Unit 1 Foundations of Meteorology (Earth and Space Science, Engineering Design)

Content Area: **Sample Content Area**
Course(s): **Sample Course, Meteorology**
Time Period:
Length: **Sample Length & Grade Level**
Status: **Published**

Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Meterology 11,12

Foundations in Meterology

Belleville Board of Education

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Board Approved: September 23, 2019

Unit Overview

"Meteorology is one of the oldest observational sciences in human history and perhaps the most relevant to a broad segment of society. Some of our first observational meteorologists and weather forecasters were shepherds, farmers and sailors whose livelihoods and safety depended upon understanding and predicting the weather."

This unit will explore meteorological terms, global mapping variables, as well as units of measure, to establish a solid foundation for the concepts ahead.

Enduring Understanding

- Analyze data using mathematical models, in order to make valid scientific claims.
- Science Investigations use diverse methods, to compile data, of which all may be valid.

- New technologies, serve to drive scientific knowledge and therefore continued innovation.
- Science arguments are mainly strengthened by multiples sources of empirical evidence.

Essential Questions

1. What are the common units of measure for temperature, pressure and time used when studying weather?
2. How can a graph be used to represent variables in weather patterns?
3. What are some meteorological terms to be familiar with when describing weather?

Exit Skills

- Create line and bar graphs to represent meteorological data
- Create contour maps using meteorological variables
- Use a model to describe how variations in energy flow, away and towards the Earth creates weather.

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

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-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-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-3	Develop a model based on evidence of Earth's interior to describe the cycling of matter by thermal convection.
HS-ESS2-4	Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

Interdisciplinary Connections

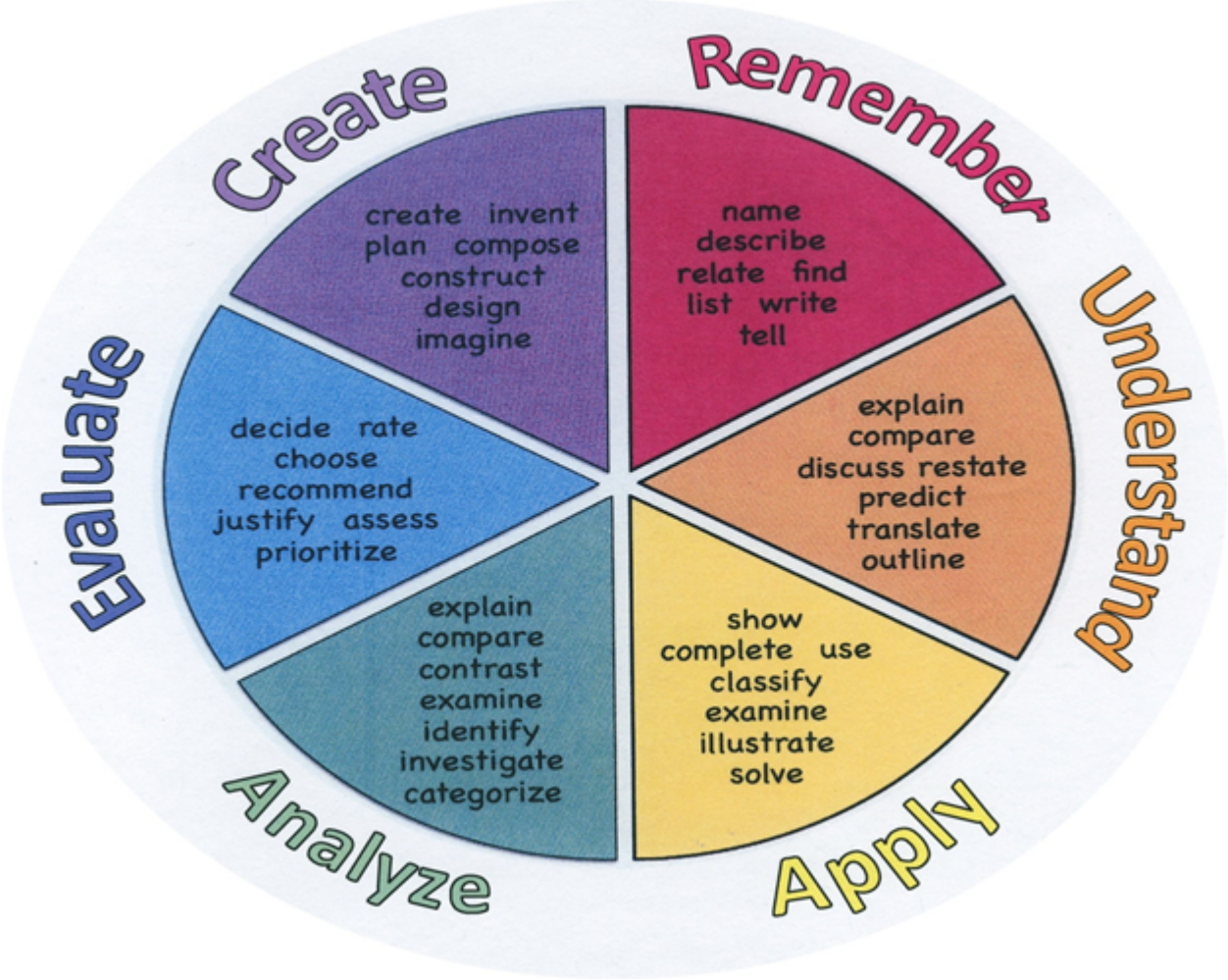
MA.S-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
MA.S-ID.A.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
MA.S-ID.A.3	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
MA.S-ID.A.4	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
MA.S-MD.B.5	Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.

