# Unit 1A Safety and Scientific Method (Physical Science, Engineering Design)

Content Area: **Science**
Course(s): **Robotics**
Time Period:
Length: **10 Days**
Status: **Published**

## Title Section

## Department of Curriculum and Instruction

**Belleville Public Schools**

**Curriculum Guide**

# Robotics Academy (12)

# Unit 1A - Safety and Scientific Method

**Belleville Board of Education**

**102 Passaic Avenue**

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## Unit Overview

1. Safety in the Laboratory - Proper laboratory techniques and safety protocols are essential in the high school science laboratory
2. Introduction to soldering and safety in robotics
3. Data Collection and Analysis - The crosscutting concepts of *structure and function*, *patterns*, *energy and matter*, and *stability and change* are called out as the framework for understanding the disciplinary core ideas. Students use *developing and using models*,*planning and conducting investigations*, *using mathematical thinking*, and *constructing explanations and designing solutions*.
4. Data Collection and Analysis -Students are also expected to use the science and engineering practices to demonstrate proficiency with the core ideas.
5. Data Collection and Analysis -Students analyze major global problems. They begin by breaking these problems into smaller problems that can be tackled with engineering methods. To evaluate potential solutions, students are expected not only to consider a wide range of criteria, but also to recognize that criteria need to be prioritized.

This unit is based on HS-PS1-1, HS-PS1-2, HS-PS1-3, HS-PS2-6, HS-ETS1-3, and HS-ETS1-4.

## Enduring Understanding

**Enduring understandings**:

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1. A learning schedule and procedures are imperative to create a safe, structured, and enthusiastic learning environment. In this first unit students will receive necessary information from instructor regarding applicable classroom and lab policies of the school.
2. If the end product of science, engineering, and design was compared to a great work of literature - the metric system and scientific notation are the language used behind a great work. Strengthening the mathematics and comprehension of our students must take place during the introduction of the coursework in order to allow the students to communicate in the language of science.

## Essential Questions

1. What is science and what are the methods that will be utilized in order to solve real world problems?
2. What are classroom expectations and rules? What is safety first?
3. How is data collected and analyzed?
4. What kinds of science are used to create products that we use every day?

## Exit Skills

Skills Checklist:

1. know, understand, and practice safety protocols and measures

- read and understand SDS sheets
- understand the selection process of safety equipment
- follow safety procedures and respond during an emergency

2. Identify basic laboratory materials

- select which measurement tools should be used

3. Use units and measure in the metric system

- show proficiency in units of measurement
- identify the differences between accuracy and precision as they pertain to measurement
- use the rules of significant figures in order to perform mathematical operations using significant figure
- use significant notation to express numerical equations
- use dimensional analysis to complete calculations
- preform simple density equation

4. use the scientific method

- collect, organize, and analyze data
    - **identify the independent and dependent variables when given a set of data**
    - **identify the independent and dependent variables in an experiment when given a research question**
    - **identify two or more variables that must be controlled in an experiment.**
    - **write a research question for an experiment stating the independent and dependent variables.**

- transfer learning of scientific method in use of the scientific method to address a specific practice or problem
- organize the data in coordination of the specific problem
- analyze the data and note errors and possible sources of error
- analyze data noting errors

identification of errors within experimental design and experimental process

## New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

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|---|---|
| HS-ETS1-1 | Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. |
| HS-PS1-1 | Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. |
| HS-ETS1-2 | Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. |
| HS-ETS1-3 | Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. |
| HS-ETS1-4 | Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. |
| HS-PS1-2 | Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties. |
| HS-PS1-3 | Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. |
| HS-PS1-6 | Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium. |

