# Unit 4: Astro-biology (Earth and Space Science, Engineering Design)

Content Area: **Science**
Course(s): **Astronomy**
Time Period: **Sept-Jan/Feb-June**
Length: **Semester 11-12**
Status: **Published**

## Title Section

## Department of Curriculum and Instruction

**Belleville Public Schools**

**Curriculum Guide**

# Astronomy 11-12

# Unit 4 - Astro-Biology

**Belleville Board of Education**

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Board Approved: September 23, 2019

## Unit Overview

Current research in Astronomy is divided between dark matter and astrobiology. While dark matter was discussed in Unit 3, astrobiology – the search for extra-terrestrial intelligence (life on other planets) will be discussed in this unit.

## Enduring Understanding

Unit Enduring Understandings

• The search for appropriate planets outside our solar system and the search for life-forms that can survive on

other objects (planets/moons) within the solar system.

• SETI – the search for extra-terrestrial intelligence is a group begun in 1960 at Cornell University by Frank Drake and Carl Sagan. They sent the Pioneer 10 mission into space looking for extra-terrestrial intelligence in 1977. It has since left the solar system on its way outside of the Oort cloud on its mission.

• Kepler, COROT and TPF are three of the current missions. Kepler has confirmed approximately 2000 possible habitable planets in the Milky Way galaxy.

• Gravitational lensing is the phenomenon predicted by Albert Einstein that shows that light bends around solid objects in its way. Planets orbiting a star show this phenomenon.

• A habitable zone is defined as the distance from a star where life as we know it could survive. The zone is dependent upon the size of the star.

• An extremophile is a life form found here on Earth that can survive under extreme conditions. Some are able to live at very high or very low temperatures, some can live with high sulfur, acidity or pressure.

• Scientists are researching some life forms that can live under extreme conditions here on Earth (Atacama desert, Antarctic, sulfur vents) with the idea that those conditions would mimic those on other planets (Venus, Mars).

## Essential Questions

Unit Essential Questions

• What are the two integral parts of astrobiology?

• What is SETI?

• What are the current missions that are looking for habitable planets in the Milky Way galaxy?

• How can astronomers tell there may be a planet orbiting a star?

• What is a habitable zone?

• What is an extremophile?

• What environments on Earth could be habitable to extremophiles?

## Exit Skills

By the end of Unit 4 Students Should be able to:

Describe the different aspects of astrobiology.

List the different scientific fields involved in astrobiology.

Distinguish between the different missions currently underway to find possible habitable planets in the Milky Way galaxy.

Explain how gravitational lensing can lead scientists to believe that a planet orbits a star outside our solar system.

Explain how the size of a star dictates the habitable zone – how far a planet can be from the star and still sustain life.

Discuss the materials sent out on the Pioneer 10 mission for SETI back in 1977.

List the environments on Earth that model other places where life may exist.

Explain how different extremophiles can live in extreme conditions.

## 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-ESS1-4 | Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. |
| HS-ESS1-5 | Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks. |
| HS-ESS1-6 | Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and |

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| | other planetary surfaces to construct an account of Earth's formation and early history. |
| HS-ESS2-7 | Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth. |

## Interdisciplinary Connections

| | |
|---|---|
| LA.RST.11-12.7 | Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. |
| LA.RST.11-12.8 | Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. |
| LA.RST.11-12.9 | Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. |
| LA.RST.11-12.10 | By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently. |
| MA.A-CED.A.1 | Create equations and inequalities in one variable and use them to solve problems. |
| MA.A-CED.A.2 | Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. |
| MA.A-CED.A.3 | Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. |
| MA.A-CED.A.4 | Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. |

## Learning Objectives

• Describe the different aspects of astrobiology.

• List the different scientific fields involved in astrobiology.

• Distinguish between the different missions currently underway to find possible habitable planets in the Milky Way galaxy.

• Explain how gravitational lensing can lead scientists to believe that a planet orbits a star outside our solar system.

• Explain how the size of a star dictates the habitable zone – how far a planet can be from the star and still sustain life.