Learning Objectives

- Students will be able to create line and bar graphs that illustrate the compiled data on weather.
- Students will be able to Convert EST or EDT to universal time.
- Students will be able to locate various places using the latitude/ longitude system.
- Students will be able to construct scientific arguments using data to support claims that human activity affects weather patterns.

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 Point Quote Recall Recognize Repeat Reproduce	Represent Restate Rewrite Select Show Summarize Tell Translate Associate Compute Convert Discuss Estimate Extrapolate Generalize Predict	Calculate Change Classify Complete Compute Discover Divide Examine Graph Interpolate Manipulate Modify Operate Subtract	Diagram Discriminate Illustrate Outline Point out Separate	Support Test	Devise Generate Integrate Prescribe Propose Reconstruct Revise Rewrite Transform



Suggested Activities & Best Practices

Assessment Evidence - Checking for Understanding (CFU)

Vocaulbulary Chapter 1 and 2 (Formative)

Performance Task - Analysis using satelite (Alternate)

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

Kenneth R Miller, Ph.D. - Joseph Levine, Ph.D. - New Jersey - Pearson Prentice Hall, Upper Saddle River - 2014

Ancillary Resources

- NASA Meteorology resources for Inquiry based learning
- Chrome Book Projects/ Research/ Analysis
- Google Classroom

1. AMS *Glossary of Meteorology*
   Authoritative source with over 12,000 definitions of meteorological terms.
2. iWeathernet
   Atmospheric data analyses and forecasts.
3. National Weather Service (NWS) Homepage
   Source for education, advisories, maps, safety, and additional information on all NOAA/NWS products.
4. NOAA's nowCOAST mapping portal
   Real-time coastal information and NOAA forecasts.
5. The Weather Channel
   Providing national and local weather forecast for cities, as well as weather radar, report, and hurricane coverage.

