Improving earth science instruction through visual organizers

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Improving Earth Science Instruction through Visual Organizers

Paulette Kealy

Fall 2013
Advisor: Dr. Peter Veronesi
IMPROVING EARTH SCIENCE INSTRUCTION THROUGH VISUAL ORGANIZERS

by

Paulette Kealy
- Fall 2013
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Chapter Three: Introduction

Visual organizers are tools that can help all students, even those with learning disabilities, improve literacy while correcting misconceptions. The use of graphic organizers is based on several educational theories: scheme theory, test structure awareness, information encoding theory, cognitive load theory and activity theory. When a graphic organizer is used to organize and frame new knowledge before the new information is read in a text, the theory that is being represented is scheme theory. Text structure awareness is represented when graphic organizers provide content in sequence in a visual way. Students are able to see the important concepts contained in the text. Graphic organizers allow information to be processed in two ways, visually and spatially. Additionally, verbal information can be represented in a visual manor. Cognitive load theory is characterized when the learner is engaged in mental activities while processing the material displayed in the graphic organizer. As students analyze the information that will be placed in a graphic organizer, the students are exemplifying activity theory. (Ozmen, 2011)

The goal of science education is to develop scientifically literate citizens. A result of this goal is that the earth and its systems need to be understood by how they relate to each other instead of as separate entities; a systems thinking approach. Systems thinking approach has three components: the understanding of the parts that make up the system, understanding the connections between the parts of the system and understanding of the system as a whole. Traditional teaching methods often lack the tools needed to develop the connections between the parts of the system. Concept maps are an excellent way to integrate the parts of the learning process thus developing understanding of the concepts and their relationships to each other (Assaraf & Orpaz, 2010).
Reading is an important skill that all students need to be successful learners and scientifically literate citizens. Many students have trouble reading complex informational textbooks. One possible explanation for this is that content area textbooks are not written in a familiar text pattern because of the way that concept relationships are arranged. Narrative texts, like many of the texts used in elementary school, are written with predictable and consistent features such as setting, conflict, climax and resolution. Informational text structures vary on the way that the information in the text is organized. Students unfamiliar with this test structure, especially those with learning problems, need support to learn from this type of text structure, such as concept maps. Concept maps use spatial configurations to show explicit relationships between the main concepts, related concepts, and details (Guastello, Beasley, & Sinatra, 2000).

A concept map is a way to organize and express concepts and their relationships in a visual form by engaging students in all levels of Bloom's taxonomy. Students' ability to understand complex concepts and gain meaning for the long term improves by using concept maps. Their ability to organize and communicate about abstract concepts also increases.

Concept maps show hierarchical relationships between concepts. The concepts can be related to previously gained information. The maps should be judged on the meaning constructed through the relationships shown in the map. The maps should be revised and reflected upon as more information is gained. (Royer & Royer, 2004) Science curriculum in the middle and high school includes many complex and abstract topics which require students to use higher order thinking and comprehension to understand. The increased demand requires students to use inductive and deductive reasoning with many unfamiliar, scientifically specific vocabulary words. While general education students often have difficulties in developing these skills, students with learning difficulties have even more difficulties. An approach that is
recommended for helping all students understand abstract concepts is the use of graphic
organizers.

**Chapter Two: Review of Literature**

**Types of Visual organizers**

Visual organizers are a tool for aiding student conceptual understanding. They are often used for instruction as well as evaluation. Visual organizers can range from spokes which represent simple linear relationships, to chains which depict consist of the main idea surrounded by supporting details, to nets which are chains where the details are connected to each other. The net is considered to be the most complex of these organizers because it shows more concept relationships. The ability to show more complex relationships allows for students to develop and display deeper understanding which is needed for comprehending scientific texts (Gerstner & Bogner, 2009) Concept maps can connect new information with prior knowledge thus aiding retention of new material. There are four types of visual organizers: semantic mapping, semantic feature analysis, syntactic/semantic feature analysis, and visual display.

Semantic mapping is comprised of a main topic in the center connected with lines to coordinating topics around it and blank lines beneath the coordinating topics. The advantage to using semantic map is that students are able to easily see the main concept and its related concepts when obtaining information from a lecture or text. This is especially helpful for students reading informational texts.

A semantic feature analysis is similar to semantic mapping in that it allows students to readily identify the important information contained in the text. Semantic feature analysis is a chart with coordinating concepts listed at the top of each column and words representing details
for the concepts at the beginning of each row. Check marks are then placed in each column where the detail applies for that concept. The title for the chart would be the main idea of the concept. A possible application for semantic feature analysis is to make predictions about relationships which can be confirmed later.

Syntactic/semantic feature analysis is the same as semantic feature analysis except for there is an addition of cloze-type sentences written about the chart. The cloze sentences have a blank space, where the students use a new vocabulary words to fill in the blank by using the semantic feature analysis and the context of the sentence. This type of concept map connects main ideas and details to the new vocabulary.

Visual displays represent concepts and facts spatially thus making relationships more apparent through both visual and spatial displays. Some typical ways that visual displays are used are to display temporal, spatial, sequential, hierarchal and comparative relationships. Timelines, decision trees, flow charts, taxonomy trees and Venn diagrams are some common examples of visual displays used in science (Dexter, Park, & Hughes, 2011).

Two common forms of concept maps used for assessment are the fill in the spaces in the map form and the construct a concept map form. The advantage of a fill in the space concept map is that they are easy to administer and score. A possible argument against using fill in the space map for assessment is that as a student's knowledge increases, the structure of their concept maps should become more complex. A fill in the space concept map does not allow for the increase in knowledge to be shown.

Construct a map assessment can vary in form since the amount of information given to the student. The rationale is that the more complex the concept map the greater the
understanding of the concept with the additional benefit is that any missing connections on a concept map alerts the teacher to missing links between concepts. The student may be given concepts or linking words or may be directed as to the type of concept map to be constructed. The concept map is then evaluated on the number and accuracy of concepts and links contained in the student created concept map. One disadvantage sighted about construct a map assessments is that score the maps can be time consuming and difficult (Ruiz-Primo & Schultz, 2001).

**Addressing misconceptions**

According to constructivist theories, students build their knowledge. Misconceptions can prevent students from building new knowledge because the new knowledge does not fit into the students' current understanding (Hamza & Wickman, 2008). Students develop misconceptions from their daily experiences and they hold onto these misconceptions because they seem reasonable from the students' point of view, even if the misconception does not match current scientific understanding. If the root cause of the misunderstanding could be determined and appropriate teaching tools to correct the misconceptions were used then the misconception could be eliminated. Concept maps are a tool that students can use to overcome their misconceptions.

Concept maps can be used to help students visualize relationships between concepts. When concept maps are used in conjunction with concept maps the misconceptions are even more effective at dismissing misconceptions. To help reduce misconceptions the students' prior knowledge needs to be assessed before teaching basic concepts. Concept texts and concept maps should be used together to eliminate misconceptions (Akbaş & Gençtürk, 2011). One study asked the students to draw a concept map during the introduction of the new
topic. This exercise allowed the instructor to identify the students' misconceptions and then plan instruction that would address those misconceptions (Roberts, 1999).

**Building background knowledge**

Core background knowledge has the following qualities: it is essential to understanding the main concept, it requires multiple exposures, it is necessary for understanding future concepts, and it will be remembered. Not all background knowledge is equal in importance. Occasionally prior knowledge is irrelevant and may interfere with gaining new knowledge such as when a word has multiple meanings. (Fisher, Frey, & Lapp, 2012). Two important aspects related to background knowledge is that students need help to activate background knowledge to provide a foundation for the new learning and the new knowledge needs to connect with any existing prior knowledge. Studies have found that students do not activate their knowledge spontaneously and struggle with organizing related pieces of information with of what they already know and do not know.

A connection to background knowledge is important when reading as well as during classroom instruction. Background knowledge directs a student when reading texts, without it they may miss important information since they do not know what is important. The students can get lost in all the available information. (Gurlitt & Renkl, 2008).

Concept maps are one way to activate prior knowledge. A concept map gives knowledge structures and groups keywords, concepts and relationships. It can also be used to focus learning on important information, thus leading the student in learning activities to the desired learning goal. This is especially important for unstructured learning activities such as webquests. All the students in the research who activated their prior learning received greater benefit from the
learning experience. (Gurtlitt & Renkl, 2008). Prior knowledge activation improves the learning outcomes for students, even for students with a low aptitude. Meaningful learning occurs when the learner connects new knowledge to existing knowledge. Middle school students often are unprepared to learn deeper content due to the lack of background knowledge gained in elementary school. Students develop background knowledge through interaction with people, places, experiences, internet sources, texts, and content formally taught (Fisher, Frey & Lapp, 2012). If teachers start with what the students already know then teachers will not have to guess about where the students will be confused.

When teachers use concept maps during instruction, the teacher can connect the new knowledge with previous knowledge. For example, if a concept map is built and expanded each day, the students will be able to see the work from the previous day and be able to remember the connections to the previous day's lesson. The students would have a daily reminder of the concepts that had been covered the day before in their lessons. So now not only would the concepts of each day connected to each other, the students would be connected to the concepts covered on previous days (Guastello, Beasley, & Sinatra, 2000).

**Improving literacy**

Reading comprehension is a skill that students need to develop to be successful in their education. This skill is not developed naturally, it requires direct instruction, especially with student who are struggling readers. When students struggle with complex texts, such as science textbooks, teachers often work with teaching the student decoding skills instead of teaching students how to understand how the text is structured. Part of understanding the text structure is recognizing which concepts are more important and which concepts are the connected details. Some of the common text structures used in science textbooks and informational text are
compare/contrast, problem/solution, cause/effect, chronological/sequence and descriptive (Ropič & Aberšek, 2012).

Students can improve their reading comprehension and writing when they understand how textbooks are organized and use visual representations, such as concept maps, to show text organization. There are many other studies focused on the use of concept maps to help students organize, plan, and understand information gained from textbooks. Students with reading difficulties may need help in recognizing relationships between previously known information and new information. They may also need to be shown how ideas are logically connected to the text (Guastello, Beasley, & Sinatra, 2000). When students can recognize these text structures; it helps them to make connections the author has made in writing the text. Research shows that students who used concept maps during instruction did better on vocabulary tests and on the unit test than the students who did not use concept maps. Another study of students with learning disabilities who used concept maps to improve reading comprehension did better than the students who only received direct instruction on the concept. Students can use graphic organizers as a tool to help them visualize the how the information in the text are structured. As the student processes the text while creating the graphic organizer they are using higher level thinking skills such as analyzing, synthesizing, evaluating, and summarizing thus transferring this information into long term memory (Ropič & Aberšek, 2012).

Graphic organizers are visual representations that can display the relationships between the main ideas and the details thus benefiting the students' development and organization of their writing. Writing displays students' ability to analyze and synthesize, higher order cognitive skills. Concept maps can be used to represent the students' current knowledge and make the authors'/students' thinking visible. Concept maps also provide immediate feedback
to the author allowing time to reflect on their own work thus further developing cognitive skills. The student can see if the most important concepts are represented and if additional concepts or relationships need to be represented to prove their argument (Villalon, & Calvo, 2011).

In addition to reading comprehension and writing, vocabulary is an important aspect of scientific literacy. Additionally, vocabulary is an integral part of background knowledge, thus increasing a student’s vocabulary can increase background knowledge. Students do not learn vocabulary by listening to the teacher use the word. They need word-solving techniques and opportunities to use the vocabulary which are modeled by the teacher. Some word solving strategies are looking at word structures, context clues and using outside resources (Fisher et al., 2012). Using vocabulary in concept maps, such a syntactic/semantic feature analysis, allows student to make connections to the vocabulary, thus increasing understanding.

**Implications for students with learning disabilities**

Concept mapping can assist learners, those with learning disabilities and those without, in many ways. Concept maps can model text organization allowing the students to develop a plan of understanding what they have read. Another way is that students are shown how new knowledge connects with previously existing knowledge thus building understanding. Another benefit recognized through research was that the new concepts were connected to each other unifying all the new knowledge instead of leaving the concepts as separate concepts (Guastello, Beasley & Sinatra, 2000).

When graphic organizers are used with students with learning disabilities, the students improve basic skills as well as higher-level thinking skills. This improvement is attributed to the better understanding of vocabulary and the relationships between concepts. Graphic organizers
that do not require instruction for relationship recognition are better for student recognition of relationships than instructionally intensive graphic organizers. Students with learning disabilities need guided instruction when putting information into graphic organizers. The research shows that the students were able to learn the information better in the short term as well as the long term, even for students with learning disabilities regardless of the type of graphic organizer. However, semantic maps and semantic feature analysis are deemed better for factual recall and syntactic/semantic feature analysis and visual displays are better for the maintenance of knowledge. Teachers need to recognize this difference when designing graphic organizers for instruction, re-teaching, studying and retention (Dexter et al, 2011).

Students are able to recall more information when they had filled in the graphic organizer after reading the text because the students can focus on the important concepts and not be distracted by the details, preventing extraneous processing. Another factor which can increase student understanding is if the students only read sections of the text, instead of reading the entire text and then working on the concept map. This would be especially helpful for students with limited memory. An additional consideration for students with learning disabilities is that the students should study their completed graphic organizer, which allows them to see how all the concepts are linked together as a whole concept (Ozmen, 2011).

Students need to develop skills in reading comprehension. This is even more evident for students who have learning disabilities, especially if the reading is an informational text. Informational texts are more difficult for students to understand because the texts often are written with an informal structure using unknown vocabulary. Graphic organizers can be a tool used to help students understand the structure of informational texts.
There have been 21 studies researching how graphic organizers can be used to help students with disabilities improve their reading comprehension. This research focuses on research that has been done with students in grades K-12 with an identified disability who use a graphic organizer to display the information contained in their texts. The graphic organizers in the studies were categorized into the following groups: semantic organizers, cognitive maps with mnemonic, cognitive maps without a mnemonic and framed outlines. Nine of the studies of students with a learning disability used semantic maps found that the students demonstrated much higher scores on the research-developed comprehension measures. In the studies that used a cognitive map with a mnemonic the students performed better than students that did not use the cognitive map. It was also observed that students that created their own graphic organizers achieved better scores than the student that were given graphic organizers. When cognitive maps without a mnemonic were used in the studies, the students achieved higher comprehension scores. The same result was observed in the studies which used framed outlines to help student reading comprehension. All the studies that were analyzed saw a positive relationship between the use of graphic organizers, whatever the form, and the reading comprehension of students with a learning disability (Ae-Hwa Kim, Vvaughn, Wanzek & Shangjin Wei, 2004).