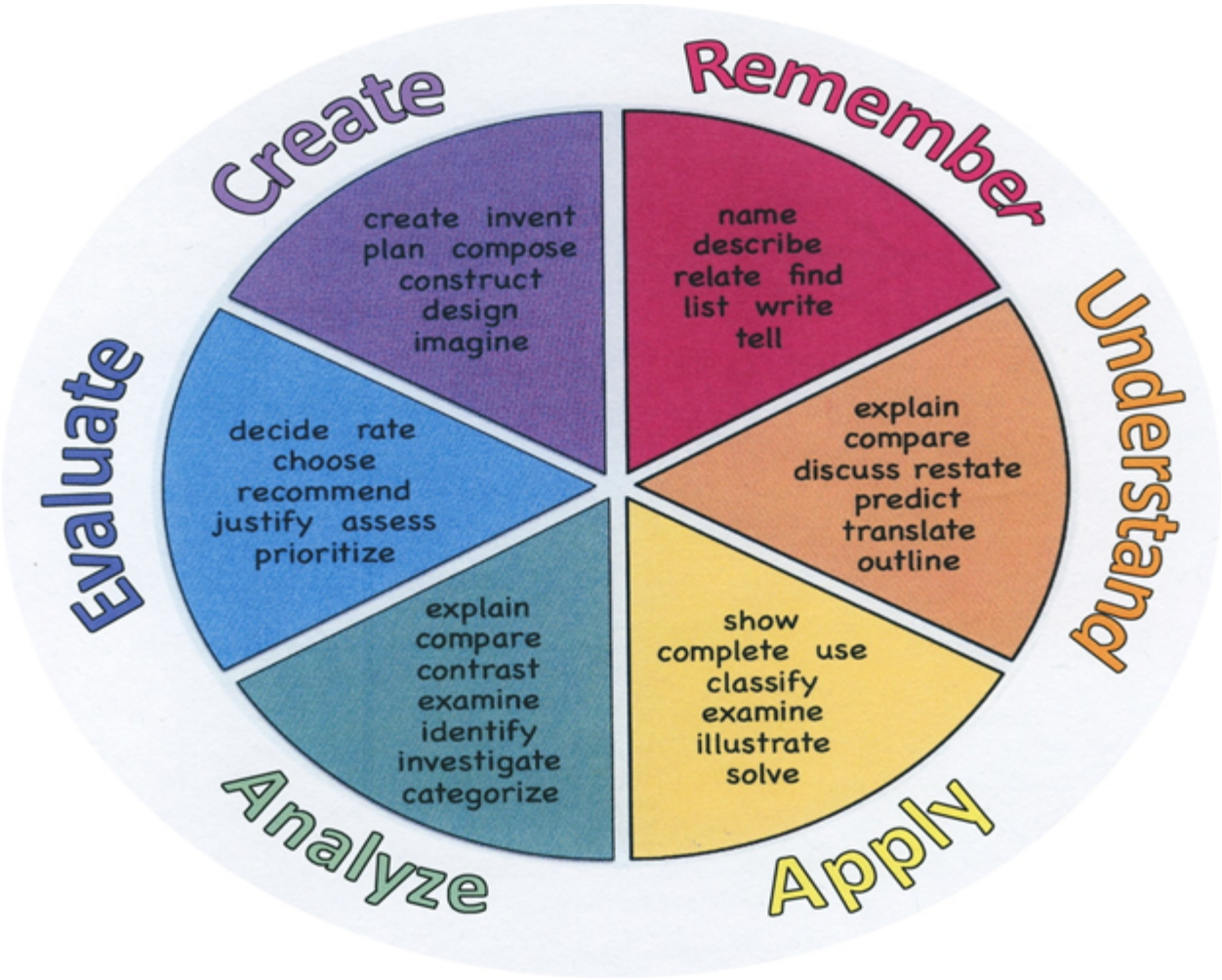
• Discuss the materials sent out on the Pioneer 10 mission for SETI back in 1977.

• List the environments on Earth that model other places where life may exist.

• Explain how different extremophiles can live in extreme conditions.

**Action Verbs:** Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

| 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)

1. Lab Reports - quadrant (Summative)
2. Project - Mars Rover (Alternate)
3. Quizzes Chapters 8-12 (Summative)
4. Tests - Chapters 8-12 (summative)
5. "Do Now/Exit Ticket" Activity (Formative)
6. Benckmark #2 (Benchmark)

- 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

Class Text: Chaisson, E. & McMillan, S. (2014). *Astronomy today*. Boston: Pearson.

### Ancillary Resources

# Fields of Study

1. Solar System
2. The Earth
3. The Moon
4. Space & Sun

# Resources

1. Observatories & Planetirums
2. Current Sky Events & Space Missions
3. Orders of Magnitude - Scale in the Universe
4. Astronomy Simulations
5. Astronomy Software
6. Absolute Astronomy - Almanac
7. Spreadsheets for teaching astronomy

# Educational Materials

1. JPL Educational Outreach: Jet Propulsion Laboratory, Pasadena CA
2. SpaceLink: NASA's electronic resources for educators
3. Space flight Now: Updates on current missions
4. NASA/JSC: Johnson Space Center, Houston TX
5. NASA Education Program: Education programs sponsored by NASA
6. NASA Quest: Learning technologies from NASA
7. NASA CORE: Central Operation of Resources for Educators: distribution of multimedia materials
8. Dryden Teacher Outreach: Education outreach programs
9. Planisphere: Template for making a planisphere

# Online Magazines

1. Astronomy Magazine: Astronomy magazine
2. Sky & Telescope: Premier magazine for amateur astronomers
3. Stardate Magazine: McDonald Observatory, University of Texas, Austin
4. Astronomy Now: Current data on astronomy