6. Hydrological Prediction Center
   Surface weather systems including regional maps.
7. NWS "Weather Page"
   Access to National Weather Service information for the entire United States.
8. Ohio State University Wx Twister
   Current real-time weather information page for weather data, maps, and imagery from Ohio State University's Atmospheric Sciences Program.
9. Penn State University e-Wall: The Electronic Map Wall
   Electronic map wall with current, future, and past data from multiple model predictions produced by Penn State University.
10. Plymouth State Weather Center
    Current real-time and archived weather information page for weather data, maps, and imagery from Plymouth State University weather program.
11. Texas A&M University Department of Atmospheric Sciences Weather Interface
    Metar data for any specific location from Texas A&M University's Department of Atmospheric Sciences.
12. The Florida State University Florida Climate Center
    Florida Climate Center data, forecasts, and topic resource for both the state of Florida and national climate data.
13. Unisys Weather Map System
    Another map source, also an archive for surface, upper air, and satellite maps.
14. University of Northern Iowa's STORM Project
    Seeks to initiate, support, and coordinate education, service, and research activities that relate weather information in Iowa and the Midwest.
15. Weather Guides at the University of Illinois
    Integrates current and archived weather data with multimedia instructional resources using new and innovative technologies.
16. AGI Education GeoSource
    Thousands of free geoscience education resources from a variety of organizations, from lessons to outreach and teacher professional development, for use in classrooms, scout programs, or at home.
17. California Education and the Environment Initiative
    Providing educators with professional learning and instructional materials that demonstrate how to blend the environment into the teaching of traditional academic subjects like science, history, and English language arts.
18. Educator’s Bridge
    Resources for elementary, middle, and high school science educators.
19. GOES-R Education Proving Ground
    Featuring the design and development of pre- and post-launch lesson plans and activities for teachers and students.
20. Iowa State University Iowa Environmental Mesonet
    Collecting environmental data from cooperating members with observing networks. The data are stored and made available on this website.
21. Learn: Atmospheric Science Explorers
    Middle-school-specific modules include background information, hands-on activities using simple materials, and authentic assessment tools for teaching weather in the classroom.
22. MetEd Educator's Portal
    Providing education and training resources to benefit the operational forecaster community, university atmospheric scientists and students, and anyone interested in learning more about meteorology, weather forecasting, and related geoscience topics.
23. National Center for Atmospheric Research (NCAR) Education and Outreach
    Resources for elementary, middle, and high school students as well as parents, teachers, college students and the public at large.

24. National Weather Service Virtual School Talks
    The NWS National School Outreach team is ready to teach and answer your students weather questions through an online virtual classroom.
25. NOAA Education Resources
    NOAA's portal to weather education.
26. NOAA's Jetstream - Online School for Weather
    Designed to help educators, emergency managers, or anyone interested in learning about weather and weather safety.
27. NSF Earth and Environment Classroom Resources
    Collection of lessons and web resources is aimed at classroom teachers, their students, and students' families.
28. Penn State University Weather Links
    Selection of weather resources both local to Pennsylvania and national.
29. Rutgers Weather Center
    Current real-time weather information page for weather data, maps, and imagery from Rutgers University's Meteorology program.
30. The GLOBE Program
    Promotes and supports students, teachers and scientists to collaborate on inquiry-based investigations of the environment and the Earth system.
31. UCAR Teaching Boxes
    Dense topic material for middle and high school science educators teaching weather-related coursework with goals and activities.
32. Weather and Climate Resource List
    Listing of available resources intended to assist those who teach weather and climate at any level from preschool through introductory college level courses.
33. Weather Safety Information
    Safety tips for earthquakes, tornadoes, hurricanes, floods, and wildfires.
34. AGI Career Compass
    Career Compass provides options, tips, suggestions, and strategies for how students can obtain critical skills, experiences, and competencies in order to launch their geoscience career.
35. AGI Geoscience in Your State Factsheets
    Highlighting geoscience areas including employment, water, minerals, energy, and hazards in each state.
36. NOAA Teaching Climate and the Essential Principles of Climate Literacy
    Climate.gov presents information that is deemed important for individuals and communities to know and understand about Earth's climate, impacts of climate change, and approaches to adaptation or mitigation.
37. Climate Literacy & Energy Awareness Network Climate Literacy Quiz
    How's your climate literacy? The explanations beneath each question describes each concept in plain language and links to teaching materials and references. Test your knowledge, and learn as you go.

