
- Soldering supplies and tools

Unit Modifications for Special Population Students	
Advanced Learners	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.
Struggling Learners	• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.
English Language Learners	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.
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Integration of 21st Century Skills

Indicators:

9.3.12.AC-DES.1 – 2
9.3.12.AR 1 – 5
9.3.12. AR – AV.1 – 2
9.3.12.AR.B4
9.3.AR-PRT. 1 – 3
9.3.12.AR-VIS.1 – 3
9.3.IT.7
9.3.IT-SUP.2-3
9.3.IT-WD. 1 -4, 6, 8, 10
9.3.ST-ET.4

Unit Title: 3 **Science of Electricity and Electronics**

Unit Description:

This unit will define matter as it applies in the physical world in terms of atomic / molecular structure. Terms such as ionization and charge particles will be discussed in the theory of electron flow. Definitions of voltage, current, and resistance will be presented, along with concepts of conductors and insulators in electrical operations.
After studying this chapter, the students will be able to:

Unit Duration: 5 weeks

Desired Results

Standard(s):
9.3.12.AR 4
9.3.12.AR.B4
9.3.IT-SUP.2-3
9.3.ST-ET.4

Indicators:

Understandings:
Students will understand that…

- Identify the relationship between elements and compounds.
- Construct a model of an atom.
- Discuss the concepts of atomic weight and atomic number.
- State the law of charges and explain it using examples.
- Explain what is meant by electric current, voltage, and resistance.
- Describe the two theories of current direction.
- Distinguish between conductors, insulators, and semiconductors.
- State and explain Ohm's law.

Essential Questions:

1. While studying electricity, why is it important to see the correlation between utilizing math and science skills in this field?

2. Why do laws of science exist with regard to electricity and electronics?

3. What role does the understanding of the atomic structure play while observing electricity, and experimenting with conductors and insulators in electric circuits?

Assessment Evidence

Performance Tasks'
Activity sheets
Laboratory Activities
Unit 3 exam

Other Evidence:

Benchmarks:
1. Matter is comprised of protons, neutrons, and electrons.
2. Electricity is the result of forces applied to atomic structures producing ionization.
3. Voltage is the electrical pressure or push necessary to move current through a circuit.
4. Current is the amount of flow of electrons traveling through a circuit.
5. Resistance is the opposing force that controls the amount of flow of electrons.
6. Certain materials, depending on their atomic structure, will be deemed conductors or insulators.

Learning Plan

Learning Activities:
1-1—Review 1-2—Static Electricity Experiment 1-3—Ohm's Law Practice 1-4—Common Electrical Terms and Symbols 1-5—Applying Ohm's Law, Electrical Terms,

and Symbols Using Word Problems 1-6—Electrical Prefixes 1-7—Ohm's Law Practice Using Common

Electronic Prefix Value

Resources:
Videos
Textbook Material
Demonstrations

Unit Modifications for Special Population Students	
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Integration of 21st Century Skills
Indicators: 9.3.12.AR 4 9.3.12.AR.B4 9.3.IT-SUP.2-3 9.3.ST-ET.4

Unit Title: 4 **Basic Instruments and Electrical Measurements**

Unit Description:
This unit covers the common electrical metering instruments. It is essential that the electronics student learn to use these common instruments as soon as possible. The use of the instruments, in conjunction with the lab activities, will help reinforce the basic concepts of voltage, current, and resistance. This unit will describe the proper operating procedures for measuring voltage, current, and resistance using analog and digital equipment. There are advantages and disadvantages to both types of meters, and the class will explore these differences. Students will learn the safe and proper use of ammeters, voltmeters, and ohmmeters on the experiment benches in laboratory situations. The color code system of labeling resistor values will also be presented. Lab materials will be introduced, including FACET bench equipment.

Unit Duration: 4 weeks

Desired Results

Standard(s):
9.3.12.AC-DES.1 – 2 9.3.AR-PRT. 1 – 3 9.3.ST-ET.4 9.3.12.AR-VIS.1 – 3

Indicators:

Understandings:
Students will :

- Explain the correct procedure for using an ammeter, a voltmeter, and an ohmmeter.
- Interpret a linear scale.
- Compute shunt resistor values.
- Compute multiplier resistor values.
- Interpret a nonlinear scale.
- Discuss the concept of meter sensitivity.
- Understand basic electrical diagrams.