**Considerations for implementation**

Concept mapping is a technique that provides many benefits for students ranging from organizing new information and connecting new concepts to each other and previously learned concepts. However, students motivation and perception of the concept maps can have a critical impact on how effectiveness of the concept maps. Concept mapping is most helpful for students who are interested in meaningful learning rather than surface learning (Bentley, Kennedy, & Semsar, 2011).
There are several factors which can foster positive attitudes for students on making concept maps. First the concept map needs to be designed to match the educational goals of the course while not being too large to fit on one piece of paper. Next the students need feedback from the teachers or from peers on their concept maps construction. Additionally, concepts contained in the concept should be closely aligned with the information tested on the exams. Students also like to use computer generated concept maps over paper and pencil concept maps.

The students who found concept maps most helpful were the students who created the concept maps in class in groups. Even high level college students need and want the teacher’s guidance in constructing concept maps. The students assigned concept maps as homework found concept maps to be the least helpful. Concept maps seem to be most effective when they are teacher driven when the purpose of the concept map is related to instruction (Bentley, Kennedy, & Semsar, 2011).

There are many computer generated concept mapping programs available. The advantages of using one of these computer programs are the ease of manipulation, linking concepts, and making changes. In a yearlong study of two classes of 9th and 10th grade biology students, focused on comparing the complexity of computer generated concept maps to hand drawn concept maps and the students’ preference between these two methods, found that the computer generated concept maps were more complex.

Students liked using the computer program, *Inspiration* better than paper and pencil for creating concept maps. The students’ stated that they felt Inspiration helped them to understand the concept better, while remembering more things, finding more relationships, and organizing their thoughts. An additional benefit was that the students were more engaged in the assignment
than the students using paper and pencil (Royer & Royer, 2004). The quality of maps can vary for the boys and girls and for the students who participated in teacher centered or student centered instruction. However, it was observed that the boys created less complex concept maps than the girls. Students who were in teacher lead classes also produced more of the complex concept maps and had higher short term retention on the information. There was no difference between the type of instruction and the long term retention of information. There seems to be some varying opinions on the effects of hands on learning and teacher directed learning on the complexity of the concept map created by the students (Gerstner & Bogner, 2009). However, if students do not have the ability to distinguish the difference between the main concepts and irrelevant detail or have trouble with how to construct a graphic organizer, the students will benefit from receiving a teacher created graphic organizer before reading the text (Ozmen, 2011). University students benefitted more from a free structure concept map while the high school students benefitted more from the structured concept map. A possible explanation for the difference in learning outcomes could be that the students with greater prior knowledge did not need the scaffolding that the structured concept map provided (Gurtlitt & Renkl, 2008).

**Summary**

Concept maps are visual diagrams that depict concepts and relationships between concepts and details. This tool allows learners to develop their knowledge in a way that prevents erroneous perceptions and adapts to a variety of learning styles. As the number of concepts, their connections and the variety in concept maps, increase so does the students’ level of thinking. Concept maps are a tool that can be used to identify students' understanding of the systems of the
earth and their relationships to each other as well as humans' impact on those systems. (Assaraf & Orpaz, 2010).

Concept maps come in many types, semantic mapping, semantic feature analysis, syntactic/semantic feature analysis and graphic organizers and can be used before, during, and after instruction. Misconceptions can be addressed when a concept map is used to show the correct relationships between concepts and details, while developing a connection to background knowledge. This connection gives students an anchor to newly learned knowledge providing a base for the new knowledge to be built upon. Concept maps can also be used to improve literacy through helping students understand complex informational text such as the text in textbooks; helping students organize writing and helping students learn new vocabulary. All these benefits apply to university students, high school students, middle school students, including those students with learning disabilities. Students appreciate teacher feedback on the concept maps that they create and value their maps more if they are closely aligned with assessment materials. Students with learning disabilities need to have more guidance when creating concept maps but they also find concept maps helpful with gaining new knowledge. Concept maps in all their varieties are a tool with many benefits for all students. Teachers need to become aware of these benefits and use concept maps more within their classrooms.

The goal of this project is to provide earth science teachers with visual organizers that can aid teachers and students when learning about earth science topics. This project is a compilation of visual organizers to use in an earth science classroom. They are organized according to the New York State Physical Setting/ Earth Science Curriculum Standards, standard 4. There is a wide variety of visual organizers to meet many different requirements, such as for use with a small group, for use during instruction or for use as an assessment tool. The forms of
the visual organizer also vary. Some examples of these forms are semantic maps, flow charts or diagrams with descriptions.

Each visual organizer has an information chart that describes the curriculum standard it is designed to apply to, the source of the visual organizer, a narrative description, the rationale for the information contained in the organizer, possible misconceptions about the content and recommendations for using this organizer. Following this information page is a blank visual organizer, which can be given to students for them to complete. The next is a completed visual organizer that is followed by a student example when available.

**Chapter Three: Final Project with 36 Visual Organizers**

**Narrative: Significance of Project**

The earth science curriculum for New York State covers a wide range of topics from geology to meteorology to astronomy, with nearly 50 major understandings. This wide range of topics can be daunting for many students, especially for students with learning disabilities. This compilation of visual organizers will provide a resource for earth science teachers in their quest to help students comprehension of these topics.

Students often struggle with making connections between concepts and between new content with previously known concepts. They often have misconceptions about earth science concepts and also have difficulties with scientific vocabulary. Visual organizers can be tool which can aid students with all these struggles in learning about the earth.

Visual organizers are versatile. They can be used when instructing large groups, small groups or individuals. In addition to instruction, visual organizers can be used for assessment and review of instruction. Visual organizers benefit students with learning disabilities but are also benefit to students without disabilities. The goal of this project is to provide earth science
teachers with visual organizers that can aid teachers and students when learning about earth science topics.
# Improving earth science instruction through visual organizers

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| **NYS Standard:** | 1.1a Most objects in the solar system are in regular and predictable motion.  
1.1f Earth’s changing position with regard to the Sun and the moon has noticeable effects. |
| **Source:** | http://science-class.net/archive/science-class/Teachers_Graphic_Organizers.htm |
| **Narrative Description of Visual Organizer:** | This visual organizer is a diagram of the eight phases of the moon as seen from earth. There are spaces for writing the name of each phase near the moon’s location when that phase can be seen. This type of graphic organizer is the most appropriate type of visual organizer for this information because of the importance of the spatial relationship between the positions of the sun, the moon, and the earth. |
| **Rationale:** | As the moon orbits the earth, the amount of sunlight reflected off the moon varies in a predictable pattern based on the location of the moon in it's orbit. The phase that happens when the moon is directly between the sun and the earth is the new moon phase. The next phase is a waxing crescent followed by the first quarter. The waxing gibbous is next, and then the full moon. As the moon continues on its path it then is in the waning gibbous phase, followed by third quarter. The last phase before returning to the new moon is the waning crescent. This whole cycle takes approximately 29 days even though the moon actually orbits the earth in 27 days. This difference is a result of the earth orbiting the sun and the moon needs to catch up to the same location for the phase. |
| **Possible Misconceptions/Alternative framework:** | The misconception paired with moon phases is that the phases of the moon are caused by the shadow of the earth on the moon. Moon phases are actually caused by the position of moon in its orbit around the earth and the amount of light from the sun that can be seen from earth. This misconception can be addressed directly through this visual organizer.  
| **Recommendations and Reflections:** | A demonstration using a light and a model of the moon would help students understand the concept of moon phases. This graphic organizer would be valid for whole group, small group or individual use for instruction, review or assessment. |
Phases of the moon
viewed from earth
Phases of the moon viewed from earth

- First quarter
- Waxing crescent
- New moon
- Waning gibbous
- Third quarter
- Waxing gibbous
- Full moon
- Waning gibbous
<table>
<thead>
<tr>
<th>Title:</th>
<th><strong>Reason for the seasons</strong></th>
</tr>
</thead>
</table>
| **NYS Standard:** | 1.1d Earth rotates on an imaginary axis at a rate of 15 degrees per hour. To people on Earth, this turning of the planet makes it seem as though the Sun, the moon, and the stars are moving around Earth once a day. Rotation provides a basis for our system of local time; meridians of longitude are the basis for time zones.  
1.1f Earth’s changing position with regard to the Sun and the moon has noticeable effects.  
1.1h The Sun’s apparent path through the sky varies with latitude and season. |
| **Source:** | blogs.ccsd.edu |
| **Narrative Description of Visual Organizer:** | This visual organizer displays the two factors that together create the seasons, as a math problem. The revolution around the sun “+” the tilt of the earth's axis “=” the season. Below the equation there are boxes where a description of each factor can be written. This graphic organizer emphasizes that there are two factors; the tilt of the earth and the location of the earth on its orbit around the sun that cause the seasons. |
| **Rationale:** | The path of the earth around the sun and the tilt of the earth's axis result in the various seasons. When the northern hemisphere is pointed away from the sun, the northern hemisphere has winter. Then the northern hemisphere is pointed toward the sun, the northern hemisphere has summer. Fall and spring are when the earth is halfway between the summer and winter points of the earth's orbit. |
| **Possible Misconceptions/Alternative framework:** | The most common misconception about the seasons is that the seasons are a result of the earth being closer to the sun during the summer than during the winter. This graphic organizer emphasizes the only reasons for the seasons by leaving no place to distance from the sun in the equation. The teacher can address this misconception during discussion of the seasons.  
Source  
| **Recommendations and Reflections:** | This graphic organizer should be used when going over the orbit of the earth. A drawing of the orbit of the earth around the sun would be beneficial to student understanding. It would be appropriate to complete this graphic organizer as a class during instruction. It could also be used as a form of assessment. |
The reasons for the seasons

Revolution around the sun + Tilt of the earth's axis = Seasons

Winter
Spring
Summer
Fall
The reasons for the seasons

Revolution around the sun
- The earth takes 365.26 days to orbit the sun
- The earth's orbit is slightly eccentric

Tilt of the earth's axis
- The earth axis is tilted at 23.5°

Seasons
- Winter: Winter solstice occurs between Dec 20th and Dec 23rd. In the winter the northern hemisphere is facing away from the sun while the southern hemisphere is facing the sun.
- Spring: Vernal equinox exactly 12 hours of daylight and 12 hours of darkness. Occurs between March 20th and March 23rd.
- Summer: In the summer northern hemisphere is facing towards the sun while the southern hemisphere is facing away from the sun. Summer solstice occurs between June 20th and June 23rd.
- Fall: Autumn equinox exactly 12 hours of daylight and 12 hours of darkness. Occurs between September 20th and September 23rd.
<table>
<thead>
<tr>
<th>Title:</th>
<th>Life cycle of a star</th>
</tr>
</thead>
</table>
| NYS Standard: | 1.2b Stars form when gravity causes clouds of molecules to contract until nuclear fusion of light elements into heavier ones occurs. Fusion releases great amounts of energy over millions of years.  
* The stars differ from each other in size, temperature, and age.  
* Our Sun is a medium-sized star within a spiral galaxy of stars known as the Milky Way. Our galaxy contains billions of stars, and the universe contains billions of such galaxies |
| Source: | amnh.org |
| Narrative Description of Visual Organizer: | This visual organizer is flow chart that shows the theorized steps in the formation of a star, from dense cloud of gas and dust to the formation of a black hole, neutron star, white dwarf star or planet. A flow chart is used to give a visual display of the life cycle of a star; it shows the sequential relationship between the various steps of this cycle. |
| Rationale: | It is theorized that stars have a predictable life cycle. Stars begin as a dense cloud of gas and dust, depending on the amount of gas and dust it can become a massive star, a brown dwarf or a planet. The next step for a massive star is a red or yellow super giant. It then might eject gas and dust and become a super nova. When the supernova burn out it is theorized to become a black hole or a neutron star.  
A low to intermediate mass star does not follow the same path; instead it becomes a red giant. The next step would be a white dwarf star. The stellar ejection, gas and dust can become a dense cloud which can become another star. |
| Possible Misconceptions/Alternative framework: | A misconception to be aware of when addressing the life cycle of the stars is that students often do not recognize that models are not miniature copies of reality, and that models allow scientists to predict what will happen. Another misconception is that as more data is obtained the model can change. When teaching about the life cycle of the star address these misconceptions by emphasizing that this model is based on theories that are still being developed since this cycle takes millions of years, much longer than the life of a human.  
Source  
| Recommendations and Reflections: | A discussion about the Hertspung Russell Diagram would be an appropriate next step in lesson planning after learning about the life cycle of stars. This progression of learning would help students learn about the color, size and luminosity of each type of star while making a connection to the stars in the life cycle.  
This visual organizer would be appropriate for direct instruction as well as for assessment. It would also be work for large or small groups. |
<table>
<thead>
<tr>
<th>Title:</th>
<th>The planets</th>
</tr>
</thead>
</table>
| **NYS Standard:** | 1.2c Our solar system formed about five billion years ago from a giant cloud of gas and debris. Gravity caused Earth and the other planets to become layered according to density differences in their materials.  
* The characteristics of the planets of the solar system are affected by each planet’s location in relationship to the Sun.  
* The terrestrial planets are small, rocky, and dense. The Jovian planets are large, gaseous, and of low density. |
| **Source:** | Created by Paulette Kealy |
| **Narrative Description of Visual Organizer:** | This graphic organizer is a semantic map that gives that radius of the orbit, the average diameter of the planet, the type of interior, the density and the classification as terrestrial or Jovian of each of the planets in our solar system. The advantage of this type of visual organizer is that it allows the students to see all the important features contained within one organizer. The student then could use the information to make comparisons or predictions. If the student were required to glean this information from an informational text, this visual organizer would guide them towards finding the facts related to Jovian and terrestrial planets. |
| **Rationale:** | The planets that make up our solar system are classified as either Jovian or terrestrial by the type of interior in the planet. Planets with a rocky interior are terrestrial. Those with a gaseous interior are classified as Jovian. The terrestrial planets have other features in common such as they are closer to the sun and they have a smaller diameter. While Jovian planets are farther from the sun with a larger diameter. |
| **Possible Misconceptions/Alternative framework:** | A misconception related to the planets is that the solar system follows the geocentric model, that the earth is the center of the universe. This misconception is not directly addressed by this visual organizer. The teacher should be aware of this misconception and address this misconception during instructions.  
<p>| <strong>Recommendations and Reflections:</strong> | The student should use their Earth Science reference tables to complete the semantic map. The completion of this semantic map could be used as an introduction to the planets. This semantic map would be appropriate for use by individual students or small groups since the students can find all the information in their earth science reference tables. |</p>
<table>
<thead>
<tr>
<th>Planet</th>
<th>Average Radius of Orbit</th>
<th>Average Diameter</th>
<th>Density</th>
<th>Rocky or Gaseous interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mars</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jupiter</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Saturn</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uranus</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Neptune</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planet</td>
<td>Average Diameter (km)</td>
<td>Average Radius of orbit (million km)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------</td>
<td>-------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>4879</td>
<td>57.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venus</td>
<td>12104</td>
<td>108.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth</td>
<td>12756</td>
<td>149.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mars</td>
<td>6794</td>
<td>227.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jupiter</td>
<td>142984</td>
<td>778.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturn</td>
<td>120536</td>
<td>1426.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uranus</td>
<td>51118</td>
<td>2871.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neptune</td>
<td>49528</td>
<td>4498.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Kealy 33

