Unit 3: Waves and Information Transfer (Waves)

Content Area: **Science**
Course(s): **Science Gr 4**
Time Period: **November**
Length: **23 Days**
Status: **Published**

Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Science: Grade 4

Unit 3: Waves and Information Transfer

Belleville Board of Education

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Board Approved: September 23, 2019

Unit Overview

Unit three provides detailed information about waves and information transfer. The content within the unit focuses on discovering different parts of waves. The unit explores how light can be reflected. Students will examine and describe how information is transferred from place to place.

Enduring Understanding

- Waves are evidence that energy is transferred.
- Waves and energy can move in different directions.
- Sound travels better through water than through air.
- The crest, top of a wave, is the point on a wave where matter is moved the farthest upward.
- The trough, bottom of the wave, is the point on a wave where the least amount of matter is moved the farthest down.
- The wavelength is the distance between a point on one wave and the identical point on the next wave.
- Waves with greater amplitude, the amount of energy in a wave, have more energy than waves with a lower amplitude.
- Sound waves with more energy and volume have larger amplitudes.
- Sound waves with less energy and volume have smaller amplitudes.
- Once light reaches its target, it might pass though the target or bounce back.
- Light can be reflected off of different surfaces.
- The color of an object and surface can impact how light is reflected.
- Refraction, the bending of light waves as they pass from one material to another, causes optical illusions.
- Codes and signals are used to transfer information.
- Communication has changed over time.
- With the discovery of electricity, signals could be sent over much greater distances.
- Computers translate words, letters, numbers, and pictures into codes.
- Codes and different ways to send codes have been around for thousands of years.
- Binary code is needed to store information in a computer.
- If a signal has too much information for the network to move, it slows down or stops.
- Images and pictures are made of pixels.

- More pixels make pictures much clearer and colors brighter (high definition).

Essential Questions

- **How do waves carry energy?**
- **What are the properties and parts of waves?**
- **What happens when waves interact?**
- **What is the difference between wavelength and amplitude?**
- **How can you determine if a wavelength is strong or weak?**
- **How does light interact with different surfaces?**
- **How does light reflect and refract?**
- **How does light allow you to see objects?**
- **How are codes and signals used to transfer information?**
- **How has the way we rely on information transfer changed over the years?**

Exit Skills

By the end of Grade 4, Science Unit 3, the student should be able to:

- Ask questions and define problems
- Construct explanations and design solutions
- Define and delimit engineering problems
- Develop possible solutions
- Optimize the design solution
- Analyze the influence of science, engineering, and technology on society and the natural world

New Jersey Student Learning Standards (NJSLS-S) & NGSS

SEP - Scientific Knowledge... Evidence

SEP - Constructing... Solutions

SEP - Developing and Using Models

DCI - Wave Properties

DCI - Electromagnetic Radiation

DCI - Information Technologies and Instrumentation

DCI - Optimizing the Design Solution

CCC - Patterns

CCC - Interdependence of Science, Engineering, and Technology

CCC - Cause and Effect

NextGen Science Standards

4-PS3-1.PS3.A.1	The faster a given object is moving, the more energy it possesses.
4-PS4	Waves and their Applications in Technologies for Information Transfer
4-PS4-1	Develop a model of waves to describe patterns in terms of amplitude and wavelength and that waves can cause objects to move.
4-PS4-1.PS4.A	Wave Properties
4-PS4-1.PS4.A.1	Waves, which are regular patterns of motion, can be made in water by disturbing the surface. When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.

Interdisciplinary Connections

Do the Math! pp. 159, 185, 211

MA.4.OA.C.5	Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself.
MA.4.MD.A.1	Know relative sizes of measurement units within one system of units including km, m, cm, mm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table.
MA.4.G.A.1	Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.

Learning Objectives

- **In Unit 3, students will demonstrate the ability to:**

  HMH Science Dimensions, Unit 3 - Lesson 1:

  - **Differentiate** between wavelength and amplitude
  - **Observe** how waves interact
  - **Explain** how energy is transferred