Essential Questions:

1. What is the difference between analog and digital in reference to a meter?
2. What is the difference between linear and non-linear scales on a meter face?
3. What would be present if a circuit is completed and is connected to a source of power?
4. Why is a multi-meter necessary for troubleshooting electrical circuits?
5. What is the purpose of universal symbols and why are they considered universal. ?
6. How can technicians protect themselves when they are working on live circuits with a meter?

Assessment Evidence

Performance Tasks:

- Activity sheets
- Laboratory Activities
- Quiz on measuring current
- Quiz on measuring voltage
- Quiz on measuring resistance
- Practical exams using the multi meters for the above topics.
- Unit 3 exam

Other Evidence:

Benchmarks:

1. Meters are used by technicians to measure values of voltage, current, and resistance when troubleshooting circuits.
2. Meter types used by technicians are analog and digital.
3. Proper connection procedures and probes are necessary for proper meter function.
4. Advantages and disadvantages of all meters must be understood before selection and use.
5. Resistors are a necessary component of all properly functioning circuits.
6. The color code system of resistors is an international labeling device that must be understood by technicians.

Learning Plan

Learning Activities:
*Discussion / notes on needs and uses of voltmeters, ammeters, and ohmmeters.
*Notes / demonstration of analog voltmeter, ammeters, and ohmmeters.
*Discussion / notes / diagrams of meter scales, controls, probes & wires.
*Complete calibration procedures.
*Presentation of scales and scale divisions (decimals) and practice readings.
*Set-up and connect analog voltmeter, ammeters, and ohmmeters to measure electrical values.
*Discussion / notes / diagrams of digital voltmeter, ammeters, and ohmmeters, controls, wires.
*Set-up and connect digital voltmeter, ammeters, and ohmmeters to measure circuit values.
*Discussion / notes on advantages and disadvantages of analog and digital meters.
*Homework assignments
*Written and practical exam on use of analog and digital voltmeters, ammeters, and ohmmeters.
*Discussion / notes on need and use of resistors in an electrical circuit.
*Discussion / notes / demo of common types of resistors.
*Discussion / notes on resistor color code system to include four- and five-band systems with tolerance percent calculations.
*Problem solving – practical reading practice of color code system.
*Problem solving / computation of tolerance range values.
*Identification of power ratings with physical size of resistors.
*Written and practical color code system test
*Proper use of FACET meters
*Discussion on circuit board and base set up procedures
*Measuring circuit values with FACET equipment
*Discussion on new vocabulary and terminology*Equipment safety discussion

Resources:
Text: Pages 33–52 2.1—Basic Analog Meter Movement, page 33 2.2—Ammeter, page 36 2.3—Voltmeter, page 38 2.4—Ohmmeters, page 41 2.5—The Volt-Ohm-Milliammeter (VOM), page 42 2.6—Electrical Diagrams, page 48

Study Guide with Laboratory Activities:

2-1—Review 2-2—Reading Linear and Nonlinear Scales 2-3—Meter Connection Practice 2-4—Power Supply Familiarization 2-5—Verifying Ohm's Law Current and Voltage

Relationship 2-6—Meter Loading

2-7—Multi-meters 2-8—Basic Measurements 2-9—Breadboard Wiring

White Board
Information Sheets

Lecture Notes

Lab Benches /

AC/DC Variable Power supply

Electrical & Electronic experimenter parts

Soldering supplies and tools
Multi meters/
Oscilloscope

Educational Kits

Calculators

Overhead projector

FACET equipment

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Integration of 21st Century Skills
• 9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2). • 9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1). • 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. • 9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).

Unit Title: 5 **Introduction to Basic Electrical Circuit Materials**

Unit Description:
This unit introduces the student to a number of wiring devices. During the lectures and demonstrations many types of conductors, switches, lamps, fuses, breakers, and other common wiring devices available as props will be discussed. This unit will describe how to properly solder wire, wire connections, and printed circuit board components following all established safety and procedure steps. Students will become familiar with basic electronic components and their operation in electronic circuits. The design and development steps necessary to produce an operating printed circuit will also be completed in this unit.