<table>
<thead>
<tr>
<th>Title:</th>
<th>Terrestrial Vs. Jovian Planets</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYS Standard:</td>
<td>1.2c Our solar system formed about five billion years ago from a giant cloud of gas and debris. Gravity caused Earth and the other planets to become layered according to density differences in their materials. * The characteristics of the planets of the solar system are affected by each planet’s location in relationship to the Sun. * The terrestrial planets are small, rocky, and dense. The Jovian planets are large, gaseous, and of low density.</td>
</tr>
<tr>
<td>Source:</td>
<td><a href="http://earthsciencelessonplans101.blogspot.com">http://earthsciencelessonplans101.blogspot.com</a></td>
</tr>
<tr>
<td>Narrative Description of Visual Organizer:</td>
<td>This Venn diagram displays the similarities and differences of terrestrial and Jovian planets. There are only a few similarities but they are often overlooked. A Venn diagram was used for this to emphasize the differences and similarities between the Jovian and terrestrial planets.</td>
</tr>
<tr>
<td>Rationale:</td>
<td>The planets that make up our solar system are classified as either Jovian or terrestrial by the type of interior in the planet. Planets with a rocky interior are terrestrial. Those with a gaseous interior are classified as Jovian. The terrestrial planets have other features in common such as they are closer to the sun and they have a smaller diameter. While Jovian planets are farther from the sun with a larger diameter.</td>
</tr>
<tr>
<td>Possible Misconceptions/Alternative framework:</td>
<td>A misconception related to the planets is that the solar system follows the geocentric model, that the earth is the center of the universe. This misconception is not directly addressed by this visual organizer. The teacher should be aware of this misconception and address this misconception during instructions. Source Gazit, E., Yair, Y., &amp; Chen, D. (2005). Emerging Conceptual Understanding of Complex Astronomical Phenomena by Using a Virtual Solar System. Journal Of Science Education &amp; Technology, 14(5/6), 459-470. doi:10.1007/s10956-005-0221-3</td>
</tr>
<tr>
<td>Recommendations and Reflections:</td>
<td>This Venn diagram could be used as an assessment of learning. It would be appropriate for the individual student or in small groups.</td>
</tr>
</tbody>
</table>
Terrestrial Planets

- Solid rocky interior
- High density
- Closest to the sun
- Smaller diameters
- Mercury
- Venus
- Earth
- Mars

Jovian Planets

- Gaseous interior
- Low density
- Farther from the sun
- Larger diameters
- Jupiter
- Saturn
- Uranus
- Neptune

Orbit the sun
Some have moons
<table>
<thead>
<tr>
<th>Title:</th>
<th>Electromagnetic spectrum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>1.2a The universe is vast and estimated to be over ten billion years old. The current theory is that the universe was created from an explosion called the Big Bang. Evidence for this theory includes: cosmic background radiation and a red-shift (the Doppler effect) in the light from very distant galaxies.</td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td><a href="http://www.lcps.org/Page/38149">www.lcps.org/Page/38149</a></td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This semantic map displays the electromagnetic spectrum with pictures depicting each type of wave from long radio waves to short gamma rays and space to describe each category. The advantage of using this type of organizer is that it will aid students' recognition of the different types of wavelengths of electromagnetic radiation and the relationships to their wavelengths.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>This chart shows the varying types of electromagnetic radiation, sometimes called radiant energy, broken down according to wavelength. A wavelength is the distance from crest to crest or trough to trough. Only very small portions of the electromagnetic spectrum are visible with the naked eye. The longest wavelengths are radio waves while the shortest are gamma rays.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>An alternate conception about waves is that sound cannot travel without air. This visual organizer does not address this misconception directly but it should be addressed during instruction. Source Caleon, I., &amp; Subramaniam, R. R. (2010). Development and Application of a Three-Tier Diagnostic Test to Assess Secondary Students' Understanding of Waves. <em>International Journal Of Science Education</em>, 32(7), 939-961. doi:10.1080/09500690902890130</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>The Earth Science Reference tables should be used when completing this graphic organizer. This organizer would be appropriate for small group or individuals. It could be used to reinforce learning about the electromagnetic spectrum.</td>
</tr>
</tbody>
</table>
Electromagnetic Spectrum

- Waves have the LEAST ENERGY
- Waves have the LONGEST Wavelengths

- Waves have the MOST ENERGY
- Waves have the SHORTEST wavelengths

Visible Light

- Can travel through matter or space
- Are transverse waves
- Are surrounded by electric and magnetic fields
- Travel the same speed in a vacuum (300,000,000 m/s)

Radio Waves
TV

Microwaves

Infrared Rays

UV Rays
Ultra Violet Rays

X-Rays

Gamma rays

1 km
1 cm
10^{-2} cm
10^{-4} cm
10^{-6} cm
10^{-8} cm
10^{-10} cm
10^{-12} cm

Radio
Microwave
Infrared
Visible
Ultraviolet
X-ray
Gamma ray
Electromagnetic Spectrum

All of these waves:
- Can travel through matter or space
- Are transverse waves
- Are surrounded by electric and magnetic fields
- Travel the same speed in a vacuum (300,000,000 m/s)

Waves have the LEAST ENERGY
Waves have the LONGEST Wavelengths

Visible Light
ROYGBIV = Red, Orange, Yellow, Green, Blue, Indigo, Violet

Waves have the MOST ENERGY
Waves have the SHORTEST wavelengths

Radio Waves
TV
AM = Amplitude Modulations
FM = Frequency Modulations

Microwaves
Microwave Cooking
Communication Radar Towers

Infrared Rays
Heat
Warmth

UV Rays
Ultra Violets Rays
Cause sunburn or skin cancer
Used to sterilize surgical equipment
Body needs UV rays to make Vitamin D

X-Rays
X-rays have enough energy to travel through skin and muscle but get absorbed by dense bones

Gamma rays:
Used for cancer treatment
Have the most ENERGY
| Title: | **Asteroids, Comets and Meteors** |
| NYS Standard: | 1.2d Asteroids, comets, and meteors are components of our solar system.  
* Impact events have been correlated with mass extinction and global climatic change.  
* Impact craters can be identified in Earth’s crust. |
| Source: | created by Paulette Kealy |
| **Narrative Description of Visual Organizer:** | This visual organizer consists of three overlapping circles displaying the similarities and differences of meteors, asteroids and comets. A Venn diagram was used for this to emphasize the differences and similarities between comets, meteors and asteroids. An advantage of the Venn diagram is that it separates important information about the concepts thus aiding the student in recognizing the supporting concepts to the main ideas. |
| **Rationale:** | Asteroids, meteors and comets are all space objects that can easily be confused. Asteroids are rocks and debris smaller than a planet but larger than 10m, that orbit the sun. Meteors are sand to boulder size debris in space that can enter the earth's atmosphere and land on the surface. Comets are made from rock, dust and ice which orbit the sun in extremely elliptical orbits. |
| **Possible Misconceptions/Alternative framework:** | A possible misconception about meteors is that meteors are fireballs that will cause fires when they hit the earth's surface.  
**Source**  
doi:10.1179/030801804225012644 |
| **Recommendations and Reflections:** | When teaching about these different space objects be sure to emphasize the "impact" of each type of space object on the earth. This organizer would be appropriate for use with large to small groups for instruction. |
Name ______________________________

Asteroids

Comets

Meteors
Asteroids

- Smaller than planets but at least 10m in diameter
- Most found in a belt between Mars and Jupiter

Comets

- Extremely elliptical orbit
- Have mini atmosphere or tail
- Made of rock, dust, water, ice, and frozen gases

Meteors

- Small sand to boulder sized debris
- Meteorite = located on surface of earth
- Meteoroid = located in space
- Meteor = coming through atmosphere
- Shooting stars
- Most burn up in the atmosphere

Celestial bodies

Orbit the sun

Space debris
<table>
<thead>
<tr>
<th><strong>Title:</strong></th>
<th>Water cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>1.2g Earth has continuously been recycling water since the outgassing of water early in its history. This constant recirculation of water at and near Earth’s surface is described by the hydrologic (water) cycle.</td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td><a href="http://www.enchantedlearning.com">www.enchantedlearning.com</a></td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This visual organizer is a diagram depicting the water cycle with lines where the various parts of the water cycle such as evaporation, condensation, precipitation, and transpiration are depicted. The advantage of using a diagram is that it can show the various sequential relationships that can occur in the water cycle.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>The hydrologic cycle is the movement of water at or near the surface of the earth as well as through the atmosphere. Water is a finite resource. Actions such as pollution in one part of the water cycle effects the amount of useable water in other parts of the cycle.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>A common misconception about the water cycle is that the only parts of the water cycle are evaporation from a body of water followed by condensation of the water into clouds which then precipitate the water back into the body of water. There are many other parts of the water cycle such as transpiration, surface runoff and underground discharge.</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>This visual organizer can be used in conjunction literacy, if the students write a story or essay about the movement of water through the water cycle. The water cycle should be connected to lessons on erosion and deposition. It could be used in small group or by individuals for assessment or reinforcement of the water cycle.</td>
</tr>
<tr>
<td>Title:</td>
<td><strong>Air masses</strong></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>
| **NYS Standard:** | 2.1e Weather variables are interrelated. For example:  
* temperature and humidity affect air pressure and probability of precipitation  
* air pressure gradient controls wind velocity |
| **Narrative Description of Visual Organizer:** | This syntactic/semantic feature analysis emphasizes the features of air masses. These features include a description of the mass, where they are formed, weather associated with them and their abbreviations. The student then could use the information to make comparisons or predictions. If the student were required to glean this information from an informational text, this visual organizer would guide them towards finding the facts related to the four types of air masses. The cloze sentences reinforce these characteristics. The advantage of this type of visual organizer is that it allows the students to see all the important features contained within one organizer. |
| **Rationale:** | There are four types of air masses; continental polar, continental tropical, maritime polar and maritime tropical; each with its own characteristics. The characteristics of where these air masses are formed are directly related to the characteristics of the type of weather delivered by these air masses. Knowing these characteristics aids in the prediction of the weather where these air masses are located. |
| **Possible Misconceptions/Alternative framework:** | A possible alternative conception that could be encountered for the topic of air masses is that air is not the same everywhere. For example the students might think that air inside is different inside than outside. The truth is that air is made up of several different gasses but those gasses are the same. The differences in air are differences in temperature and moisture content. This alternative conception is not directly addressed but can be addressed when discussing the air mass characteristics. Source  
<p>| <strong>Recommendations and Reflections:</strong> | Use a map to show where these air masses are formed. This graphic organizer could be completed during instruction or after instruction for an assessment of learning. This visual organizer would be appropriate for use in large or small groups. The semantic feature analysis could be completed as a group and then the questions could be completed individually as a form of assessment, such as a ticket out the door. |</p>
<table>
<thead>
<tr>
<th>Air Mass</th>
<th>Continental Polar</th>
<th>Continental Tropical</th>
<th>Maritime Polar</th>
<th>Maritime Tropical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbreviation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where it formed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description of air mass</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associated weather conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Air that has similar characteristics and covers a large region is called __________________________________________.
Continental polar air masses form over ________________________________________________________________.
Maritime Polar air masses form over ________________________________________________________________.
Maritime tropical air masses form over ________________________________________________________________.
<table>
<thead>
<tr>
<th>Air Mass</th>
<th>Description of air mass</th>
<th>Where was it formed</th>
<th>Associated weather conditions</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continental Polar</td>
<td>dry and cold</td>
<td>over land in polar region</td>
<td>colder temperatures, lower dew point</td>
<td>cP</td>
</tr>
<tr>
<td>Continental Tropical</td>
<td>dry and warm</td>
<td>over land in equatorial region</td>
<td>warmer temperatures, lower dew point</td>
<td>cT</td>
</tr>
<tr>
<td>Maritime Polar</td>
<td>wet and cold</td>
<td>over ocean near poles</td>
<td>cooler temperatures, higher dew points</td>
<td>mP</td>
</tr>
<tr>
<td>Maritime Tropical</td>
<td>wet and warm</td>
<td>over ocean near equator</td>
<td>warmer temperatures, high dew points</td>
<td>mT</td>
</tr>
</tbody>
</table>

Air that has similar characteristics and covers a large region is called _air mass._
Continental polar air masses form over _land near the poles._
Maritime Polar air masses form over _the oceans near the poles._
Maritime tropical air masses form over _ocean near equator._
Continental tropical air masses form over _land near the equator._
| Title: | **Weather fronts** |
| NYS Standard: | 2.1f Air temperature, dew point, cloud formation, and precipitation are affected by the expansion and contraction of air due to vertical atmospheric movement.  
2.1g Weather variables can be represented in a variety of formats including radar and satellite images, weather maps (including station models, isobars, and fronts), atmospheric cross-sections, and computer models. |
| Source: | hongscience.pbworks.com/f/Air+Masses+and+Fronts.ppt |
| Narrative Description of Visual Organizer: | This semantic map displays the map symbols, associated weather and characteristics of cold, warm, stationary and occluded fronts. The student then could use the information to make comparisons or predictions. If the student were required to glean this information from an informational text, this visual organizer would guide them towards finding the facts related to the four types of air masses. Another advantage of this type of visual organizer is that it allows the students to see all the important features contained within one organizer. |
| Rationale: | Students have probably heard the words cold front, warm front, stationary front and occluded front on weather reports. However they do not make the connection between these words and the weather associated with each front. Cold fronts often bring colder temperatures followed by brief severe storms. Warm fronts are associated with long periods of light rain followed by warmer temperatures. Stationary fronts occur in areas where two equal size air masses collide resulting long periods of precipitation. An occluded front happens when a warm air mass is caught between two cold air masses. Fog is common when this occurs. |
| Possible Misconceptions/Alternative framework: | A misconception associated with weather fronts and symbols on weather maps is that H represents hot temperatures while the L represents cold temperatures. This misconception is addressed directly by this graphic organizer but many students' only exposure to the map symbols on weather maps that they see on television.  
Source  
<p>| Recommendations and Reflections: | This visual organizer would be appropriate for any size group; small, medium, or large group use. It could be used during instruction, review or as an assessment of content knowledge. |</p>
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Associated weather</th>
<th>Map Symbol</th>
<th>Type of Front</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cold Front</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Warm front</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stationary front</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Occluded front</td>
</tr>
<tr>
<td>Type of Front</td>
<td>Map Symbol</td>
<td>Associated weather</td>
<td>Characteristics</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cold Front</td>
<td><img src="image" alt="Cold Front" /></td>
<td>Brief severe storms will develop. Cold air comes first, then precip.</td>
<td>When a cold air mass runs into a warmer air mass producing tall cumulonimbus clouds.</td>
</tr>
<tr>
<td>Warm front</td>
<td><img src="image" alt="Warm Front" /></td>
<td>Light drizzle over an extended time period. Precip. Comes first and then the warm air</td>
<td>When a warm air mass overtakes a colder airmass. Warm moist air will rise over the colder air creating stratus and cirrus clouds</td>
</tr>
<tr>
<td>Stationary front</td>
<td><img src="image" alt="Stationary Front" /></td>
<td>A lot of precipitation</td>
<td>2 air-masses of equal size collide with each other. Since neither is strong enough to push the other out of the way</td>
</tr>
<tr>
<td>Occluded front</td>
<td><img src="image" alt="Occluded Front" /></td>
<td>Fog will be produced until the warm air is lifted to a higher altitude.</td>
<td>Where a warm air mass is caught in between 2 colder air-masses and forced up as the cold air-masses collide</td>
</tr>
</tbody>
</table>
## Title:
Atmospheric layers

## NYS Standard:
2.1f Air temperature, dew point, cloud formation, and precipitation are affected by the expansion and contraction of air due to vertical atmospheric movement.