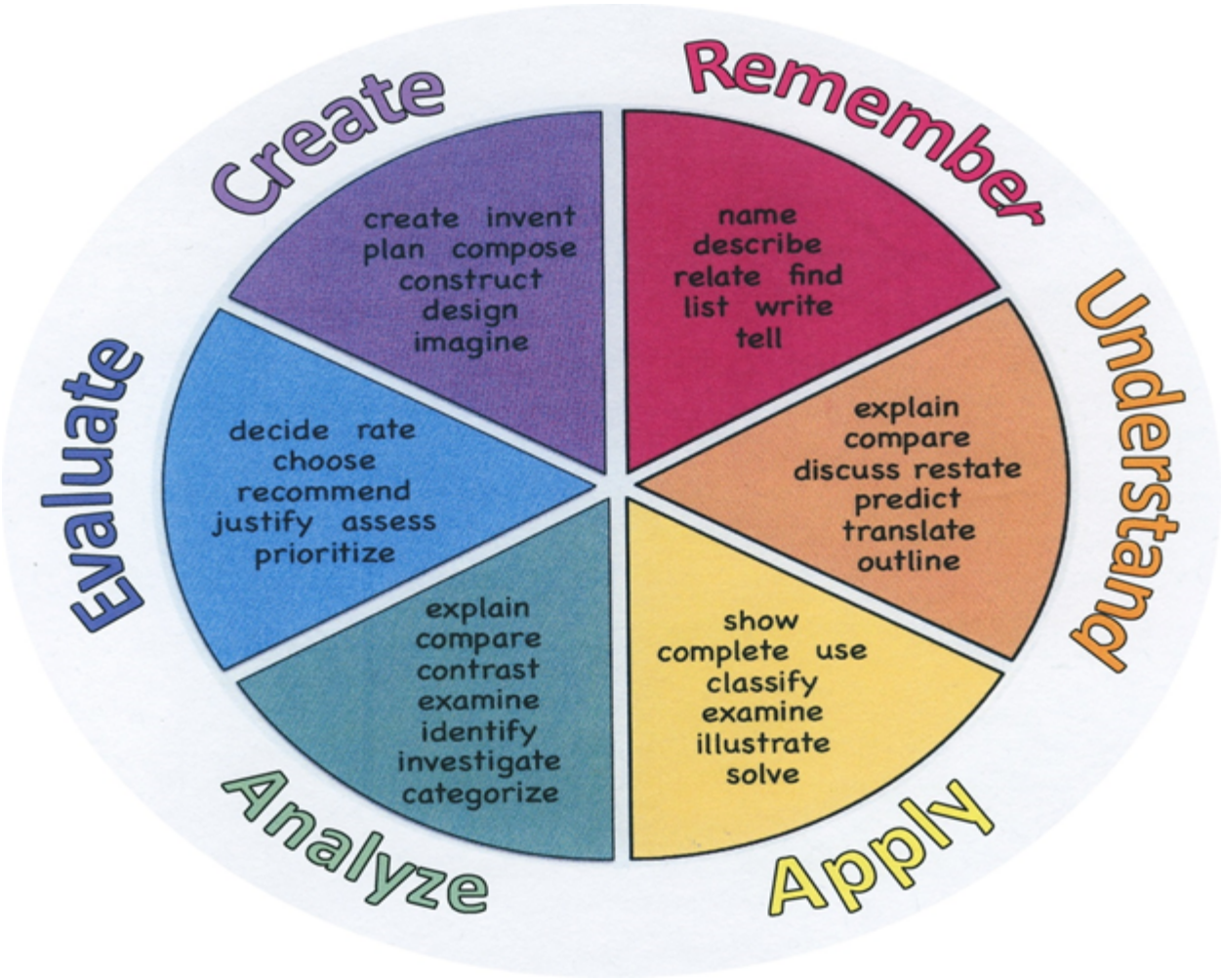
HMH Science Dimensions, Unit 3 - Lesson 2:

- **Investigate** how images differ when light interacts with air and water
- **Generate** a list of effects matter has on light
- **Compare and Contrast** how light interacts with mirrors. lenses, prisms, and non-reflective surfaces due to their unique properties

HMH Science Dimensions, Unit 3 - Lesson 3:

- **Compare** patterns in multiple methods of transferring information
- **Transform** information using codes and a pixilated image
- **Evaluate** how the way we received information changed over years

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

HMH Science Dimensions, Unit 3 - Lesson 1:

- **Engage:** "Can You Explain It?" lesson
- **Explore/Explain:** "How Waves Transfer Energy?," "Wave Parts" and " Waves Interact" lessons and hands-on activity (Exploration 1, 2, & 3)
- **Elaborate:** "Discover More" extension activity
- **Evaluate:** "Lesson Check" and "Lesson Roundup" assessments (formative/summative)

HMH Science Dimensions, Unit 3 - Lesson 2:

- **Engage:** "Can You Explain It?" lesson
- **Explore/Explain:** "Reflection and Our Eyes" and "Refraction and Lenses" lessons and hands-on activity (Exploration 1 & 2)
- **Elaborate:** "Discover More" extension activity

- **Evaluate:** "Lesson Check" and "Lesson Roundup" assessments (formative/summative)

HMH Science Dimensions, Unit 3 - Lesson 3:

- **Engage:** "Can You Explain It?" lesson and hands-on activity
- **Explore/Explain:** "History of Information Transfer" and "Bites and Bytes" lessons and hands-on activity (Exploration 1 & 2)
- **Elaborate:** "Discover More" extension activity
- **Evaluate:** "Lesson Check" and "Lesson Roundup" assessments (formative/summative)

HMH Science Dimensions, Unit 3 - Performance Task (The Rainbow Show):

- **Understand Goal**
- **Research**
- **Demonstration Preparation**
- **Arrange Information**
- **Prepare**
- **Editing and Revision**
- **Communicate**

HMH Science Dimensions, Unit 3 - Unit Project (Reflecting Light):

- **Plan and Design**
- **Analyze Results**
- **Claims, Evidence, and Reasoning**