Unit Duration: 4 weeks

Desired Results

Standard(s): • 9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2). • 9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1). • 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. • 9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).

Indicators:

Understandings:
Students will understand that…

- ❑ Identify different conductor types.
- ❑ Determine the cross-sectional area of a conductor.
- ❑ List the factors affecting resistance.
- ❑ Identify various insulation materials.
- ❑ List three special conductor pathways.
- ❑ Explain the manufacture of printed circuit boards.
- ❑ Identify various switching devices.
- ❑ Identify various lighting devices.
- ❑ Identify different types of resistors.
- ❑ Determine the value of color-coded resistors

Essential Questions:
How do you think Thomas Edison came up with his version of the incandescent light bulb

Have inventions in electricity and electronics stood the test of time or have they evolved with the new technologies available today? Site examples.

What determines a great conductor of electricity as opposed to an insulator?

What is the advantage of using a color code wrapped around a resistor?

Why are schematic diagrams a valuable tool in the field of electronics?

What advantages do printed circuit boards have over wired construction?

Assessment Evidence

Performance Tasks:
Lab experiments
Lab Activity sheets
Circuit board construction
Unit Exam

Other Evidence:

Benchmarks:

1. Each student will be able to describe the basic steps and proper soldering techniques to connect electrical components to a PC board.

2. Each student will be able to describe the need for heat sinks when soldering semi-conductor components.

3. Each student will be able to describe the need / use of the new components.

4. Each student will have the knowledge to properly layout, etch / develop, and construct a printed circuit board to solve a given circuit requirement.

Learning Plan

Learning Activities:

*Notes/discussion on:
- Safety procedures
- All soldering steps
- Clean-up procedures
- Job responsibilities

*Tinning stranded wire
*Soldering solid wire for splice application
*Notes/discussion on PC board development and soldering procedures
*PC components soldering
*Discussion on heat sensitive components / heat sinks
*Bench activities to familiarize students with new components
*Complete Learn to Solder kit
* Discussion/notes on design procedures for parts layout and crossover problems
* PC board development techniques using Ferric Chloride and masks.
* PC board prep for dry transfer or resist pens
* Etching PC boards
* Cleaning and drilling PC Board
* Mounting and soldering components on PC board
* Test board operation
* Written test on PC board development
*TLA on switching circuits

Resources:

Text: Pages 53–74 3.1—Conductors, page 53 3.2—Special Conductor Pathways, page 60 3.3—Common Circuit Devices, page 61 3.4—Lighting, page 64 3.5—Resistors, page 67

Study Guide with Laboratory Activities:

3-1—Review 3-2—Converting Resistor Color Code 3-3—Matching Resistor Color Code 3-4—Switches and Lamps 3-5—Converting Circuit Descriptions

to Schematics 3-6—Schematic Design Challenge 3-7—Basic Soldering Techniques

Lab Manual:

Lab 3-1—Introduction to Various Switch Styles Lab 3-2—Measuring Resistance Values Lab 3-3—Simple Circuit: Blown Fuse

Instructor's Resource: Pages 85–100 Reproducible Masters

RM 3-1: Incandescent Lamps

RM 3-2: Discharge Lamps Transparencies (CD only)

CT 3-1: Conductors

CT 3-2: Resistor Color Codes

White Board

Information Sheets

Lecture Notes

Lab Benches /

AC/DC Variable Power supply

Electrical & Electronic experimenter parts

Soldering supplies and tools

Multi meters/
Oscilloscope

Educational Kits

Calculators

Unit Modifications for Special Population Students	
Advanced Learners	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.
Struggling Learners	• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.
English Language Learners	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and

	participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections				
Visual and Performing Arts	English Language Arts	Mathematics	Science	Social Studies
	Gr.11-12, NJSLSA. R-1,3,4,8,10 RL- 1,2,3,7 RI- 1,3,9 RST- 7,8,9 Gr. 9-10, NJSLSA. R- 1,3,4,8,10 RL- 1,2,3,7 RI- 1,3,9 RST- 7,8,9	NJSLS N-Q.1-3	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4	

Integration of 21st Century Skills
Indicators: 8.1.12.CS.1 8.1.12.CS.2 8.1.12.CS.3 8.1.12.CS.4

Unit Title: 6 **Energy & Sources of Electricity**

Unit Description:
This unit will introduce students to the various chemical methods of producing electricity. The class will focus on cell connections and their arrangements to produce desired values of voltage and current. Basic principles of the automotive storage battery will be covered, along with safe and proper methods of maintenance.