## Source:
www.eduplace.com/science/hmsc/content/organizer/

## Narrative Description of Visual Organizer:
This graphic organizer displays the five layers of the atmosphere, troposphere, stratosphere, mesosphere and exosphere, with details for each layer. The advantage to using this type of graphic organizer is that it emphasizes that there are layers in the atmosphere and those differences give each layer its own characteristics. It would also aid a student who needed to find the information in a text to keep the information organized for each layer.

## Rationale:
The atmosphere has five layers with different characteristics based on their temperature and altitude. The troposphere is the layer closest to the surface of the earth where all weather occurs. The stratosphere is above the troposphere: it contains the ozone layer. The next layer is the mesosphere where most meteors burn up. The thermosphere is above that. This layer has high temperatures and is where aurora borealis is found. The outer layer of the exosphere. The atmosphere is a finite resource. Acts such as air pollution affects other layers of the atmosphere as well as earth below.

## Possible Misconceptions/Alternative framework:
The alternative framework associated with the atmosphere center on misconceptions about the ozone layer. One common misconception is that the ozone layer protects the earth from acid rain and that the ozone layer keeps the temperature of the earth at a level that allows life. These misconceptions are not directly addressed in this visual organizer.

Source:

## Recommendations and Reflections:
Use the earth science reference tables to complete the visual organizer. This visual organizer would be appropriate to use during introductory instruction or as an assessment of learning after instruction. This visual organizer would be appropriate of small groups or individuals.
Earth's Atmosphere

Exosphere
- thin outer layer of atmosphere

Thermosphere
- highest temps
- contains ionosphere and auroras

Mesosphere
- Meteors burn up here
- temp decreases with height

Stratosphere
- contains ozone layer
- planes fly here
- temp increases with height

Troposphere
- all life
- clouds
- water vapor
- temp and pressure decrease with height
<table>
<thead>
<tr>
<th><strong>Title:</strong></th>
<th><em>Atmospheric layers</em></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>2.1f Air temperature, dew point, cloud formation, and precipitation are affected by the expansion and contraction of air due to vertical atmospheric movement.</td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td><a href="http://www.eduplace.com/science/hmsc/content/organizer/">www.eduplace.com/science/hmsc/content/organizer/</a></td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This graphic organizer displays the five layers of the atmosphere, troposphere, stratosphere, mesosphere and exosphere, with details for each layer. The advantage to using this type of graphic organizer is that it emphasizes that there are layers in the atmosphere and those differences give each layer its own characteristics while also displaying the spatial location of each of these layers. An additional benefit is that it would aid a student who needed to find the information in a text to keep the information organized for each layer.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>The atmosphere has five layers with different characteristics based on their temperature and altitude. The troposphere is the layer closest to the surface of the earth where all weather occurs. The stratosphere is above the troposphere: it contains the ozone layer. The next layer is the mesosphere where most meteors burn up. The thermosphere is above that. This layer has high temperatures and is where aurora borealis is found. The outer layer of the exosphere. The atmosphere is a finite resource. Acts such as air pollution affects other layers of the atmosphere as well as earth below.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>The alternative framework associated with the atmosphere center on misconceptions about the ozone layer. One common misconception is that the ozone layer protects the earth from acid rain and that the ozone layer keeps the temperature of the earth at a level that allows life. These misconceptions are not directly addressed in this visual organizer. Source: Arslan, H., Cigdemoglu, C., &amp; Moseley, C. (2012). A Three-Tier Diagnostic Test to Assess Pre-Service Teachers’ Misconceptions about Global Warming, Greenhouse Effect, Ozone Layer Depletion, and Acid Rain. <em>International Journal Of Science Education, 34</em>(11), 1667-1686. doi:10.1080/09500693.2012.680618</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>Use the earth science reference tables to complete the visual organizer. This visual organizer would be appropriate to use during introductory instruction or as an assessment of learning after instruction. This visual organizer would be appropriate of small groups or individuals.</td>
</tr>
</tbody>
</table>
**Atmospheric Layers**

- **160km** or **100mi**
- **120km** or **75mi**
- **80km** or **50mi**
- **17km** or **11mi**

Altitude (Height above the surface of the earth)

The upper limit of the atmosphere that merges into space is known as the **Exosphere**.
Atmospheric Layers

- **Troposphere**
  - Weather occurs in this layer
  - Upper boundary is the tropopause
  - Temperature and pressure decrease with height

- **Stratosphere**
  - Jet planes fly in this layer
  - Ozone layer found here
  - Upper boundary is the stratopause
  - Temperatures increase with height

- **Mesosphere**
  - Meteors and rock fragments burn up here
  - Temperature decreases with height

- **Thermosphere**
  - Auroras occur in this layer
  - The space shuttle orbits in this layer
  - Highest temperatures

- **Exosphere**
  - The upper limit of the atmosphere that merges into space

Altitude
(Height above the surface of the earth)

<table>
<thead>
<tr>
<th>Sea Level</th>
<th>0</th>
<th>0</th>
<th>Sea Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>160km</td>
<td>100mi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120km</td>
<td>75mi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80km</td>
<td>50mi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17km</td>
<td>11mi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title:</td>
<td><strong>Air pressure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>2.1h Atmospheric moisture, temperature and pressure distributions; jet streams, wind; air masses and frontal boundaries; and the movement of cyclonic systems and associated tornadoes, thunderstorms, and hurricanes occur in observable patterns. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td>created by Paulette Kealy</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This T diagram compares and contrasts the features of high pressure and low pressure systems. These systems are separate but influence each other since air flows from the high pressure system to the low pressure system. The advantage to using this type of graphic organizer is that it emphasizes that there are layers in the atmosphere and those differences give each layer its own characteristics while also displaying the spatial location of each of these layers. An additional benefit is that it would aid a student who needed to find the information in a text to keep the information organized for each layer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>Air pressure is a dependent on the temperature and density of the air. High pressure centers are areas in the atmosphere occur where the air has a higher density due to a lower temperature. Low pressure centers in the atmosphere occur where the there are warmer temperatures causing the air to have a lower density. Air from high pressure systems feed into low pressure systems. This movement of air is one factor in predicting wind direction.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>A misconception associated with weather fronts and symbols on weather maps is that H represents hot temperatures while the L represents cold temperatures. This misconception is addressed directly by this graphic organizer. Another alternate conception about air pressure is that gasses exert pressure because of the weight of the air above it. This misconception is directly addressed by the T diagram.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>The earth science reference tables would be resource for finding the information needed for this organizer. This visual organizer would be appropriate to use during instruction or as an assessment of learning after instruction. It could be used for whole group or small group work.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Name ______________________________

<table>
<thead>
<tr>
<th>High Pressure</th>
<th>Low Pressure</th>
</tr>
</thead>
</table>

Name ______________________________

<table>
<thead>
<tr>
<th>High Pressure</th>
<th>Low Pressure</th>
</tr>
</thead>
</table>
| • cool and dry air that sinks because of its high density, diverges, and spins clockwise.  
• Calm clear weather | • warm and moist air that converges, rises and spins counter-clockwise because of the low density of the air  
• Stormy cloudy weather |

[Diagram showing high pressure and low pressure systems with relevant weather conditions and air movement patterns]
<table>
<thead>
<tr>
<th>Title:</th>
<th><strong>Comparing temperature scales</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>2.1g Weather variables can be represented in a variety of formats including radar and satellite images, weather maps (including station models, isobars, and fronts), atmospheric cross-sections, and computer models.</td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td><a href="http://www.lcps.org/page/38149">www.lcps.org/page/38149</a></td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This graphic organizer displays the three different scales for measuring temperature; Celsius, Kelvin, ad Fahrenheit, with descriptions of each. The benefit of using this type of graphic organizer is that it separates the information into three different sections, limiting the confusion that can happen when important information is grouped together.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>Temperature is measured by three scales; Fahrenheit, Celsius and Kelvin. In the United States the Fahrenheit scale is used for everyday temperature readings. However in the rest of the world and in science the Metric system is used. The Kelvin system is used in chemistry and physics. Students are usually unfamiliar with both the Celsius and Kelvin scales.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>An alternative framework about temperature is that temperature is a measure of heat. Heat is the transfer of thermal energy while temperature is a measure of the kinetic energy in a system. This alternate framework is not directly addressed however a discussion about the differences between heat and temperature would be proper while working on this graphic organizer.</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>Be sure that students put the units to their answers. Use the earth science reference tables when completing this organizer. This graphic organizer could be used as an introduction at the beginning of the year when reviewing measurements. It would also be appropriate for use when introducing weather, where temperature is an important factor.</td>
</tr>
</tbody>
</table>
Temperature scales

- Fahrenheit
  - Water freezes: 32°F
  - Water boils: 212°F
  - Absolute 0: -459°F

- Celsius
  - Water freezes: 0°C
  - Water boils: 100°C
  - Absolute 0: -273°C

- Kelvin
  - Water freezes: 273 K
  - Water boils: 373 K
  - Absolute 0: 0 K
<table>
<thead>
<tr>
<th>Title:</th>
<th>Layers of the earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYS Standard:</td>
<td>2.1j Properties of Earth’s internal structure (crust, mantle, inner core, and outer core) can be inferred from the analysis of the behavior of seismic waves (including velocity and refraction). * Analysis of seismic waves allows the determination of the location of earthquake epicenters, and the measurement of earthquake magnitude; this analysis leads to the inference that Earth’s interior is composed of layers that differ in composition and states of matter.</td>
</tr>
<tr>
<td>Source:</td>
<td><a href="http://www.enchantedlearning.com/geology/label/outerlayers/">http://www.enchantedlearning.com/geology/label/outerlayers/</a></td>
</tr>
<tr>
<td>Narrative Description of Visual Organizer:</td>
<td>This graphic organizer is a diagram of the layers in the earth's interior. It is a combination of a visual organizer and a diagram. The benefit of using this graphic organizer is that the diagram displays the locations of the layers of the earth in relationship to each other. Students would be able to see the visual relationships between the layers of the earth.</td>
</tr>
<tr>
<td>Rationale:</td>
<td>Students have never and will never go to the center of the earth. Yet the movement within these layers impact life on the surface with earthquakes and volcanoes. Understanding the composition of the earth will aid in the understanding of these events and possibly aid in predicting future events. The outside layer of the earth that contains all life is the crust. The layer below is the mantle. Convection currents are contained within in mantle. These convection currents are the driving force for plate tectonics. The next layer is the</td>
</tr>
<tr>
<td>Possible Misconceptions/Alternative framework:</td>
<td>There are many misconceptions associated with the layers of the earth. One that is addressed directly with this graphic organizer is a misunderstanding of the thickness of the earth. Another misconception directly addressed is that the interior of the earth is liquid. Source: Francek, M. (2013). A Compilation and Review of over 500 Geoscience Misconceptions. <em>International Journal Of Science Education</em>, 35(1), 31-64. doi:10.1080/09500693.2012.736644</td>
</tr>
<tr>
<td>Recommendations and Reflections:</td>
<td>Use the earth science reference table to complete the graphic organizer. This graphic organizer could be used for small group or individual assessment such as a do now or as a ticket out the door.</td>
</tr>
</tbody>
</table>
Earth's interior
Earth's interior
<table>
<thead>
<tr>
<th>Title:</th>
<th>Layers of the earth</th>
</tr>
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<td>Source:</td>
<td><a href="http://www.enchantedlearning.com/geology/label/outerlayers/">http://www.enchantedlearning.com/geology/label/outerlayers/</a></td>
</tr>
<tr>
<td>Narrative Description of Visual Organizer:</td>
<td>This graphic organizer is a diagram of the layers in the earth's interior with spaces to put the descriptions of each layer. It is a combination of a visual organizer and a diagram. This type of visual organizer is appropriate for this information because it brings information from different sources onto one page. It would benefit students by helping them pull out the important details about the layers of the earth while seeing exactly where the layer is located within the earth, thus adding the spatial relationship to their understanding.</td>
</tr>
<tr>
<td>Rationale:</td>
<td>Students have never and will never go to the center of the earth. Yet the movement within these layers impact life on the surface with earthquakes and volcanoes. Understanding the composition of the earth will aid in the understanding of these events and possibly aid in predicting future events.</td>
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</tr>
<tr>
<td>Recommendations and Reflections:</td>
<td>Use the earth science reference table to complete the graphic organizer. This graphic organizer should be completed as a whole class activity during instruction. The use of colored pencils would be beneficial.</td>
</tr>
</tbody>
</table>
Kealy 68

Earth's interior

Thinner than continental layer more dense
Density of 3.0g/cm³
young
Basaltic

Granitic
Density of 2.7g/cm³
Thicker than oceanic crust
old

Density of 2.7g/cm³

Oceanic crust

Ridged Mantle
(part of the mantle)

Asthenosphere
(part of the mantel)

Convection currents that move crust occur in mantle
soft partially molten (plastic)

Density 3.4-5.6g/cm³
solid

Ocean water

Lithosphere

The earth's crust broken into 9 plates

Stiffer Mantle

Outer core

Inner Core

Separates the mantle from the crust

Solid
Made of iron and nickel
Density 12.8-13.1g/cm³
info based on study of metallic meteorites

Liquid
Made of iron and nickel
Density 9.9-12.2g/cm³
evidence = earth's magnetic field

Density 3.4-5.6g/cm³
non-molten solid
made of magnesium, silicon and iron

Solid
Made of iron and nickel
Density 12.8-13.1g/cm³
info based on study of metallic meteorites

Density 3.4-5.6g/cm³
non-molten solid
made of magnesium, silicon and iron
Earth's interior

Moho

Asthmosphere

Grisser Mantle

Plastic mantle
- 3.4 - 5.6 g/cm³
- 0 million atm
- 1000°C

Outer core
- Iron and Nickel
- 9.9 - 12.2 g/cm³
- 1.8 million atmosphere
- 5000°C

Melted neck
- 3.4 - 5.6 g/cm³
- 2 million atmosphere
- 2,500°C

Inner core
- Iron and Nickel
- 12.8 - 13.1 g/cm³
- 31 million atmospheres of pressure
- 6200°C

Boundary bw.
The mantle and crust.