Assessment Evidence - Checking for Understanding (CFU)

- Admit Tickets
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define

- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- HMH End-of-Year Test (Benchmark)
- HMH Mid-Year Test (Benchmark)
- HMH Performance-based Assessment (Alternative)
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports
- Outline
- Question Stems
- Quickwrite
- Quizzes (Formative)
- Red Light, Green Light
- Self- assessments
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Unit review/Test prep
- Unit tests (Summative)
- Web-Based Assessments
- Written Reports

Primary Resources & Materials

HMH Science Dimensions: Teacher Edition, Student workbooks, online resources

HMH Equipment & Safety Kits

HMH Science Dimensions S&E Leveled Readers

- On Level: How do we use Forms of Energy?
- Extra Support: How do we use Forms of Energy?
- Enrichment: What Happens Under the Hood?

Ancillary Resources

Science Weekly, Scholastic News, NewsELA, YouTube/TeacherTube, National Geographics Kids, Science Channel

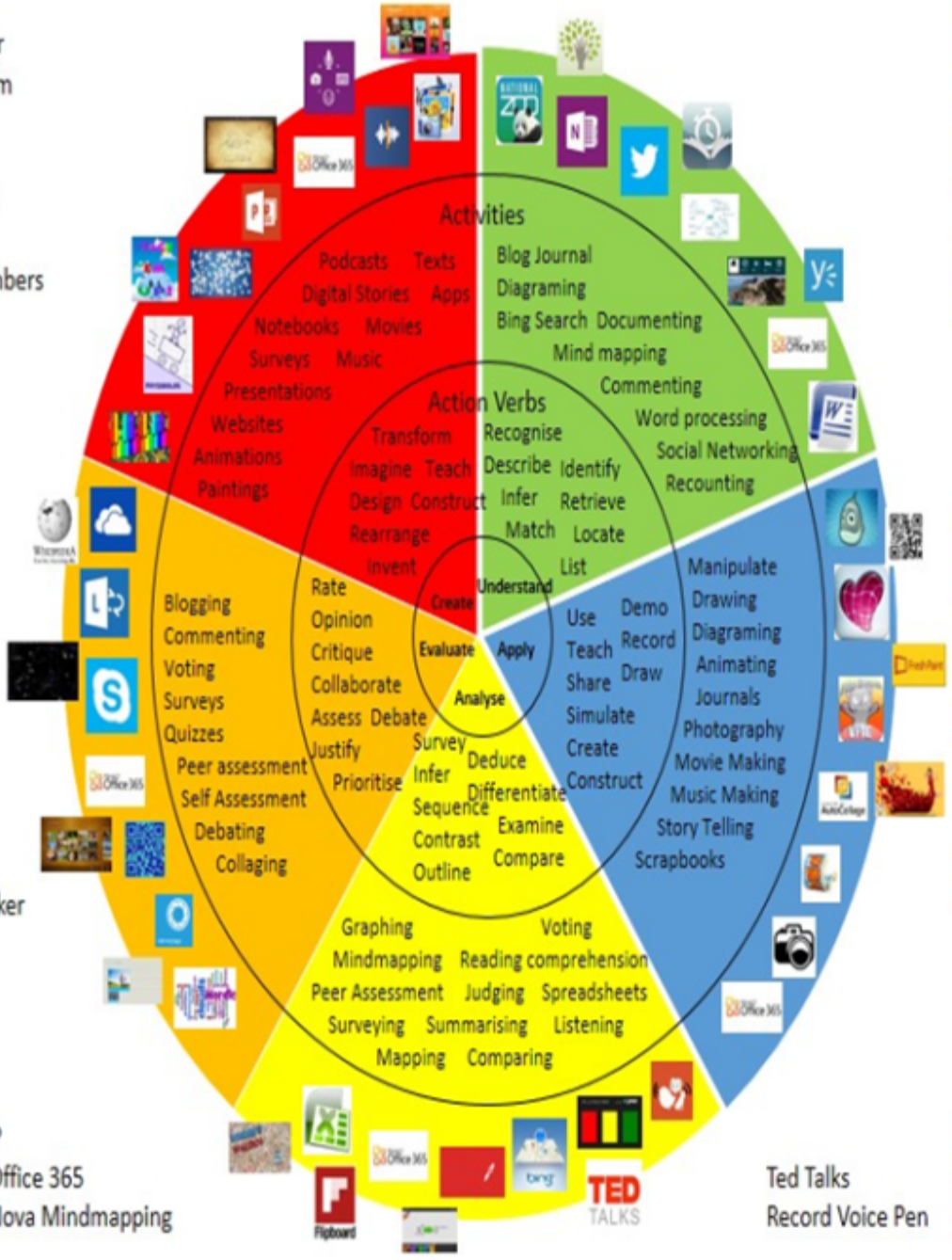
https://ngss-assessment.portal.concord.org/

Technology Infusion

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
Flipboard
Office 365
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.

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.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.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
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.

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

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)

- 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
- multiple test sessions
- multi-sensory presentation
- 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)

- 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

- 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)

- 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