## Interdisciplinary Connections

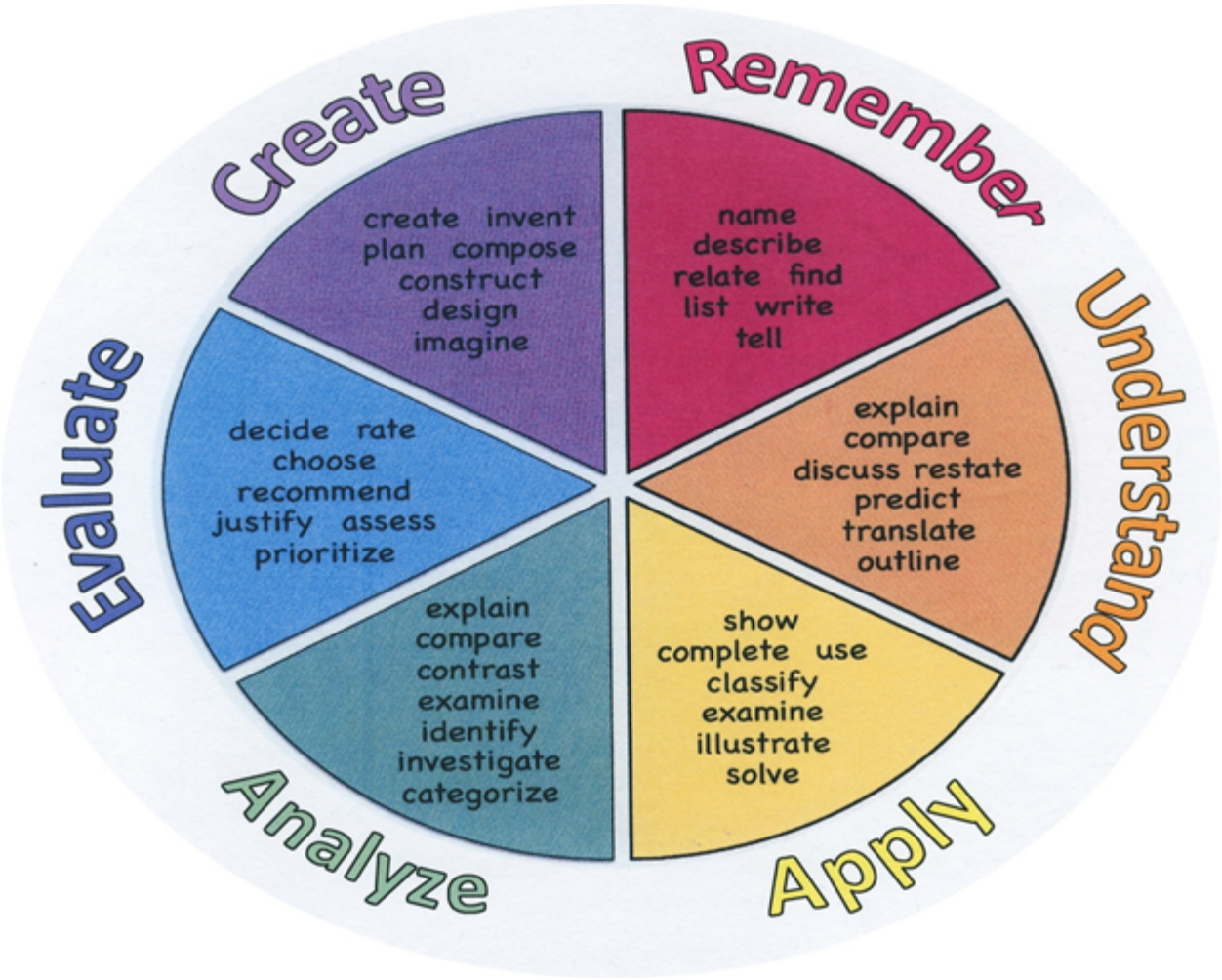
| | |
|---|---|
| MA.G-CO.A.1 | Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.<br><br>Data are gathered, displayed, summarized, examined, and interpreted to discover patterns and deviations from patterns. Quantitative data can be described in terms of key characteristics: measures of shape, center, and spread. The shape of a data distribution might be described as symmetric, skewed, flat, or bell shaped, and it might be summarized by a statistic measuring center (such as mean or median) and a statistic measuring spread (such as standard deviation or interquartile range). Different distributions can be compared numerically using these statistics or compared visually using plots. Knowledge of center and spread are not enough to describe a distribution. Which statistics to compare, which plots to use, and what the results of a comparison might mean, depend on the question to be investigated and the real-life actions to be taken.<br><br>Decisions or predictions are often based on data—numbers in context. These decisions or predictions would be easy if the data always sent a clear message, but the message is often obscured by variability. Statistics provides tools for describing variability in data and for making informed decisions that take it into account. |

## Learning Objectives

The student will be able to:

- Define and distinguish between a hypothesis, a scientific law, and a theory.
- Understand the role of experiments in testing hypotheses.
- Understand that scientific theories are built from strong experimental evidence and that the term "theory" in science is used much differently than in pop culture.
- Compare and contrast pure research, applied research, and technology.
- Apply knowledge of laboratory safety.