Unit Duration: 2 weeks

Desired Results

Standard(s):
9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2). • 9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1). • 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. • 9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).

Indicators:

Understandings:
Students will understand that…

- ❑ List the six basic sources of electricity.
- ❑ Explain the chemical action that creates electricity in various types of cells.
- ❑ Define polarization.
- ❑ Explain the differences between primary cells and secondary cells.
- ❑ Distinguish between series and parallel connections in batteries.
- ❑ Calculate the outputs of batteries connected in series and parallel
- ❑ Demonstrate proper use of a hydrometer and explain its use.
- ❑ Calculate the theoretical capacity of a battery.

Essential Questions:
How can electricity be produced using chemicals and various metals?

What are primary cells and secondary cells?

How can the voltage of a battery be determined by cell connection?

How can we safely work with an automotive storage battery

Assessment Evidence

Performance Tasks:
*Reading assignment
*Discussion and notes
- Chem. Action
- Terms
- Principles of Op.
- Types of cells
- Cell Connections

*Lead Acid Cell
- Parts
- Testing
- Maintenance
- Charging & Jumping
- Specific Gravity

*FACET 4-1 Series & Parallel Connections
*FACET 4-2 Aiding and Opposing connections
*Battery connection TLA

Other Evidence:

Benchmarks:

1. Each student will be able to list / describe the need of basic cell parts.
2. Each student will be able to list at least three types of cells (primary or secondary) and compare / contrast.
3. All students will be able to list and describe the parts operation principles of the Lead-Acid storage battery.
4. Each student will be able to compute total voltage of Series and Parallel connections along with available current.
5. Students will be able to compute total voltage of Series-Aiding and Series-Opposing cell connections.
6. Properly connect cells to produce desired values of E & I.

Learning Plan

Learning Activities:

Text: Pages 83–101 5.1—Chemical Action, page 83 5.2—Other Sources of Electrical Energy, page 95

Study Guide with Laboratory Activities: 5-1—Review 5-2—Simple Electrical Cell 5-3—Battery Cells on Series and Parallel 5-4—Exploring a Piezo Cell 5-5—Producing Electricity Using a Photovoltaic Cell

NI Multisim Lab Manual: Lab 5-1—Connecting Batteries in Series and Parallel

Lab 5-2—The TD5A Transducer

Resources:

Instructor's Resource: Pages 113–122 Reproducible Masters

RM 5-1: Batteries in Series

RM 5-2: Batteries in Parallel Transparencies (CD only)

CT 5-1: Series Connection CT 5-2: Parallel Connection CT 5-3: Series-Parallel Connection

Unit Modifications for Special Population Students	
Advanced Learners	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.
Struggling Learners	• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.
English Language Learners	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and

	participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections				
Visual and Performing Arts	English Language Arts	Mathematics	Science	Social Studies
	Gr.11-12, NJSLSA. R-1,3,4,8,10 RL- 1,2,3,7 RI- 1,3,9 RST- 7,8,9 Gr. 9-10, NJSLSA. R- 1,3,4,8,10 RL- 1,2,3,7 RI- 1,3,9 RST- 7,8,9	NJSLS N-Q.1-3	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4	

Integration of 21st Century Skills

Indicators:
8.1.12.CS.1
8.1.12.CS.2
8.1.12.CS.3
8.1.12.CS.4

Unit Title: 7 **DC Series Circuit analysis through Ohm's law and Kirchoff's law**

Unit Description:
This unit will introduce students to the mathematical relationship of voltage, current, and resistance in any basic electrical circuit. Students will calculate unknown values of voltage, current, and resistance using Ohm's Law formulas. Proper units of measure for all computations will be discussed. The basic and fundamental series circuits will be covered in this unit, along with calculation procedures for solving voltage, current, and resistance levels. This unit focuses on the application of the laws of series circuits. The only way to master the laws of series circuits is with practice, simulated calculations, demonstrations, and lab experiments.