Ocean

Continental

Litosphere

Earth's crust (which is broken into 9 major and several minor plates).
<table>
<thead>
<tr>
<th><strong>Title:</strong></th>
<th><strong>Plate Boundaries</strong></th>
</tr>
</thead>
</table>
| **NYS Standard:** | 2.11 The lithosphere consists of separate plates that ride on the more fluid asthenosphere and move slowly in relationship to one another, creating convergent, divergent, and transform plate boundaries. These motions indicate Earth is a dynamic geologic system.  
* These plate boundaries are the sites of most earthquakes, volcanoes, and young mountain ranges.  
* Compared to continental crust, ocean crust is thinner and denser. New ocean crust continues to form at mid-ocean ridges.  
* Earthquakes and volcanoes present geologic hazards to humans. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness. |
| **Source:** | created by Paulette Kealy |
| **Narrative Description of Visual Organizer:** | The semantic map presents the three types of plate boundaries with a sketch, a description, the direction of movement, the types of landscape formed and an example of where that type of boundary can be found on the earth. An advantage for using this graphic organizer is that it provides a visual rendition of the emphasizing the differences between the different plate boundaries. It also allows the students to gather and organize information from a variety of locations. |
| **Rationale:** | There are three types of plate boundaries; divergent, convergent, and transform. Each of these boundaries is defined by the type of movement of the tectonic plates at that boundary. Divergent plate boundaries are areas where the plates are moving away from each other. Convergent plate boundaries are where plates are moving towards each other. Transform plate boundaries occur when plates are sliding past each other. It is at these plate boundaries that most earthquakes and volcanoes occur. |
| **Possible Misconceptions/Alternative framework:** | Two misconceptions about plate boundaries are that a plate boundary is the same as a plate or that plate boundary is the same as the continent edge. Both of these misconceptions are addressed through this semantic feature analysis. The misconception about what plate boundaries are is explained in the description column. When examples of plate boundaries that are not at a continental edge are used in the example column then the other misconception can be explained.  
Source:  
<p>| <strong>Recommendations and Reflections:</strong> | Use the earth science reference tables to look for the current location of these plate boundaries. This chart could be used for whole or small group instruction. |</p>
<table>
<thead>
<tr>
<th>Example</th>
<th>Features formed</th>
<th>Description</th>
<th>Direction of movement</th>
<th>Sketch</th>
<th>Type of plate boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Divergent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Convergent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Transform</td>
</tr>
<tr>
<td>Type of plate boundary</td>
<td>Sketch</td>
<td>Direction of movement</td>
<td>Description</td>
<td>Features formed</td>
<td>Example</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------</td>
<td>----------------------</td>
<td>-------------</td>
<td>----------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Divergent</td>
<td>![Sketch]</td>
<td>![Direction]</td>
<td>Where 2 or more plates move away from each other</td>
<td>ridges, new ocean crust, rift valleys, spreading centers, deep-focus earthquakes</td>
<td>Mid-Atlantic ridge, Southeast Indian ridge, East African rift</td>
</tr>
<tr>
<td>Convergent</td>
<td>![Sketch]</td>
<td>![Direction]</td>
<td>Where 2 or more plates come together</td>
<td>mountains, subduction zones, trenches, volcanoes, shallow focus earthquakes</td>
<td>Mariana trench, Peru-Chile trench</td>
</tr>
<tr>
<td>Transform</td>
<td>![Sketch]</td>
<td>![Direction]</td>
<td>Where 2 or more plates slide by one another</td>
<td>Displaced crust, Shallow focus earthquakes</td>
<td>San Andreas Fault</td>
</tr>
</tbody>
</table>
Title: Plate tectonics

NYS Standard: 2.11 The lithosphere consists of separate plates that ride on the more fluid asthenosphere and move slowly in relationship to one another, creating convergent, divergent, and transform plate boundaries. These motions indicate Earth is a dynamic geologic system.
* These plate boundaries are the sites of most earthquakes, volcanoes, and young mountain ranges.
* Compared to continental crust, ocean crust is thinner and denser. New ocean crust continues to form at mid-ocean ridges.
* Earthquakes and volcanoes present geologic hazards to humans. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness.

Source: http://cmapspaceexp.ihmc.us/rid=1236281720659_1128954781_10013/32%20PlateTectonics.cmap

Narrative Description of Visual Organizer: This visual organizer displays the many factors that impact plate tectonics and their relationships. It begins with how the earth is shaped through plate tectonics and continues with the results of the movement and ends with examples.

Rationale: Plate tectonics is the theory that the plates move as a result of convection currents within the mantle. This movement can lead many features including earthquakes, volcanoes, mountains and rift valleys. Convection currents also lead to the creation of crust at mid ocean ridges and the subduction of crust at convergent plate boundaries.

Possible Misconceptions/Alternative framework: Misconceptions about plate tectonics are that continents do not move or that they moved in the past but do not move any more. Both of these misconceptions are directly focused on through this graphic organizer. Source: Francek, M. (2013). A Compilation and Review of over 500 Geoscience Misconceptions. *International Journal Of Science Education*, 35(1), 31-64. doi:10.1080/09500693.2012.736644

Recommendations and Reflections: Make sure to go into detail about convection currents within the mantle, subduction, convergent and divergent plate boundaries. This graphic organizer would be best used in a teacher lead discussion/instruction where an emphasis on the relationships between plate movement and convection currents could be made.
Earth is shaped by Plate Tectonics.

Plate Tectonics describes Motions of Continental Crust, which is driven by Mantle Convection.

Creation of New Crust at Mid-Ocean Ridges occurs at DIVERGENT Plate Boundaries.

Subduction of Old Crust at Plate Boundaries occurs at CONVERGENT Plate Boundaries.

Earthquakes lead to Volcanism, which leads to Creation of Mountain Ranges and Opening & Closing of Ocean Basins.

Deep Ocean Trench IF Neither Plate Carries Continent leads to Marianas Trench example.

Mountain Chain IF One Plate Carries Continent leads to Andes Of South America example.

High Mountain Range IF Both Plates Carry Continents leads to Himalayas & Alps examples.
<table>
<thead>
<tr>
<th>Title:</th>
<th><strong>Oceanic crust vs. continental crust</strong></th>
</tr>
</thead>
</table>
| **NYS Standard:** | 2.1l The lithosphere consists of separate plates that ride on the more fluid asthenosphere and move slowly in relationship to one another, creating convergent, divergent, and transform plate boundaries. These motions indicate Earth is a dynamic geologic system.  
* These plate boundaries are the sites of most earthquakes, volcanoes, and young mountain ranges.  
* Compared to continental crust, ocean crust is thinner and denser. New ocean crust continues to form at mid-ocean ridges.  
* Earthquakes and volcanoes present geologic hazards to humans. Loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness. |
| **Source:** | created by Paulette Kealy |
| **Narrative Description of Visual Organizer:** | This Venn diagram displays the similarities and differences between oceanic crust and continental crust. |
| **Rationale:** | The oceanic crust, comprised of basaltic rock, is created at mid-ocean ridges. Continental crust made of granitic rock is very old and less dense than the oceanic crust. These differences in composition cause the crust to respond differently when part of plates that converge. |
| **Possible Misconceptions/Alternative framework:** | A misconception about the crust is that the plates are composed of crust. The response to this misconception is displayed in the Venn diagram which shows the composition of each type of crust.  
| **Recommendations and Reflections:** | Use this organizer as an introduction to the types of crust. It would be appropriate for small groups or individual work. Some of the information can be found in the earth science reference tables. |
Continental crust

- Thick
- Less dense
- Old
- Granitic rock
- Thickest under mountains
- Forced upward when oceanic crust subducts underneath it
- Mountains formed when 2 continental crust plates converge

Oceanic crust

- Thin
- More dense
- Young
- Basaltic rock
- Subducts under continental crust at convergent plate boundary
- Created at mid-ocean ridges

Part of the crust broken into plates
Oceanic crust

- Thin
- Young
- More dense
- Basaltic rock

Continental crust

- Thick
- Old
- Less dense
- Made of granitic rock
- Grows as plates move on the mantle
<table>
<thead>
<tr>
<th>Title:</th>
<th>Weathering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>2.1s Weathering is the physical and chemical breakdown of rocks at or near Earth’s surface. Soils are the result of weathering and biological activity over long periods of time.</td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td>Created by Paulette Kealy</td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer</strong></td>
<td>The weathering graphic organizer visually organizes the physical and chemical weathering and their factors with descriptions and examples of each type. An advantage of using a graphic organizer is to aid students’ understanding through a visual depiction of key terms and concepts and the relationships between them.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>This graphic organizer emphasizes that there are two types of weathering: chemical and physical. Chemical weathering is when the chemical composition is changed. Physical weathering is when the size and shape are changed. Chemical weathering happens more rapidly in warm moist climates while physical weathering is more common in cold moist climates.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>There are several common misconceptions about weathering. Some of the common misconceptions about physical weathering are rocks are weathered only by frost action and that frozen water in cracks of rock cannot break rock. Chemical weathering misconceptions are that water cannot dissolve rock or deposit dissolved rock. This graphic organizer clearly displays that there are several different types of physical weathering in addition to weathering from frozen water. It also shows that carbonation is one type of chemical weathering as well as the other types of chemical weathering.</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>The weathering graphic organizer could be used in many situations. It could be used during instruction to emphasize the differences and similarities between the each types of weathering. Another possible use would be as assessment. The teacher could give the students the skeleton and ask the students to complete the graphic organizer for a ticket out the door.</td>
</tr>
</tbody>
</table>
Weathering

Physical
Change in size and shape

Chemical
Change in composition
Weathering

**Physical**
Change in size and shape

- Frost action
  - Water seeps into cracks, freezes and expands
  - Ex. potholes

- Abrasion
  - Scraping of rocks against each other
  - Creates smooth round rocks

- Exfoliation
  - Peeling away of rock due to pressure reduction

**Chemical**
Change in composition

- Oxidation
  - Oxygen combines with atoms and changes composition
  - Ex. rust

- Carbonation
  - Carbonic acid dissolves rock
  - Forms caves

- Plant acids
  - Excretion from plants such as fungi break down rock

- Hydrolysis and hydrations
  - Water reacts with minerals to change composition

- When salts dissolve in water and then form acetic acid

Faster in warm moist climates

Faster in cold moist climates
<table>
<thead>
<tr>
<th><strong>Title:</strong></th>
<th><strong>Soil horizons</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>2.1s Weathering is the physical and chemical breakdown of rocks at or near Earth’s surface. Soils are the result of weathering and biological activity over long periods of time.</td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td><a href="http://www.enchantedlearning.com">www.enchantedlearning.com</a></td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This graphic organizer displays the soil horizons, their locations, and their characteristics. An advantage of using a graphic organizer is to aid students' understanding through a visual depiction of key terms and concepts and the relationships between them.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>As bedrock is weathered it develops into 4 layers with distinct characteristics. The C layer develops first. The B develops next and the A develops last. The top layer is comprised of organic material that comes from decomposed plant and animal remains. All these layers can be observed if no erosion has occurred.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>A misconception is that soil is unchanging. This misconception is displaced by directly displaying how soil changes from horizon C which is primarily made of broken and weathered rock to the organic layer comprised of decomposed plants and other organic materials. Source: Francek, M. (2013). A Compilation and Review of over 500 Geoscience Misconceptions. <em>International Journal Of Science Education, 35</em>(1), 31-64. doi:10.1080/09500693.2012.736644</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>Use this graphic organizer after weathering but before erosion. This organizer could be used for small group or individual assessment.</td>
</tr>
</tbody>
</table>
Soil Horizons
(soil layers)
Soil Horizons
(soil layers)

Organic layers

horizon A

Horizon B

Horizon C

Bedrock

©EnchantedLearning.com
<table>
<thead>
<tr>
<th>Title:</th>
<th>Soil horizons</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>2.1s Weathering is the physical and chemical breakdown of rocks at or near Earth’s surface. Soils are the result of weathering and biological activity over long periods of time.</td>
</tr>
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<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This graphic organizer displays the soil horizons and their locations. An advantage of using a graphic organizer is to aid students' understanding through a visual depiction of key terms and concepts and the relationships between them.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>As bedrock is weathered it develops into 4 layers with distinct characteristics. The C layer develops first. The B develops next and the A develops last. The top layer is comprised of organic material that comes from decomposed plant and animal remains. All these layers can be observed if no erosion has occurred.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>A misconception is that soil is unchanging. This misconception is displaced by directly displaying how soil changes from horizon C which is primarily made of broken and weathered rock to the organic layer comprised of decomposed plants and other organic materials.</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>Use this graphic organizer after weathering but before erosion. This organizer could be used for small group or individual during instruction.</td>
</tr>
</tbody>
</table>
Soil Horizons
(soil layers)
Solid rock layers that soil forms from

1st to form
broken and weathered rock
that resembles the parent
rock

2nd to form
C horizon breaks down
into subsoil
looks reddish-brown

last to form
weathering of B horizon
dark in color
some organic material

decomposed plants and
other organic material
top soil

Organic layers

Horizon A

Horizon B

Horizon C

Bedrock

©EnchantedLearning.com
<table>
<thead>
<tr>
<th>Title:</th>
<th>Weathering/erosion/deposition</th>
</tr>
</thead>
</table>
| NYS Standard: | 2.1s Weathering is the physical and chemical breakdown of rocks at or near Earth’s surface. Soils are the result of weathering and biological activity over long periods of time.  
2.1t Natural agents of erosion, generally driven by gravity, remove, transport, and deposit weathered rock particles. Each agent of erosion produces distinctive changes in the material that it transports and creates characteristic surface features and landscapes.  
In certain erosional situations, loss of property, personal injury, and loss of life can be reduced by effective emergency preparedness. |
| Source: | By Natalie Dixon at indulgy.com |
| Narrative Description of Visual Organizer: | This graphic organizer displays that relationship between weathering, erosion, and deposition including definitions and descriptions of each process. |
| Rationale: | Weathering is the breaking down of rock into smaller parts. Erosion is the movement of these particles. Deposition is when the particles are deposited. These processes with cementation and compaction are how sedimentary rocks are formed. These processes occur separately yet they are related. |
| Possible Misconceptions/Alternative framework: | A common misconception is that erosion and weathering are synonymous. This graphic organizer clearly separates and defines erosion and weathering as two separate processes.  
Source:  
| Recommendations and Reflections: | This cycle should be tied to the rock cycle. It could be used as a whole group activity as well as in small groups for instruction as well as assessment. |
Processes that change the earth's surface

Weathering

Caused by

Erosion

Caused by

Deposition

Creates
Processes that change the earth's surface

Weathering
Breakdown of Rock into sediment

Erosion
The transportation of weathered rock

Deposition
The settling of eroded sediment which occurs when the velocity of the erosional agent decreases.