| Remember | Understand | Apply | Analyze | Evaluate | Create |
|---|---|---|---|---|---|
| Choose | Classify | Choose | Categorize | Appraise | Combine |
| Describe | Defend | Dramatize | Classify | Judge | Compose |
| Define | Demonstrate | Explain | Compare | Criticize | Construct |
| Label | Distinguish | Generalize | Differentiate | Defend | Design |
| List | Explain | Judge | Distinguish | Compare | Develop |
| Locate | Express | Organize | Identify | Assess | Formulate |
| Match | Extend | Paint | Infer | Conclude | Hypothesize |
| Memorize | Give Examples | Prepare | Point out | Contrast | Invent |
| Name | Illustrate | Produce | Select | Critique | Make |
| Omit | Indicate | Select | Subdivide | Determine | Originate |
| Recite | Interrelate | Show | Survey | Grade | Organize |
| Select | Interpret | Sketch | Arrange | Justify | Plan |
| State | Infer | Solve | Breakdown | Measure | Produce |
| Count | Match | Use | Combine | Rank | Role Play |
| Draw | Paraphrase | Add | Detect | Rate | Drive |
| Outline | Represent | Calculate | Diagram | Support | Devise |
| Point | Restate | Change | Discriminate | Test | Generate |
| Quote | Rewrite | Classify | Illustrate | | Integrate |
| Recall | Select | Complete | Outline | | Prescribe |
| Recognize | Show | Compute | Point out | | Propose |
| Repeat | Summarize | Discover | Separate | | Reconstruct |
| Reproduce | Tell | Divide | | | Revise |
| | Translate | Examine | | | Rewrite |
| | Associate | Graph | | | Transform |
| | Compute | Interpolate | | | |
| | Convert | Manipulate | | | |
| | Discuss | Modify | | | |
| | Estimate | Operate | | | |
| | Extrapolate | Subtract | | | |
| | Generalize | | | | |
| | Predict | | | | |




## Suggested Activities & Best Practices

## Assessment Evidence - Checking for Understanding (CFU)

Google Classroom Registration and Assignments (Formative)

QUIA Quiz - Safety (Summative)

Pear Deck Safety (Formative)

Common, Department Quarterly Benchmarks (Benchmark)

Oncourse Assessment Tools (Formative)

Unit Test/Quiz (Summative)

"Do Now/Exit Ticket" Activity (Formative)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist

- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests
- Web-Based Assessments
- Written Reports

## Primary Resources & Materials

http://curriculum.vexrobotics.com/

http://curriculum.vexrobotics.com/teacher-materials.html

## Ancillary Resources

1. Teacher and Publisher supplied powerpoints, notes, laboratory guides, and worksheets
2. Textbooks
3. Resource Manuals
4. Internet Resources
5. Computer and smartboard Activities