Unit Duration: 3 weeks

Desired Results

Standard(s):
9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2). • 9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1). • 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. • 9.4.5.CT.4: Apply critical thinking and problem-solving

strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).

Indicators:

Understandings:

Students will understand that…

❑ Determine the total resistance of a series circuit.

❑ Determine the voltage drops in a series circuit.

❑ Determine the current values of a series circuit.

❑ Determine the wattage values of a series circuit.

❑ Apply Ohm's law to solve for unknown voltage, current, and resistance in a series circuit.

❑ Apply series circuit theory to assist in troubleshooting a series circuit

Essential Questions:

1. What are the implications of Kirchhoff's two laws for electrical circuits?

2. Why does the total resistance of a circuit increase as more resistive components are placed in series with each other in a circuit?

3. What are the advantages of series circuits and what are the disadvantages of series circuits?

Assessment Evidence

Performance Tasks:

1. Place a voltmeter across the open to demonstrate how it equals source voltage.

2. Connect an ammeter to different parts of the circuit to demonstrate that current is equal in all parts of the circuit.

3.Take resistance readings of individual lamps and compare to total resistance value of the circuit

4.Determine the total resistance of a series circuit

5.Determine the voltage drops in a series circuit

6.Determine the current values of a series circuit

7.Determine the wattage values of a series circuit

8. Apply Ohm's law to solve for unknown voltage, current, and resistance in a series circuit.

9. Apply series circuit theory to assist in troubleshooting a series circuit.

Other Evidence:

Benchmarks:
1. There is only one path of electron flow through a series circuit.

2. An open anywhere in a series circuit will make the circuit appear dead.

3. Circuits that are soldered together may be damaged by unsoldering the circuit to assist in troubleshooting.

4. By applying the characteristics of series circuits and using voltage readings, the student will be able to troubleshoot quickly

5. Good systematic troubleshooting procedures are imperative when working with large, complex circuits.

Learning Plan

Learning Activities:
Student Activity Sheets & Lab Experiments
Laboratory Activity 6-1—Voltage in a Series Circuit

Laboratory Activity 6-2—Current and Resistance in a Series Circuit

Laboratory Activity 6-3—Challenge: Troubleshooting Series Circuits

Resources:
Text: Pages 103–108

Study Guide with Laboratory Activities:

6-1—Review 6-2—Series Circuit Practice 6-3—Verifying Kirchhoff's and Ohm's Laws 6-4—Variable Resistance and Voltage:

Kirchhoff's and Ohm's Laws 6-5—Solving Series Circuits 6-6—Resistor Challenge

6.1—Series Circuit Principles, page 103 6.2—Applications and Troubleshooting Series

Circuits, page 105RM 6-1: Applying Ohm's Law to Series Circuit

Unit Modifications for Special Population Students

Advanced Learners	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation.

	• Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students
Struggling Learners	• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.
English Language Learners	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.
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Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections				
Visual and Performing Arts	English Language Arts	Mathematics	Science	Social Studies
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Integration of 21st Century Skills

Indicators:
9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2). • 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. • 9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).

Unit Title: 8 **DC Parallel Circuit analysis through Ohm's law and Kirchoff's law.**

Unit Description:
It takes time to master the concept of parallel circuits due to the many formulas for finding total resistance and the math competencies required to learn them. A student having difficulties with parallel circuits may not actually be having difficulty with the concept of parallel circuits, but rather difficulties with fractions and common denominators. Calculators in the classroom will prove to be a valuable aid. Some students may find it easier to learn to graph the approximate answer before trying to solve it mathematically This chapter focuses on the application of the laws of parallel circuits. The only way to master the laws of parallel circuits is with practice, simulated calculations, demonstrations, and lab experiments.

Unit Duration: 4 weeks

Desired Results

Standard(s): 9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2). • 9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1). • 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. • 9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).

Indicators:

Understandings:
Students will understand that…

❑ Determine the total resistance of a parallel circuit.

❑ Determine the voltage drops in a parallel circuit.

❑ Determine the current values of a parallel circuit.

❑ Determine the wattage values of a parallel circuit.