Caused by
Physical weathering
Abrasion
Exfoliation
Frost action
Chemical weathering
Oxidation
Carbonation
Hydrolysis
Hydration
Plant acids

Caused by
Running water
Glaciers
Gravity
Wind
Waves

Creates
Sand dunes
Fluvial plains
River deltas
<table>
<thead>
<tr>
<th>Title:</th>
<th><strong>Agents of erosion</strong></th>
</tr>
</thead>
</table>
| NYS Standard: | 2.1u The natural agents of erosion include:  
|             | * Streams (running water): Gradient, discharge, and channel shape influence a stream’s velocity and the erosion and deposition of sediments. Sediments transported by streams tend to become rounded as a result of abrasion. Stream features include V-shaped valleys, deltas, flood plains, and meanders. A watershed is the area drained by a stream and its tributaries.  
|             | * Glaciers (moving ice): Glacial erosional processes include the formation of U-shaped valleys, parallel scratches, and grooves in bedrock. Glacial features include moraines, drumlins, kettle lakes, finger lakes, and outwash plains.  
|             | * Wave Action: Erosion and deposition cause changes in shoreline features, including beaches, sandbars, and barrier islands. Wave action rounds sediments as a result of abrasion. Waves approaching a shoreline move sand parallel to the shore within the zone of breaking waves.  
|             | * Wind: Erosion of sediments by wind is most common in arid climates and along shorelines. Wind-generated features include dunes and sand-blasted bedrock.  
|             | * Mass Movement: Earth materials move downslope under the influence of gravity. |
| Source:     | created by Paulette Kealy |
| Narrative Description of Visual Organizer: | This graphic organizer displays the five agents of erosion: running water, moving ice, wave action, wind and mass movement with their descriptions. |
| Rationale:  | Erosion is the movement of weathered materials, powered by gravity. Each agent of erosion can be recognized by decoding the clues left behind as the agent deposits the eroded material. |
| Possible Misconceptions/Alternative framework: | There are many misconceptions related to the agents of erosion. They vary from wind cannot carry any large rock to waves cannot have an effect on a solid rock cliff over time. This graphic organizer is an introduction to agents of erosion which can be a beginning towards reducing these misconceptions.  
|             | Source:  
| Recommendations and Reflections: | This graphic organizer would be appropriate as a whole class, small group or individual activity after and introduction to the agents of erosion. It could be used as a way to reinforce the new material or as an assessment. |
Agents of erosion

Running Water
- Most common rivers and streams
- deposited particles with be sorted, rounded and smooth

Wind
- common in arid, desert regions
- deposited particles have frosted, pitted appearance

Gravity
- avalanches
- mass movements
- mudslides
- deposited particles are angular and sharp

Wave erosion
- waves from lakes and oceans crash on shore and drag sediment in direction of current
- deposited particles are rounded and smooth

Glaciers
- in polar or mountain regions
- deposited particles unsorted with scratches
Agents of erosion

Running water

- Most common agent deposited particles will be sorted, rounded, and smooth.
- In polar or mountainous regions, deposited particles will be unsorted with scratches.

Wind

- Most common in and desert regions, will cause rocks to have a frosted, pitted appearance.

Gravities

- Acre avalanches, mass movement, and mudslides that occur due to gravity's constant force. Deposited particles will be unsorted, angular, and sharp.

Wave erosion

- Water from lakes and oceans crusts ashen and crus sediments into direction of the current. Deposited particles will be rounded and smooth.
<table>
<thead>
<tr>
<th>Title:</th>
<th><strong>Sedimentary rock particles</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>2.1v Patterns of deposition result from a loss of energy within the transporting system and are influenced by the size, shape, and density of the transported particles. Sediment deposits may be sorted or unsorted.</td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td>Lynn Panton, earth science teacher at East High School Rochester NY</td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This semantic map displays details about the six sediment particle classifications: clay, silt, sand, pebbles, cobbles and boulders. This semantic feature analysis emphasizes that the main difference between the sediments is their sizes. Another beneficial feature about this semantic feature analysis is that students can see/touch the different sediments.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>Each type of the five sediments, boulders, cobbles, pebbles, sand, silt and clay are classified by its size. The smallest particles, clay are less than 0.0004cm in diameter while boulders are greater than 25.6cm. The size of the sediment is directly related to the velocity needed to move that sediment and the type of sedimentary rock created.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>A misconception that is associated with rocks is that the shape of the rock will help with identifying the rock. Another misconception is that all rocks are heavy. Both of these misconceptions can be addressed as the students touch the samples and see how the rocks/sediment are different sizes and shapes but are still the sedimentary rocks.</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>Use the relationship of transported particle size to water velocity and scheme for sedimentary rock id chars from the earth science reference tables. Another suggestion is to glue real pebble, sand, silt and clay particles into the sample square. This semantic map could be used as a small group or individual activity. It could be changed into a lab by adding questions about the sediments and the rocks each sediment creates.</td>
</tr>
<tr>
<td>Map symbol</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----</td>
</tr>
<tr>
<td>Composition/comments</td>
<td></td>
</tr>
<tr>
<td>Rock formed</td>
<td></td>
</tr>
<tr>
<td>Sample</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td></td>
</tr>
<tr>
<td>Map symbol</td>
<td>Comments</td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td>conglomerate=round fragments</td>
</tr>
<tr>
<td></td>
<td>breccia=angular fragments</td>
</tr>
<tr>
<td></td>
<td>fine to coarse grain</td>
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<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Sample

- More than 25.6 cm
- 25.6 - 6.4 cm
- 6.4 - 0.2 cm
- 0.2 - 0.006 cm
- Less than 0.004 cm

Name

- Boulder
- Cobble
- Pebble
- Sand
- Silt
- Clay
<table>
<thead>
<tr>
<th><strong>Title:</strong></th>
<th><strong>Sedimentary Rocks</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>2.1w Sediments of inorganic and organic origin often accumulate in depositional environments. Sedimentary rocks form when sediments are compacted and/or cemented after burial or as the result of chemical precipitation from seawater.</td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td><a href="http://www.lcps.org/Page/38151">www.lcps.org/Page/38151</a></td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This visual organizer displays the three ways that sedimentary rocks are formed, from clasts, organic material, and evaporites and precipitates, as well as the types of sediments and the sedimentary rocks they form. This graphic organizer shows that all the clastic rocks are related while the organic and chemically formed are separate from the clastic. It also shows that limestone can be formed both from compacted shells and from the precipitates of biologic origin. Students could be able to extract this information from a text or from a chart and reinforce their learning.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>Sedimentary rocks are organized into three different categories based on the kind of particles that they are formed from. These categories are clastic, organic or chemical. Rocks that are clastic are rocks that are formed from particles of weathered rock and are further classified by the size of those particles. Organic sedimentary rocks are formed from organic materials such as shell fragments or plant material. Chemical sedimentary rocks are formed when crystals form from evaporates or precipitates.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>A misconception is that compression is the only way to form sedimentary rocks. This misconception is directly addressed through this graphic organizer by showing that sedimentary rocks are also formed through the cementation of clastic particles, compaction of plant and animal remains, and through the evaporation or precipitation of sediments out of water. Another misconception associated with sedimentary rocks is that the weight of the ocean water causes sedimentary rocks to form. This misconception could be discussed during instruction since it is related to the concepts displayed in this visual organizer.</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>Have samples of the different types of sedimentary rocks that the students can observe while learning about the different types of sedimentary rocks. Use the Scheme for Sedimentary Rock identification chart from the earth science reference tables to fill out the graphic organizer. This graphic organizer is appropriate for small group or individuals students.</td>
</tr>
</tbody>
</table>
Sedimentary Rocks

Compaction and Cementation of Sediment

Classified by

Clastic rocks formed from

Organic formed from or

Chemical formed from

Clasts = Particles large to small
Sedimentary Rocks

formed by

Compaction and Cementation of Sediment

Classified by

Clastic rocks formed from sediment that is buried, compacted and cemented

Organic formed from compacted shell fragments or plant remains

Chemical formed from crystals from precipitates and evaporites.

Clasts = Particles large to small
boulder
cobble
pebble
sand
silt
clay

Shale
clay sediment
>.0004cm
compact
may split easily

Siltstone
Silt sediment
.0004-.006cm
very fine grained

Sand
Sand sediment
.006-.2cm
fine to coarse grained

1. Conglomerate rounded fragments
2. Breccia angular fragments
boulders, cobbles and pebbles embedded in sand, silt and or clay

Coal - plant remains

Limestone can precipitates of biological origin or cemented shell fragments

Rock salt
Rock gypsum
Dolostone
Sedimentary Rocks

Organic formed when plant remains are compacted.

Clastic rocks formed from fragments of rock.

Clasts = Particles large to small
- Pebbles
- Gravel
- Sand
- Silt
- Clay

Chemical formed when crystalline precipitates and evaporites.

Concretion and Cementation of Sediment

Limestone
- Micritic or tuffey, coaly - compacted fragments
- Coarser - tuffey concretion - plant remains

1. Precipitate Crystals from chemical precipitates
2. Dolomite - fine to coarse - crustacean - precipitated carbonate

1. Conglomerate - size is greater than 0.2 cm
2. Breccia - angular fragments

Siltstone - fine to course - size 0.002 to 0.02 cm

Shale - compact, splits easily
- Size 0.002 to 0.004 cm
### Heat transfer

#### NYS Standard:

2.2b The transfer of heat energy within the atmosphere, the hydrosphere, and Earth’s surface occurs as the result of radiation, convection, and conduction.

* Heating of Earth’s surface and atmosphere by the Sun drives convection within the atmosphere and oceans, producing winds and ocean currents.

#### Source:

www.lcps.org/Page/38149

**Narrative Description of Visual Organizer:**

This graphic organizer shows the three ways that heat is transferred as separate branches; convection, conduction and radiation with boxes for definitions and another for a picture. This type of visual organizer fulfills the purpose of emphasizing each type of heat transfer as different and separate from the others without any significant relationship between the three.

**Rationale:**

Heat is energy transferred between a system and its surroundings without work or the transfer of matter. Each type of heat transfer has its own distinct way of transferring heat. Convection transfers heat as warm air or liquid rises and the cold air or liquid sinks. Conduction is the movement of energy from molecule to molecule while radiation is the flow of energy through empty space. This graphic organizer displays that they are separate ways of transferring heat.

**Possible Misconceptions/Alternative framework:**

There are many alternative frameworks for heat. One that is related to this visual organizer is that heat in equivalent to temperature. Another is that heat is a substance. Both of these frameworks are directly addressed through this visual organizer.


**Recommendations and Reflections:**

This concept should be connected to both the astronomy unit and the weather unit. This graphic organizer could be used in small groups or by individuals to introduce, reinforce or assess learning.
Heat Transfer

Convection

Conduction

Radiation

Visual created by J. Haughe, 2005
Energy that is transferred between a system and its surroundings without work or the transfer of matter

Heat Transfer

Convection
- WARM air or liquid rises
- COOL air or liquid sinks

Conduction
- MOVEMENT of energy from molecule to molecule

Radiation
- FLOW of energy through Empty Space

Visual created by J. Ilaugh, 2005
<table>
<thead>
<tr>
<th>Title:</th>
<th>Climate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>2.2c A location’s climate is influenced by latitude, proximity to large bodies of water, ocean currents, prevailing winds, vegetative cover, elevation, and mountain ranges.</td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td>created by Paulette Kealy</td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This graphic organizer displays the factors that influence climate, latitude, nearness to large body of water, nearness to large body of water, nearness to mountain range, ocean currents, and vegetation coverage, with descriptions and examples as well as the relationships between factors. Graphic organizers are beneficial for showing relationships while delivering the information in a different manner.</td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>There are many factors that influence the climate of and area. The factors in this graphic organizer are latitude, nearness to large body of water, nearness to large body of water, nearness to mountain range, ocean currents, and vegetation coverage. The higher the latitude the lower the temperatures due to lower solar intensity. The prevailing wind patterns affect the climate when they move more north or south seasonally. Elevation impacts climate in that the higher the elevation the cooler the temperature, approximately 1 degree Celsius cooler per 100 meters of elevation. Land on the leeward side of a mountain range will be warmer and receive less precipitation than land on the windward side. Regions near the coast have more precipitation and a lower range of temperatures while inland areas will be drier with wider temperature range. Ocean currents also impact the climate by warming areas on the eastern side of continents and cooling western sides of climates. The greater the vegetation coverage causes a climate to be cooler in the summer but more humidity.</td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>One major misconception is that climate and weather are same. This misconception is not directly addressed through this graphic organizer. It should be emphasized that climate is the trend of the weather over a long period of time while weather is the current conditions.</td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>Use a world map to show examples of locations where these factors are influencing the climate. This visual organizer would be appropriate for use as an introduction to climate as a whole group activity. It could also be used as an assessment for small groups or individuals.</td>
</tr>
</tbody>
</table>
Climate is influenced by
Climate is influenced by:

- **Latitude**: As latitude decreases, the yearly temperature increases, also determines the general amount of precipitation that will accumulate. Coastal regions have a smaller range in yearly temperature and a greater amount of rainfall.
- **Vegetation**: The greater the coverage by vegetation, then cooler summers but more humidity.
- **Prevailing winds**: There are 3 major wind patterns in the Northern Hemisphere. These patterns shift north or south seasonal.
- **Ocean currents**: Warm temperatures of eastern coastal areas and cool temps. of western coastal locations.
- **Nearness to large body of water**: Nearness to mountain range
- **Nearness to mountain range**: The higher a location’s elevation, the colder it is.
- **Windward** side of a mountain range will be cooler and have much more precipitation. **Leeward** side will be arid (dry) and warmer.
<table>
<thead>
<tr>
<th>Title:</th>
<th>Mineral properties</th>
</tr>
</thead>
</table>
| NYS Standard: | 3.1a Minerals have physical properties determined by their chemical composition and crystal structure.  
* Minerals can be identified by well-defined physical and chemical properties, such as cleavage, fracture, color, density, hardness, streak, luster, crystal shape, and reaction with acid.  
* Chemical composition and physical properties determine how minerals are used by humans.  
3.1b Minerals are formed inorganically by the process of crystallization as a result of specific environmental conditions. These include:  
* Cooling and solidification of magma  
* Precipitation from water caused by such processes as evaporation, chemical reactions, and temperature changes  
* Rearrangement of atoms in existing minerals subjected to conditions of high temperature and pressure. |
| Source: | www.science.glencoe.com |
| Narrative Description of Visual Organizer: | This semantic feature analysis gives definitions, descriptions, examples, pictures and comments on some of the properties which can be used to identify minerals. The advantage of this visual organizer is that it would allow a student to focus on the important properties with their appropriate definitions. |
| Rationale: | Minerals are naturally occurring inorganic solids with definite chemical compositions. There are many properties that can be used to help identify an unknown mineral. The color of the mineral can be helpful but it is unreliable in determining identity. Streak is when a mineral leaves a mark on a porcelain streak plate. Luster is the reflectivity or shine of a mineral, described as metallic or nonmetallic. Hardness is a mineral's resistance to being scratched and is very helpful in determining a mineral's identity. Cleavage describes a mineral that breaks in a specific pattern. Fracture describes a mineral that breaks in a random pattern. Related to the internal atomic structure, the crystal shape is the natural form of a crystal. The specific gravity of a mineral is the mineral's density divided by the density of water. Malleability is the ability of the mineral to be hammered into a shape. The chemical composition of a mineral is the elements that make up a mineral. These properties can all be used to identify an unknown mineral. |
| Possible Misconceptions/Alternative framework: | One common misconception for high school students about minerals is that rocks are the same as minerals. This semantic feature analysis does not directly address this misconception. The awareness of this misconception will help the teacher address it during instruction. |
| Recommendations and Reflections: | This semantic analysis could be used during the introduction of minerals or as a way to assess at the end of a lesson such as in a ticket out the door. It would be appropriate for whole group or small group to use. A connection to the earth science reference tables' properties of common minerals should be made. |
# Properties of minerals

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
<th>Notes/Example/Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Streak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luster</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleavage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fracture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crystal shape</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific gravity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malleability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical composition</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Properties of minerals

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
<th>Notes/Example/Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>type of reflected light exhibited by a material</td>
<td>Sulfur = yellow</td>
</tr>
<tr>
<td>Streak</td>
<td>the color of a mineral's powder after scratched on a porcelain streak plate</td>
<td></td>
</tr>
<tr>
<td>Luster</td>
<td>reflectivity or shine of a mineral</td>
<td>Metallic looks like metal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-metallic does not look like metal</td>
</tr>
<tr>
<td>Hardness</td>
<td>mineral's resistance to being scratched.</td>
<td>soft if scratched easily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*great for mineral identification</td>
</tr>
<tr>
<td>Cleavage</td>
<td>When mineral breaks in a specific pattern</td>
<td>Ex. Halite, galena</td>
</tr>
<tr>
<td>Fracture</td>
<td>When a mineral breaks in a random pattern</td>
<td>Ex sulfur</td>
</tr>
<tr>
<td>Crystal shape</td>
<td>true form of a mineral related to internal arrangement of atoms</td>
<td></td>
</tr>
<tr>
<td>Specific gravity</td>
<td>mineral's density ÷ density of water</td>
<td></td>
</tr>
<tr>
<td>Malleability</td>
<td>ability of a substance to be hammered into a shape</td>
<td>many metals such as gold and aluminum</td>
</tr>
<tr>
<td>Chemical composition</td>
<td>the elements that a mineral contains which determine its outward characteristics</td>
<td>Quartz = SiO₂</td>
</tr>
<tr>
<td>Title:</td>
<td><strong>Intrusive vs. extrusive</strong></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>NYS Standard:</strong></td>
<td>3.1b Minerals are formed inorganically by the process of crystallization as a result of specific environmental conditions. These include: * cooling and solidification of magma * precipitation from water caused by such processes as evaporation, chemical reactions, and temperature changes * rearrangement of atoms in existing minerals subjected to conditions of high temperature and pressure.</td>
<td></td>
</tr>
<tr>
<td><strong>Source:</strong></td>
<td>Created by Paulette Kealy</td>
<td></td>
</tr>
<tr>
<td><strong>Narrative Description of Visual Organizer:</strong></td>
<td>This graphic organizer was developed as part of a guided reading about igneous rocks. The graphic organizer displays the characteristics, composition, characteristics of rock formed and rocks formed in extrusive and intrusive environments. Students with difficulties in reading would benefit from this graphic organizer because it would help them focus on the important details associated with intrusive and extrusive environments.</td>
<td></td>
</tr>
<tr>
<td><strong>Rationale:</strong></td>
<td>Igneous rocks are formed when lava or magma cools and solidifies. If magma cools and hardens deep below the surface, intrusively, the igneous rock formed will have coarse grained interlocking crystals. When lava cools and hardens at or near the earth’s surface, extrusive formation, the rock formed can have a glassy, vesicular or fine grained crystals. By observing the texture of an igneous rock, inferences about the formation environment can be made.</td>
<td></td>
</tr>
<tr>
<td><strong>Possible Misconceptions/Alternative framework:</strong></td>
<td>Two misconceptions that are related to the igneous rocks are the igneous rocks are formed by pressure and that igneous rocks are formed by the crushing and compaction of rocks over time. Both of these misconceptions are addressed directly with this visual organizer since the focus of the organizer is on the two accepted forms of igneous rock formation, cooling and solidification of molten rock either intrusively or extrusively. Francek, M. (2013). A Compilation and Review of over 500 Geoscience Misconceptions. <em>International Journal Of Science Education, 35</em>(1), 31-64. doi:10.1080/09500693.2012.736644</td>
<td></td>
</tr>
<tr>
<td><strong>Recommendations and Reflections:</strong></td>
<td>This graphic organizer would be appropriate individual use as they read the textbook.</td>
<td></td>
</tr>
</tbody>
</table>
**Name __________________________________________**

**Earth Science Textbook pg121-123**

**Intrusive vs. Extrusive**

<table>
<thead>
<tr>
<th></th>
<th>Extrusive</th>
<th>Intrusive</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Place Formed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rate of cooling</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Type of Crystals</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Texture</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Earth Science Textbook pg121-123**

**Intrusive vs. Extrusive**

<table>
<thead>
<tr>
<th></th>
<th>Extrusive</th>
<th>Intrusive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place Formed</td>
<td>At or near the earth's surface</td>
<td>Deep in the earth's crust</td>
</tr>
<tr>
<td>Rate of cooling</td>
<td>Very slowly</td>
<td>Quickly can be as short as a few hours</td>
</tr>
<tr>
<td>Type of Crystals</td>
<td>Coarse interlocking crystals</td>
<td>-no crystals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-fine crystals</td>
</tr>
<tr>
<td>Texture</td>
<td>Coarse grained</td>
<td>-glassy if no crystals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-fine grained</td>
</tr>
<tr>
<td>Title:</td>
<td>Rock Classification</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------</td>
<td></td>
</tr>
</tbody>
</table>
| NYS Standard:  | 3.1c Rocks are usually composed of one or more minerals.  
* Rocks are classified by their origin, mineral content, and texture.  
* Conditions that existed when a rock formed can be inferred from the rock’s mineral content and texture.  
* The properties of rocks determine how they are used and also influence land usage by humans |
| Source:        | www.lcps.org/Page/38151 |
| Narrative Description of Visual Organizer: | This graphic organizer displays the three categories of rocks, igneous, sedimentary, and metamorphic. Each category is displayed with how they are formed and how they are classified. An advantage for students for using this type of organizer is that the differences between the categories are emphasized. |
| Rationale:     | Rocks are categorized as igneous, sedimentary, or metamorphic based on how the rock is formed. Igneous rocks are formed when lava or magma cools and solidifies. Sedimentary rocks are formed when sediments are compacted and cemented. Metamorphic rocks are formed when a preexisting rock is changed by heat and pressure. Igneous rocks are classified by their chemical composition and their texture. Sedimentary rocks are classified by the type of sediment that makes up the sedimentary rock. Metamorphic rocks are classified as foliated or nonfoliated. |
| Possible Misconceptions/Alternative framework: | Two misconceptions that are related to the rock cycle are that only igneous and sedimentary rocks are the only rocks that are part of the rock cycle and that the rock cycle only shows how rocks are created not the relationships between rocks. First misconception is obviously addressed through the graphic organizer since it shows metamorphic rocks as well as igneous and sedimentary rocks. The other misconception is indirectly addressed but the idea that the rock cycle is a model of the relationships between the rock types should be directly addressed and emphasized during instruction. Source: Francek, M. (2013). A Compilation and Review of over 500 Geoscience Misconceptions. International Journal Of Science Education, 35(1), 31-64. doi:10.1080/09500693.2012.736644 |
| Recommendations and Reflections: | This graphic organizer would be appropriate for whole class or small group instruction during instruction or as an assessment. It could be completed in parts as each rock type was introduced, complete that portion of the graphic organizer. A benefit of this would be that it would allow the concepts to be connected as each concept is covered. |
Rocks are classified by how they form.

Metamorphic Rocks
- Formed by heat and pressure on rocks.
  - Classified by foliated or non-foliated.

Sedimentary Rocks
- Formed by compaction and cementing of layers of sediments made of:
  - Rock particles
  - Plant and animal remains
  - Minerals that settle out of water solutions
- Classified by:
  - Chemical composition
  - Organic material in rock
  - Clastic material in rock
  - Intrusive or extrusive texture

Igneous Rocks
- Formed by cooling and hardening of hot, molten rock (magma) from inside the Earth.
- Classified by chemical composition.
<table>
<thead>
<tr>
<th>Title:</th>
<th><strong>Felsic vs Mafic</strong></th>
</tr>
</thead>
</table>
| **NYS Standard:** | 3.1c Rocks are usually composed of one or more minerals.  
* Rocks are classified by their origin, mineral content, and texture.  
* Conditions that existed when a rock formed can be inferred from the rock’s mineral content and texture.  
* The properties of rocks determine how they are used and also influence land usage by humans |
| **Source:** | created by Paulette Kealy |
| **Narrative Description of Visual Organizer:** | Venn diagram displaying the similarities and differences between felsic and mafic rocks. |
| **Rationale:** | Igneous rocks are formed from the cooling and solidification of molten rocks, magma. There are two classifications of magma; felsic and mafic. Felsic magma is slow moving thick magma which cools and solidifies to form light colored, lower density igneous rocks such as rhyolite, granite, and pumice. Mafic magmas are thinner fast moving magmas which cool to form dark colored, dense igneous rocks such as gabbro, diabase, and basalt. |
| **Possible Misconceptions/Alternative framework:** | A misconception about igneous rocks is that basalt and granite are formed from the same magmas. This misconception is directly addressed through the Venn diagram separating Granite into the Felsic circle completely separate from the basalt which is in the mafic circle.  
Source:  
| **Recommendations and Reflections:** | This could be used as an assessment such as a ticket out the door for individuals or small groups. It could also be used for students to help identify the supporting details in a reading about felsic and mafic igneous rocks. |
Mafic

Hotter, thinner, more fluid magma
Darker color
higher density
rich in Fe, Mg
has plagioclase feldspar, pyroxene biotite and olivine
Ex Gabbro, basalt

Felsic

Thick slow moving magma
light color
lower density
rich in Si, Al
has potassium feldspar, plagioclase feldspar, quartz, biotite, and amphibole
Ex granite, rhyolite

form igneous rocks
can be magma or lava
Felsic
- high amounts of aluminium
- light in color
- low in density
- Pegmatite
- Granite
- Rhyolite
- Vetricular rhyolite
- Pumice
- Obsidian

Mafic
- high amounts of iron and magnesium
- dark in color
- high in density
- Gabbro
- Diabase
- Basalt
- Vetricular Basalt
- Scoria
- Basaltic Glass
- Peridotite
- Dunite
<table>
<thead>
<tr>
<th>Title:</th>
<th>Felsic vs Mafic Magmas</th>
</tr>
</thead>
</table>
| NYS Standard: | 3.1c Rocks are usually composed of one or more minerals.  
* Rocks are classified by their origin, mineral content, and texture.  
* Conditions that existed when a rock formed can be inferred from the rock’s mineral content and texture.  
* The properties of rocks determine how they are used and also influence land usage by humans |
| Source: | created by Paulette Kealy |
| Narrative Description of Visual Organizer: | This graphic organizer was developed as part of a guided reading about igneous rocks. The graphic organizer displays the characteristics, composition, characteristics of rock formed and rocks formed from felsic and mafic magmas/lavas. Students with difficulties in reading would benefit from this graphic organizer because it would help them focus on the important details associated with felsic and mafic magmas. |
| Rationale: | Igneous rocks are formed from the cooling and solidification of molten rocks, magma. There are two classifications of magma; felsic and mafic. Felsic magma is slow moving thick magma which cools and solidifies to form light colored, lower density igneous rocks such as rhyolite, granite, and pumice. Mafic magmas are thinner fast moving magmas which cool to form dark colored, dense igneous rocks such as gabbro, diabase, and basalt. |
| Possible Misconceptions/Alternative framework: | A misconception about igneous rocks is that basalt and granite are formed from the same magmas. This graphic organizer directly addresses this misconception by putting basalt in the mafic side of the graphic organizer while granite is on the felsic side.  
Source:  
| Recommendations and Reflections: | This graphic organizer would be used by individuals while they read the textbook. It could also be used for students to help identify the supporting details in a reading about felsic and mafic igneous rocks. |
**Name ____________________________

*Earth Science Textbook pg121-122*

**Types of Magma**

<table>
<thead>
<tr>
<th></th>
<th>Felsic</th>
<th>Mafic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characteristics of rock formed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minerals formed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Name ____________________________________________**