- NWS Weather Forecast Offices
- NWS Office of Climate, Water, and Weather Services

Lockheed Martin GOES-R Series
Explore the GOES-R satellite series with a wealth of facts, videos, and outreach material


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
Activities
Podcasts Texts
Digital Stories Apps
Notebooks Movies
Surveys Music
Presentations
Websites
Animations
Paintings
Blog Journal
Diagraming
Bing Search Documenting
Mind mapping
Commenting
Word processing
Social Networking
Recounting
Action Verbs
Transform
Imagine Teach
Design Construct
Rearrange
Invent
Recognise
Describe Identify
Infer Retrieve
Match Locate
List
Understand
Create
Evaluate
Apply
Analyse
Blogging
Commenting
Voting
Surveys
Quizzes
Peer assessment
Self Assessment
Debating
Collaging
Rate
Opinion
Critique
Collaborate
Assess Debate
Justify
Prioritise
Use
Demo
Teach
Record
Share
Draw
Simulate
Create
Construct
Manipulate
Drawing
Diagraming
Animating
Journals
Photography
Movie Making
Music Making
Story Telling
Scrapbooks
Survey
Infer
Deduce
Differentiate
Sequence
Contrast
Examine
Compare
Outline
Graphing
Voting
Mindmapping
Reading comprehension
Peer Assessment
Judging
Spreadsheets
Surveying
Summarising
Listening
Mapping
Comparing
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

TECH.8.1.12.A.2	Produce and edit a multi-page digital document for a commercial or professional audience and present it to peers and/or professionals in that related area for review.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.C.CS3	Develop cultural understanding and global awareness by engaging with learners of other cultures.
TECH.8.1.12.C.CS4	Contribute to project teams to produce original works or solve problems.

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.CRP2.1	Career-ready individuals readily access and use the knowledge and skills acquired through

	experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation.
CRP.K-12.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.

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

1. **1. Using reading materials at varying readability levels;**
2. **2. Using spelling or vocabulary lists**
3. **3. Presenting ideas through both auditory and visual means;**
4. **4. Using small groups and share pairs; and**
5. **5. Meeting with small groups to re-teach an idea or skill for struggling learners, or to extend the thinking or skills of advanced learners.**

Process

1. **1. Using tiered activities through which all learners work with the same important understandings and skills, but proceed with different levels of support, challenge, or complexity;**
2. **2. Developing personal agendas**
3. **3. Offering manipulatives or other hands-on supports**
4. **4. Varying the length of time a student may take to complete a task in order to provide additional support for a struggling learner or to encourage an advanced learner to pursue a topic in greater depth.**

Products

1. **1. Giving students options of how to express required learning**
2. **2. Using rubrics that match and extend students' varied skills levels;**
3. **3. Allowing students to work alone or in small groups on their products; and**
4. **4. Encouraging students to create their own product assignments as long as the assignments contain required elements.**

Learning environment

1. **1. Making sure there are places in the room to work quietly and without distraction, as well as places that invite student collaboration;**
2. **2. Providing materials that reflect a variety of cultures and home settings;**
3. **3. Setting out clear guidelines for independent work that matches individual needs;**
4. **4. Developing routines that allow students to get help when teachers are busy with other students and cannot help them immediately; and**
5. **5. Helping students understand that some learners need to move around to learn, while others do better sitting quietly (Tomlinson, 1995, 1999; Winebrenner, 1992, 1996).**

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)

- Textbook for at-home use - Metrology
- Additional time for assignments: Performance Task - Satelite
- Provision of notes or outlines - Chapter 1 and 2
- Choice of test format (multiple-choice, essay, true-false) - Test 1 - Chapter 1 and 2 - Test 2 Chapter 3 and 4
- Alternate ways to evaluate (projects or oral presentations instead of written tests) - Performance Task - Definning STEM
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- 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)

Use flexible grouping; deliberately pair students heterogeneously by proficiency level.

ELP Level 2: Define vocabulary concepts from illustrations and word/ phrase banks. Vocabulary Chapter 1-4

ELP Level 3: Give examples of vocabulary concepts from illustrations and word/phrase banks. Vocabulary Chapter 1-4

- 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)

Special Topics Project, TED Talk, Independent Study Project: Current trends in global climate

- 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