❑ Apply Ohm's law to solve for unknown voltage, current, and resistance in a parallel circuit.

❑ Apply parallel circuit theory to assist in troubleshooting a parallel circuit

Essential Questions:

1. What are the implications of Kirchhoff's two laws for electrical circuits?

2. Why does the total resistance of a circuit decrease as more resistive components are placed in parallel with each other in a circuit?

3. What are the advantages of parallel circuits and what are the disadvantages of parallel circuits?

Assessment Evidence

Performance Tasks:

1. Determine the equivalent circuit resistance for a given combination circuit.

2. Determine the voltage drops in a combination circuit.

3. Determine the current values in a combination circuit.

4. Determine the wattage values in a combination circuit.

5. Apply combination circuit theory to troubleshoot a combination circuit.

Other Evidence:

Formative Assessment:

1. Worksheets
2. Classroom exercises
3. Quizzes
4. Lab work
5. Skill assessments

Building models

Summative Assessment

	-Benchmark TEST

Benchmarks:

1. Know the equivalent circuit resistance for a given combination circuit. When given time to compute such a problem.

2. Know the voltage drops in a combination circuit. When given time to compute such a problem.

3. Know the current values in a combination circuit. When given time to compute such a problem.

4. Know the wattage values in a combination circuit. When given time to compute such a problem.

5. Apply combination circuit theory to troubleshoot a combination circuit.

Learning Plan

7-1: *Review*, Study Guide with Laboratory Activities,
page 111
7-2: *Parallel Circuit Practice*, Study Guide with
Laboratory Activities, page 113
7-3: *Verifying Kirchhoff's and Ohm's Law*,
Study Guide with Laboratory Activities, page 115
7-4: *Solving Parallel Circuits*, Study
Guide with Laboratory Activities, page 119
7-5: *Parallel Circuit Challenge*,
Study Guide with C, page 121
7-6: *Solving for Total Resistance*, Study
Guide with Laboratory Activities, page 123
7-1: *Equal Resistors in Parallel*,
NI Multisim Lab Manual, page 91
Laboratory Activity 7-2:
Two Unequal Resistors in Parallel,
NI Multisim Lab Manual, page 95

Unit Modifications for Special Population Students

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Struggling Learners	• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.
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Interdisciplinary Connections				

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Integration of 21st Century Skills

Indicators:

8.1.12.CS.1
8.1.12.CS.2
8.1.12.CS.3
8.1.12.CS.4

Unit Title: 9 **Residential Housing Wiring**

Unit Description:

This unit is designed to provide students with a comprehensive understanding of residential house wiring systems, covering the principles, materials, and techniques used in electrical installations for homes. Students will learn how to plan, install, and troubleshoot common electrical circuits and components found in residential settings. This unit is suitable for individuals pursuing a career in electrical installation, maintenance, or anyone interested in DIY home wiring projects.

Unit Duration: 4 weeks

Desired Results

Standard(s): 9.4.5.CT.1: Identify and gather relevant data that will aid in the problem-solving process (e.g., 2.1.5.EH.4, 4-ESS3-1, 6.3.5.CivicsPD.2). • 9.4.5.CT.2: Identify a problem and list the types of individuals and resources (e.g., school, community agencies, governmental, online) that can aid in solving the problem (e.g., 2.1.5.CHSS.1, 4-ESS3-1). • 9.4.5.CT.3: Describe how digital tools and technology may be used to solve problems. • 9.4.5.CT.4: Apply critical thinking and problem-solving strategies to different types of problems such as personal, academic, community and global (e.g., 6.1.5.CivicsCM.3).

Indicators:

Understandings:

Students will understand that…

- Identify and explain the key components of a residential electrical system.
- Safely use and handle electrical tools and equipment.
- Interpret electrical drawings and blueprints.
- Calculate electrical loads and circuit requirements for a residential building.
- Select and install appropriate electrical cables, wires, and conduits.

Essential Questions:

1. What are some safety rules an electrician should observe?
2. What is the Primary Purpose of the National Electrical Code?
3. Why are insulated tools important?
4. What are some considerations when deciding on a method to attach a fixture to a box?
5. Where are GFCI's Located?