**Earth Science Textbook pg121-122**

**Types of Magma**

<table>
<thead>
<tr>
<th></th>
<th>Felsic</th>
<th>Mafic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Characteristics</strong></td>
<td>Thick slow moving</td>
<td>Thin fast moving</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td>Large amounts of Silica (SiO$_2$)</td>
<td>Large amounts of Iron and Magnesium</td>
</tr>
<tr>
<td></td>
<td>Smaller amounts of Calcium, Magnesium and Iron</td>
<td>Much smaller amount of Silica</td>
</tr>
<tr>
<td><strong>Characteristics of rock formed</strong></td>
<td>Light colored Low density</td>
<td>Dark colored High density</td>
</tr>
<tr>
<td><strong>Minerals formed</strong></td>
<td>Quartz Orthoclase Feldspar</td>
<td>Hornblende Biotite</td>
</tr>
</tbody>
</table>
### Types of Magma

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Felsic</th>
<th>Mafic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thick &amp; Slow Moving</td>
<td>Hotter &amp; thinner, runny, fluid</td>
</tr>
<tr>
<td><strong>Composition</strong></td>
<td>Contains large amounts of silica ($SiO_2$) &amp; smaller amounts of the elements calcium, iron, &amp; magnesium.</td>
<td>Larger amounts of iron &amp; magnesium &amp; much lower amounts of silica.</td>
</tr>
<tr>
<td><strong>Characteristics of rock formed</strong></td>
<td>Typically hardening into rocks of light-colored silicate.</td>
<td>Formed to mafic magma usually containing large amounts of dark silicate.</td>
</tr>
<tr>
<td><strong>Minerals formed</strong></td>
<td>Quartz and orthoclase feldspar</td>
<td>Hornblende, augite &amp; biotite.</td>
</tr>
<tr>
<td>Title:</td>
<td><strong>Igneous rock classification</strong></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>
| **NYS Standard:** | 3.1c Rocks are usually composed of one or more minerals.  
* Rocks are classified by their origin, mineral content, and texture.  
* Conditions that existed when a rock formed can be inferred from the rock’s mineral content and texture.  
* The properties of rocks determine how they are used and also influence land usage by humans |
| **Source:** | www.lcps.org/Page/38151 |
| **Narrative Description of Visual Organizer:** | This graphic organizer displays the two categories of how igneous rocks are categorized with descriptions and examples of each. This visual organizer's benefit is that it displays the correlations between the types of textures and compositions that can be found in an igneous rock. |
| **Rationale:** | Intrusive igneous rocks are formed deep beneath the surface of the earth and as a result of where the rock is formed it will have larger coarser grains. Extrusive igneous rocks are formed at or near the earth's surface and will have a fine to glassy texture. By observing the size and types of crystals of an igneous rock, the location of formation can be determined. |
| **Possible Misconceptions/Alternative framework:** | A possible misconception about igneous rocks is that coarse grained igneous rocks are rough while fine grained igneous rocks are smooth. The misconception about the texture of the rocks is addressed through this graphic organizer by connecting the concept of texture to the environment where the rocks formed and the rate of cooling associated with each texture. Source: Francek, M. (2013). A Compilation and Review of over 500 Geoscience Misconceptions. *International Journal Of Science Education, 35*(1), 31-64. doi:10.1080/09500693.2012.736644 |
| **Recommendations and Reflections:** | Use the scheme for igneous rock identification chart in the earth science reference tables. This graphic organizer would be appropriate for the introduction of igneous rocks or for an assessment of learning. It could be used for small groups or for individual learners. |
Igneous Rocks

formed by

Cooling and hardening of HOT, MOLTEN ROCK (Magma)

Classified by

Chemical Composition

Mafic Magma Composition
- Characteristics
  - HOTTER
  - Fast moving
  - THIN fluid
  - High Metal
  - Dark Color
  - MORE dense
- Example:
  - Gabbro family
  - gabbro
  - scoria
  - basaltic glass
  - diabase

Felsic Magma Composition
- Characteristics
  - Cooler
  - SLOW moving
  - THICK fluid
  - High SILICA
  - LIGHT Color
  - LESS dense
- Example:
  - Granite Family
  - granite
  - rhyolite
  - obsidian
  - pumice

Texture

Intrusive
- Formed from MAGMA INSIDE the Earth that cools SLOWLY allowing crystals (grains) to grow LARGE makes
- LARGE mineral grains (Large crystals) = COARSE grained Texture

Extrusive
- Formed from LAVA or ASH OUTSIDE the Earth that cools FAST So only small crystals can form, or none at all makes
- small mineral grains (small crystals) = FINF grained Texture
  - No crystals=
  - glassy or porous texture
Igneous Rocks

Formed by

The cooling and solidification of lava or magma.

Classified by

Chemical Composition

- Mafic
  - Characteristics: Contains high amounts of iron and magnesium, dark in color, high in density.
  - Example: Granite

- Felsic
  - Characteristics: Contains high amounts of aluminum, light in color, low in density.
  - Example: Gabbro

Texture

- Intrusive
  - Formed from magma that cools slowly from the atmosphere.
  - Large Crystals

- Extrusive
  - Formed from lava that cools fast on the surface.
  - Small Crystals
<table>
<thead>
<tr>
<th><strong>Title:</strong></th>
<th><strong>Metamorphic rock classification</strong></th>
</tr>
</thead>
</table>
| **NYS Standard:** | 3.1c Rocks are usually composed of one or more minerals.  
* Rocks are classified by their origin, mineral content, and texture.  
* Conditions that existed when a rock formed can be inferred from the rock’s mineral content and texture.  
* The properties of rocks determine how they are used and also influence land usage by humans |
| **Source:** | www.lcps.org/Page/38151 |
| **Narrative Description of Visual Organizer:** | This graphic organizer displays the two categories of how metamorphic rocks are classified, foliated and non-foliated, with definitions and characteristics associated with each type. This visual organizer’s benefit is that it displays the primary distinguishing characteristic of metamorphic rocks. |
| **Rationale:** | Metamorphic rocks with foliated texture have a visible feature that is readily identified. Non-foliated rocks lack this visible feature. Once the type of metamorphic rocks is determined other characteristics can be determined. |
| **Possible Misconceptions/Alternative framework:** | A possible alternate framework associated with metamorphic rocks is that they are formed by as over burden of pressure. This framework is addressed by repeatedly showing that heat and pressure cause the formation of metamorphic rocks.  
| **Recommendations and Reflections:** | Use the scheme for metamorphic rock identification in the earth science reference tables. This graphic organizer would be appropriate for large or small group introduction to metamorphic rocks. It could also be used as an assessment tool after learning about metamorphic rocks. |
Metamorphic Rocks
“Changed Rocks”

formed by

- __________ and __________ from the earth affect any kind of rock.
- metamorphic rocks are formed from preexisting rocks called _________________.

Classified by

Foliated
Metamorphic Rocks

Non-foliated
Metamorphic Rocks

Heat and Pressure CHANGE Parent Rocks

- Sandstone (Parent Rock)
  - Heat and Pressure form

- Shells
  - Heat and Pressure form

- Organic Limestone (Parent Rock)
  - Heat and Pressure form

- Chemical Limestone (Parent Rock)
  - Heat and Pressure form

- Shale (Parent Rock)
  - Heat and Pressure form
**Metamorphic Rocks**

"Changed Rocks"

formed by

- Heat and Pressure from the Earth is exerted on any kind of rock
- Metamorphic rocks are formed from preexisting rocks called **Parent Rocks**

Classified by

**Foliated**
Metamorphic Rocks

**DO** have LAYERS or BANDS

**Non-foliated**
Metamorphic Rocks

**DO NOT** have layers but have "massive" one piece structures

**Heat and Pressure CHANGE Parent Rocks**

- Sandstone (Parent Rock)
  - Heat and Pressure form
  - Quartzite

- Shells

- Organic Limestone (Parent Rock)
  - Heat and Pressure form

- Chemical Limestone (Parent Rock)
  - Heat and Pressure form
  - Phyllite
  - Marble
  - Schist

- Shale (Parent Rock)
  - Heat and Pressure form
  - Slate

Metamorphic Rocks
"Changed Rocks"

formed by

- **heat** and **pressure** from the earth affect any kind of rock.
- metamorphic rocks are formed from preexisting rocks called ____________.

Classified by

- **Foliated**
  - Metamorphic Rocks
  - mineral alignment
  - banding

- **Non-foliated**
  - Metamorphic Rocks
  - distorted
  - nonbanding

Heat and Pressure CHANGE Parent Rocks

- Sandstone (Parent) → Heat and Pressure form → Quartzite
- Shells → Organic Limestone (Parent Rock) → Heat and Pressure form → Phyllite
- Shale (Parent Rock) → Heat and Pressure form → Slate
- Chemical Limestone (Parent Rock) → Heat and Pressure form → Marble
- Slate → Heat and Pressure form → Serpentine

Kealy 134
<table>
<thead>
<tr>
<th>Title:</th>
<th><strong>The rock cycle</strong></th>
</tr>
</thead>
</table>
| NYS Standard: | 3.1c Rocks are usually composed of one or more minerals.  
* Rocks are classified by their origin, mineral content, and texture.  
* Conditions that existed when a rock formed can be inferred from the rock’s mineral content and texture.  
* The properties of rocks determine how they are used and also influence land usage by humans |
| Narrative Description of Visual Organizer: | This diagram represents the relationships between the three types of rocks; igneous, sedimentary and metamorphic. This visual organizer's benefit is that it visually displays the relationships between igneous, sedimentary and metamorphic rocks. |
| Rationale: | The rock cycle is a representation of the various processes that rocks can go through and the rocks that can be formed as a result of those processes. Igneous rocks are formed as a result of the cooling and solidification of lava or magma. Lava is molten rock that is at or near the earth's surface while magma is molten rock beneath the surface of the earth. Sedimentary rocks are formed from the compaction and cementation of sediment. Sediment is formed with a rock is weathered and eroded, which usually occurs after a rock has been uplifted and exposed. Metamorphic rocks are formed when rocks have undergone heating and pressure great enough to alter the crystal structure without melting the rock. Any rock can go through any of the processes of the rock cycle. |
| Possible Misconceptions/Alternative framework: | A misconception associated with the rock cycle is that only sedimentary and igneous rocks go through the rock cycle. This misconception is addressed through this graphic organizer by showing that metamorphic rocks have a relationship to igneous rocks as well as to sedimentary rocks.  
| Recommendations and Reflections: | Use the scheme for metamorphic rock identification in the earth science reference tables. This graphic organizer would be appropriate for use during whole group instruction or for small group and individual assessment. |
**Personal Reflection**

I am an earth science teacher in an urban school district with an earth science regents passing rate of approximately 25%. I am continually amazed by my students' misconceptions and lack of recognition of the relationships between various parts of the earth. As a teacher, I want my students to succeed and I began this project as a search for tools to help my students develop a better understanding of earth science concepts.

My research began with a look at the misconceptions associated with earth science and I contemplated ways to overcome these misconceptions. This contemplation led my research to concept maps as a possible way to overcome misconceptions. This discovery led my research in the direction of other types of visual organizers that might also help alleviate misconceptions. As I began the researching visual organizers specifically, I was amazed to find out about all the benefits that can result from the use of visual organizers, especially for students with learning disabilities and was excited to put the research to the test.

My first attempt at using a graphic organizer in my classroom was a graphic organizer that the students were to create based on the key concepts of the water cycle. I gave the students ten concepts that they needed to use while showing the relationships between those concepts. I was pleasantly surprised to see how many connections the students could make, even my low performing students. After that experience, I was hooked on the idea of using graphic organizers. However, through these experiences in the classroom, I saw confirmation of the research's complaint that student created visual organizers are time consuming and can be ineffective in addressing misconceptions if those misconceptions are not directly addressed before the creation of the visual organizer. As a result of this knowledge, I focused this project
on finding or creating visual organizers that could be given to students with the hope of making sure that those misconceptions could be part of the focus of the organizers.

   Many of the visual organizers contained in this project were found after endless hours of searching the internet, looking at textbooks and studying the earth science content. A majority of the visual organizers that I found needed to be adapted for use in a high school classroom. I also found several that were incorrect and needed corrections. I wish that there were more visual organizers for meteorology. Meteorology is a vocabulary intense unit where students often do not recognize the connections between the various factors involved in our weather.

   As this school year began I made a conscientious effort to use more graphic organizers in my classroom and I have seen some of the benefits already, especially in a 12:1:1 class that I co-teach. I am looking forward to using all these visual organizers in my classroom and will continue to create more visual organizers for my students. I hope that other earth science teachers will use them and find them beneficial for their students.
Discussion and Summary of Process

In the project titled *Improving earth science Instruction through Visual Organizers*, the benefits of using visual organizers were researched with a focus on how visual organizers can be used to help students' understanding of earth science content. Once these benefits were recognized, the focal point of the research turned to finding or designing visual organizers that could be used specifically in the earth science classroom based on the New York State Physical Settings/earth science standards.

The format for this project is comprised of nine components needed to describe and explain the standard addressed and how the visual organizer can be used by other earth science teachers. These components are title, New York State standard, source, narrative description of visual organizer, rationale, possible misconceptions/alternate framework and recommendations and reflections. The title lets a teacher know the general concept addressed in the visual organizer. The New York state standard allows teachers to know which standard the visual organizer is focused on. The narrative description provides the type of visual organizer as well as any possible benefits of using the visual organizer. The rationale section is a description of the concept that the visual organizer as well as definitions of key vocabulary words. The misconceptions/alternative framework portion discusses misconceptions associated with the concept addressed in the visual organizer and the research source for that misconception. It also covers how this organizer would address the misconception. The recommendation and reflection section gives suggestions for how to use the visual organizer, such as if the organizer would be best used during instruction or assessment and for the size of the group it is recommended for, whole group, small, or individuals. Additional suggestions, such as concepts that could be attached to this visual organizer or other resources, such as if the reference table should be used
in conjunction with the organizer, are also in this section. The table, containing these components, is followed by a visual organizer with blank spaces that could be printed and copied for the students. The next page is a completed visual organizer to help the teacher when using the visual organizer with the class. A copy of the completed organizer could also be used as a part of SMART Board presentation. When available, the following page is a student completed example.

Science curriculum in the middle and high school includes many complex and abstract topics which require students to use higher order thinking and comprehension to understand. The increased demand requires students to use inductive and deductive reasoning with many unfamiliar, scientifically specific vocabulary words. While general education students often have difficulties in developing these skills, students with learning difficulties have even more difficulties. Visual organizers make relationships more obvious through the use of visual and spatial displays. They also can connect new information with prior knowledge thus aiding retention of new material. Additionally, students can improve their reading comprehension and writing when they understand how textbooks are organized and use visual representations of text organization. Visual organizers also allow learners to develop their knowledge in a way that identifies "erroneous perceptions and various learning styles" (Assaraf & Orpaz, 2010).
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