## Technology Infusion

VEX Robotics

Student Surface Tablets

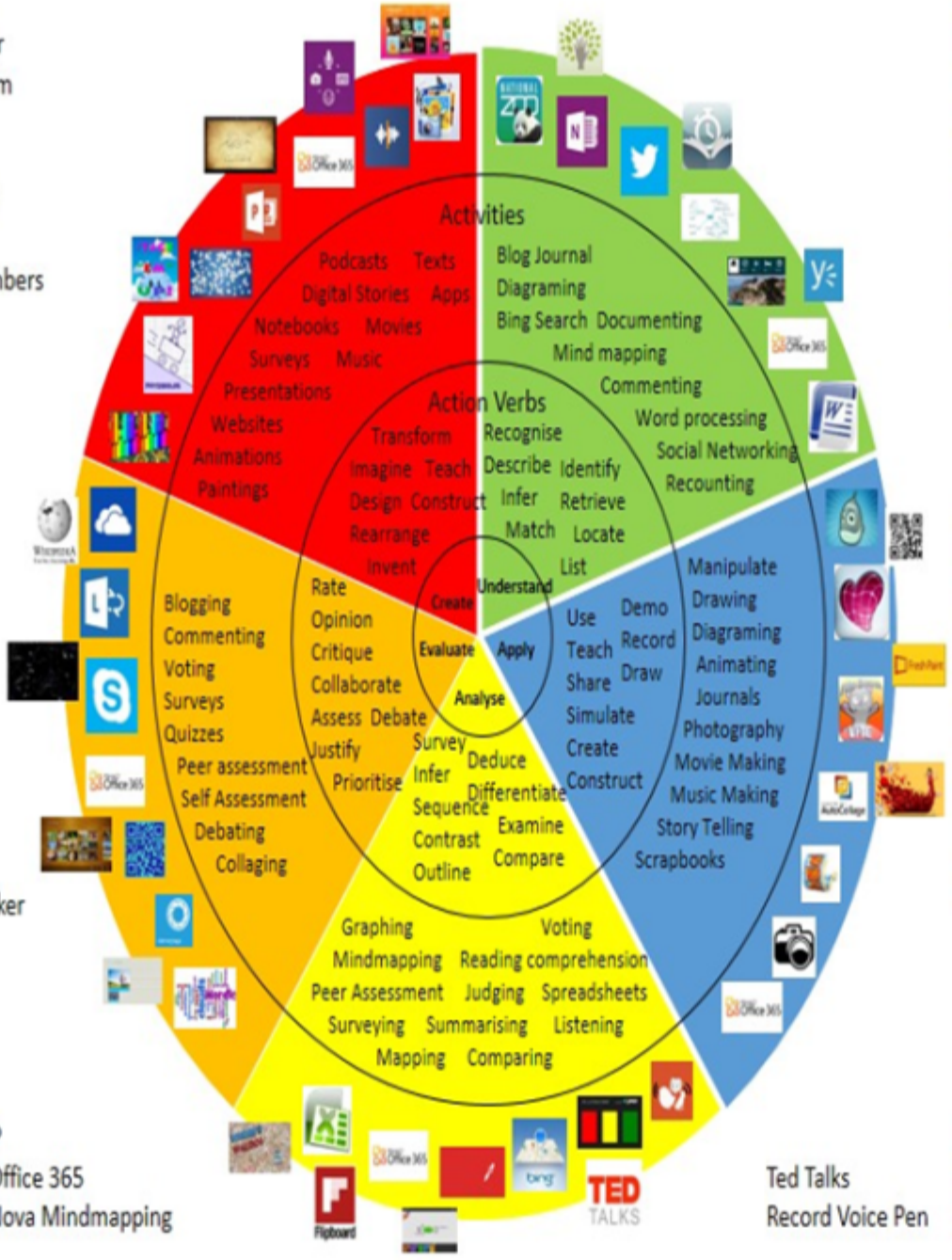
Chromebook

Google Classroom

# Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker




Where's Waldo?
MS Excel Office 365
Flipboard Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

## Alignment to 21st Century Skills & Technology

Mastery and infusion of **21st Century Skills & Technology** and their Alignment to the core content areas is essential to student learning. The core content areas include:

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

## 21st Century Skills/Interdisciplinary Themes

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

## 21st Century Skills

- Civic Literacy
- Environmental Literacy
- Financial, Economic, Business and Entrepreneurial Literacy
- Global Awareness
- Health Literacy

## Differentiation

Content:

- Providing audio/visual supports for taking in text or other information
- Posing situations, problems, or dilemmas that vary by complexity, skill mastery, or background knowledge required
- Modeling or demonstrating
- Working with content/skills that are pre-requisite to targeted content/skills
- Varying the time allotted to take in/learn content

Process:

- Giving tiered questions/organizers (same idea, different phrasing or emphasis, more/less support)
- Increasing/decreasing the facets of a task Increasing/decreasing the degree of scaffolding for a task
- Working more/less like an expert, practitioner, or professional
- Providing models of work at different levels of complexity
- Asking students to see content through a certain focus or lens

Product:

- Varying the audience for the product (from closer to student experience/more familiar to further from student experience/less familiar)
- Varying the demands or sophistication of the product
- Having varied arrangements for working on a product
- Giving more or fewer check-in dates and chunks in progress of completing task
- Providing more or fewer givens or knowns (models/examples, resources, guidelines)

**Differentiations:**

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals

- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

**Hi-Prep Differentiations:**

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

**Lo-Prep Differentiations**

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students

- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

## Special Education Learning (IEP's & 504's)

Content:

- Providing audio/visual supports for taking in text or other information
- Posing situations, problems, or dilemmas that vary by complexity, skill mastery, or background knowledge required
- Modeling or demonstrating
- Working with content/skills that are pre-requisite to targeted content/skills
- Varying the time allotted to take in/learn content

Process:

- Giving tiered questions/organizers (same idea, different phrasing or emphasis, more/less support)
- Increasing/decreasing the facets of a task Increasing/decreasing the degree of scaffolding for a task
- Working more/less like an expert, practitioner, or professional
- Providing models of work at different levels of complexity
- Asking students to see content through a certain focus or lens

Product:

- Varying the audience for the product (from closer to student experience/more familiar to further from student experience/less familiar)
- Varying the demands or sophistication of the product

- Having varied arrangements for working on a product
- Giving more or fewer check-in dates and chunks in progress of completing task
- Providing more or fewer givens or knowns (models/examples, resources, guidelines)

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format
- modified test length
- multi-sensory presentation
- multiple test sessions
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

## English Language Learning (ELL)

Please identify the **English Language Learning** adaptations that will be employed in the unit, using the ones identified below.

- teaching key aspects of a topic.  Eliminate nonessential information

- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

## At Risk

Content:

- Providing audio/visual supports for taking in text or other information
- Posing situations, problems, or dilemmas that vary by complexity, skill mastery, or background knowledge required
- Modeling or demonstrating
- Working with content/skills that are pre-requisite to targeted content/skills
- Varying the time allotted to take in/learn content

Process:

- Giving tiered questions/organizers (same idea, different phrasing or emphasis, more/less support)
- Increasing/decreasing the facets of a task Increasing/decreasing the degree of scaffolding for a task
- Working more/less like an expert, practitioner, or professional
- Providing models of work at different levels of complexity
- Asking students to see content through a certain focus or lens

Product:

- Varying the audience for the product (from closer to student experience/more familiar to further from

student experience/less familiar)

- Varying the demands or sophistication of the product
- Having varied arrangements for working on a product
- Giving more or fewer check-in dates and chunks in progress of completing task
- Providing more or fewer givens or knowns (models/examples, resources, guidelines)

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning
- allowing students to select from given choices
- allowing the use of note cards or open-book during testing
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

## Talented and Gifted Learning (T&G)

Content:

- Providing audio/visual supports for taking in text or other information
- Posing situations, problems, or dilemmas that vary by complexity, skill mastery, or background knowledge required
- Modeling or demonstrating
- Working with content/skills that are pre-requisite to targeted content/skills

- Varying the time allotted to take in/learn content

Process:

- Giving tiered questions/organizers (same idea, different phrasing or emphasis, more/less support)
- Increasing/decreasing the facets of a task Increasing/decreasing the degree of scaffolding for a task
- Working more/less like an expert, practitioner, or professional
- Providing models of work at different levels of complexity
- Asking students to see content through a certain focus or lens

Product:

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- Varying the demands or sophistication of the product
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- Giving more or fewer check-in dates and chunks in progress of completing task
- Providing more or fewer givens or knowns (models/examples, resources, guidelines)

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

## Sample Lesson

**Enduring Understandings:** Scientific Measurement is used during experimentation to collect data. Students must learn to express and evaluate measurements in a scientific way. The metric system is the system in which scientist's measure length, mass, and volume. Students will become familiar with the system of unites used for scientific measurement and apply dimensional analysis to solve conversion problems.

**Lesson Rational:** Scientists use research techniques to explore, examine, and extrapolate knowledge. Students must experience conduction experiments, collect data, examine data, and analyze data along with expressing their finding in writing in a clear and well developed report.

**Essential Questions:** How do scientists use, express, and evaluate measurements in experiments?

**Objectives:** Students will be able to

1. Convert measurements to scientific notation
2. Distinguish among accuracy, precision, and give examples
3. Define the error of measurement
4. Determine the number of significant figures in a measurement and summarize rules
5. Determine the number of significant figures in a calculation and summarize the rules fro addition and subtraction

**Anticipatory Set:** What is the difference between accuracy and precision

**Student Centered Inquiry-based Learning Procedure/Method:**

1.) Anticipatory Set

2.) Didactic Presentation - Power Point

3.) Sample Problems

4.) Concept Check

**Meaningful Closure:** Socratic Questioning

**Differentiation:** Use of didactic and practical exercises are used in this lesson

**Accommodations:** Accommodations will be made as specified by IEP.

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| **Pre, Formative and/or Summative Assessment Strategies Evaluations:** Students will complete learning and concept checks with an accuracy of 100%. |
| **Report, Reflect, Discuss:** |
| **Independent Practice/Upcoming Tasks:** Soldering |
| **Integrated Cross Disciplinary Lesson:** Math |