- Install electrical outlets, switches, lighting fixtures, and receptacles.
- Wire basic residential circuits, including lighting, receptacle, and switch circuits.
- Understand grounding and bonding requirements for electrical safety.
- Troubleshoot and diagnose common residential wiring problems.
- Comply with electrical codes, regulations, and safety standards.

Assessment Evidence

Performance Tasks:

- Quizzes and Examinations
- Hands-on Wiring Projects
- Electrical Circuit Design Assignments
- Troubleshooting and Problem-Solving Scenarios
- Compliance and Code Knowledge Assessments

Other Evidence:

Formative Assessment:

- Worksheets
- Classroom exercises
- Quizzes
- Lab work
- Skill assessments

Building models

Summative Assessment

-Benchmark TEST

Benchmarks:

This residential house wiring unit will equip students with the knowledge and practical skills needed to perform safe and compliant electrical installations in residential settings. Students will also gain an understanding of electrical codes and regulations, ensuring that they adhere to best practices in the industry.

Learning Plan

- Teacher led discussion and demos
- Review question from textbook
- Student electrical wiring projects
- Trouble shooting techniques

Unit Modifications for Special Population Students	
Advanced Learners	• Provide ample opportunities for creative behavior. • Create assignments that call for original work, independent learning, critical thinking, problem solving, and experimentation. • Show appreciation for creative efforts • Respect unusual questions, ideas, and solutions. • Encourage students to test their ideas. • Provide opportunities and give credit for self-initiated learning. • Avoid overly detailed supervision and too much reliance on prescribed curricula. • Allow time for reflection. • Resist immediate and constant evaluation. • Avoid comparisons to other students.
Struggling Learners	• Assist students in getting organized. • Give short directions. • Use drill exercises. • Give prompt cues during student performance. • Let students with poor writing skills use a computer. • Break assignments into small segments and assign only one segment at a time. • Demonstrate skills and have students model them. • Give prompt feedback. • Use continuous assessment to mark students' daily progress. • Prepare materials at varying levels of ability.
English Language Learners	• Use a slow, but natural rate of speech; speak clearly; use shorter sentences; repeat concepts in several ways. • When possible, use pictures, photos, and charts. • Corrections should be limited and appropriate. Do not correct grammar or usage errors in front of the class. • Give honest praise and positive feedback through your voice tones and visual articulation whenever possible. • Encourage students to use language to communicate, allowing them to use their native language to ask/answer questions when they are unable to do so in English. • Integrate students' cultural background into class discussions. • Use cooperative learning where students have opportunities to practice expressing ideas without risking language errors in front of the entire class.
Learners with an IEP	Each special education student has in Individualized Educational Plan (IEP) that details the specific accommodations, modifications, services, and support needed to level the playing field. This will enable that student to access the curriculum to the greatest extent possible in the least restrictive environment. These include: • Variation of time: adapting the time allotted for learning, task completion, or testing • Variation of input: adapting the way instruction is delivered • Variation of output: adapting how a student can respond to instruction • Variation of size: adapting the number of items the student is expected to complete • Modifying the content, process or product Additional resources are outlined to facilitate appropriate behavior and increase student engagement. The most frequently used modifications and accommodations can be viewed here. Teachers are encouraged to use the Understanding by Design Learning Guidelines (UDL). These guidelines offer a set of concrete suggestions that can be applied to any discipline to ensure that all learners can access and

	participate in learning opportunities. The framework can be viewed here www.udlguidelines.cast.org
Learners with a 504	Refer to page four in the Parent and Educator Resource Guide to Section 504 to assist in the development of appropriate plans.

Interdisciplinary Connections				
Visual and Performing Arts	English Language Arts	Mathematics	Science	Social Studies
	Gr.11-12, NJSLSA. R-1,3,4,8,10 RL- 1,2,3,7 RI- 1,3,9 RST- 7,8,9 Gr. 9-10, NJSLSA. R- 1,3,4,8,10 RL- 1,2,3,7 RI- 1,3,9 RST- 7,8,9	NJSLS N-Q.1-3	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4	

Integration of 21st Century Skills
Indicators: 8.1.12.CS.1 8.1.12.CS.2 8.1.12.CS.3 8.1.12.CS.4