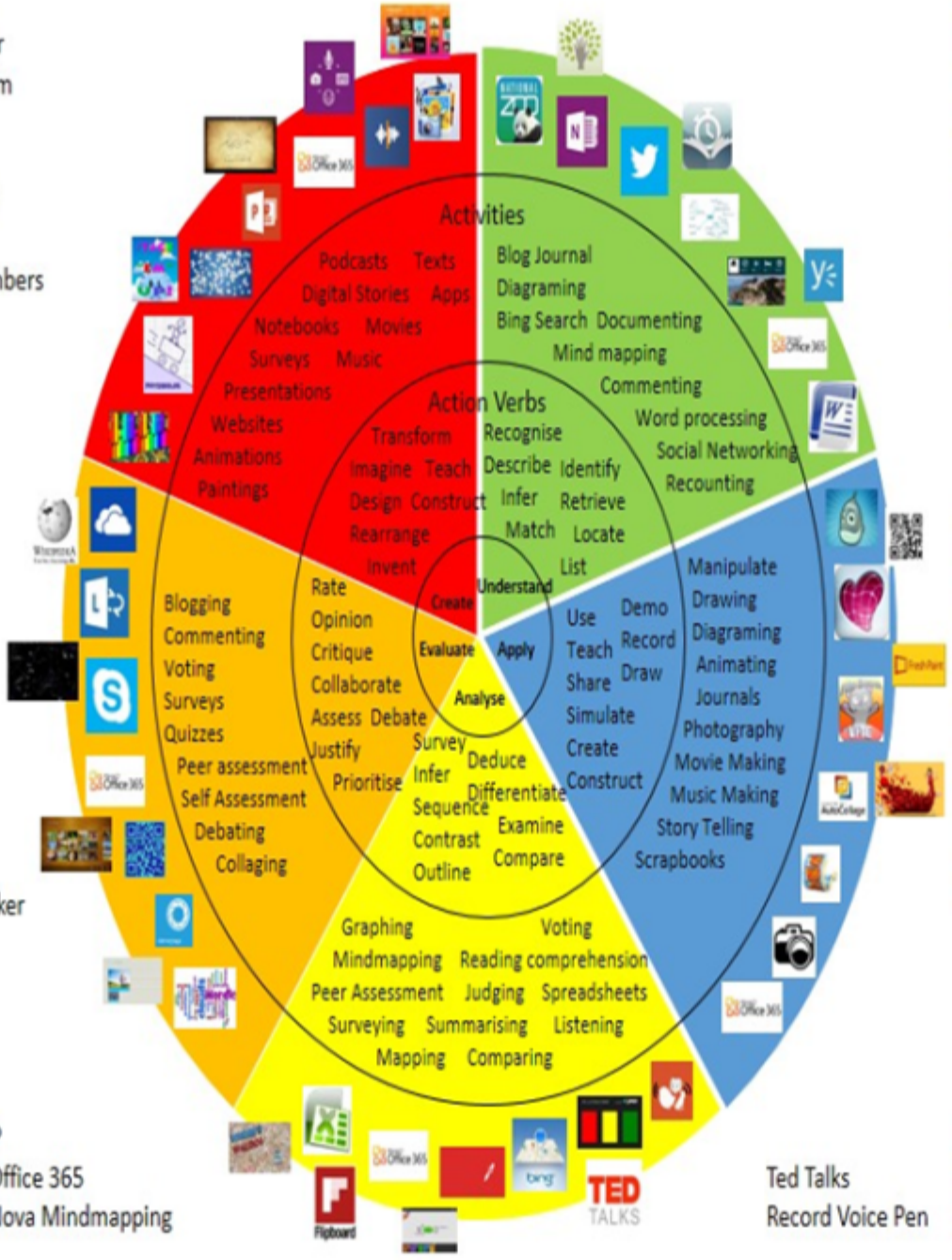
5. SpaceScience.com: Current events in space science

## 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 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

| | |
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| 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.A.CS2 | Select and use applications effectively and productively. |
| TECH.8.1.12.B.CS1 | Apply existing knowledge to generate new ideas, products, or processes. |
| TECH.8.1.12.C.CS1 | Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media. |
| TECH.8.1.12.C.CS2 | Communicate information and ideas to multiple audiences using a variety of media and formats. |
| TECH.8.1.12.E.CS1 | Plan strategies to guide inquiry. |
| TECH.8.1.12.E.CS2 | Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media. |
| TECH.8.1.12.E.CS3 | Evaluate and select information sources and digital tools based on the appropriateness for specific tasks. |
| TECH.8.1.12.E.CS4 | Process data and report results. |
| TECH.8.1.12.F.CS3 | Collect and analyze data to identify solutions and/or make informed decisions. |
| TECH.8.1.12.F.CS4 | Use multiple processes and diverse perspectives to explore alternative solutions. |
| TECH.8.2.12.B.CS2 | The effects of technology on the environment. |

## 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.

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| 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 |

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| | 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.CRP7.1 | Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation. |
| CRP.K-12.CRP8.1 | Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others. |
| CRP.K-12.CRP11.1 | Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks. |
| CRP.K-12.CRP12.1 | Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings. |

## 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 - Astronomy
- Additional time for assignments - quadrant - Mars Rover
- Provision of notes or outlines - Chapters 8-12
- Alternate ways to evaluate (projects or oral presentations instead of written tests) - Quizes Chapter 8-12 and Tests Chapter 8-12

- 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.

ELP Level 3: Give examples of vocabulary concepts from illustrations and word/phrase banks.

- 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 - Life on Mars

- 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