Grade 8 Science
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The Purpose of the Science Curriculum Guide

The purpose of the Science Curriculum Guide is to provide teachers with all of the components and content which, when fully implemented, will lead to deep alignment of the Youngstown City Schools science Curriculum and Ohio’s New Learning Standards.

The Science Curriculum Guide is designed to maximize student achievement and is intended to be followed by all teachers. Much of the Science Curriculum Guide is flexible for teacher’s to design their own lessons within the framework of Ohio’s New Learning Standards. Student achievement is enhanced when students are taught the content on which they will be tested (content alignment); taught the curriculum in the format that it will be tested (context alignment); and taught the curriculum at the appropriate level of cognition (cognitive alignment). The Science Curriculum Guide contains teaching methodologies that are varied to ensure that students have acquired learning for both long-term and short-term mastery.

This curriculum document is designed to be a working resource. It provides the essential information and example that will assist teachers in providing classroom instruction that maximizes student learning. The strategies contained in this guide are designed to provide guidance to teachers on how to approach key concepts and skills. This curriculum guide cannot replace good teaching, but it can reinforce and guide teachers to provide all students with the skills, knowledge and experiences they will need to succeed in science in Youngstown City Schools and be successful at levels set by the Ohio Department of Education.

It is the intent of the Science Curriculum Guide that teachers and students are successful in meeting the expectations of the state science standards. Therefore, teaching and learning must be an active inquiry process. This means that teachers should take the opportunity to teach science as something in which students are actively engaged. When participating in inquiry, students learn to construct their knowledge and communicate their ideas and learning to others. This includes engaging all students with relevant, real-world activities that develop students’ knowledge, verbal and written communication skills and scientific process skills.

The following terms are used throughout this document:

**Content Statements:** These state the science content to be learned. They are the “what” of science that should be accessible to students at each grade level to prepare them to learn about and use scientific knowledge, principles and processes with increasing complexity in subsequent grades. These statements come directly from the Ohio New Learning Standards Document.

**Content Elaboration:** This section provides anticipated grade-level depth of content knowledge and examples of science process skills that should be integrated with the content. Content Elaborations also provides information to help identify what prior knowledge students should have and to what future knowledge the content will build. This section comes directly from the Ohio New Learning Standards Document and is the content from which state assessments are being developed.
# 8th Grade New Learning Standards at a Glance

## Earth and Space Sciences

<table>
<thead>
<tr>
<th>Condensed Content Statement</th>
<th>Content Elaboration</th>
</tr>
</thead>
</table>
| **8.ESS.1** The composition and properties of Earth’s interior are identified by the behavior of seismic waves. | • It is important to provide the background knowledge regarding how scientists know about the structure and composition of the interior of Earth (without being able to see it). Seismic data, graphics, charts, digital displays and cross sections must be used to study Earth’s interior. Actual data from the refraction and reflection of seismic waves can be used to demonstrate how scientists have determined the different layers of Earth’s interior. New discoveries and technological advances relating to understanding Earth’s interior also play an important role in this content.  
- Earth and other planets in the solar system formed as heavier elements coalesced in their centers. Planetary differentiation is a process in which more dense materials of a planet sink to the center, while less dense materials stay on the surface. A major period of planetary differentiation occurred approximately 4.6 billion years ago (College Board Standards for College Success, 2009).  
- In addition to the composition of Earth’s interior, the history of the formation of Earth and the relationship of energy transfer, transformation and convection currents within the mantle and crust are essential in understanding sources of energy. |
| **8.ESS.2** Earth’s crust consists of major and minor tectonic plates that move relative to each other. | • The historical data related to the present plate tectonic theory must include continental “puzzle-like-fit” noticed as early as Magellan and by other mapmakers and explorers, paleontological data, paleoclimate data, paleomagnetic data, continental drift (Wegener), convection theory (Holmes) and sea floor spreading (Hess, Deitz). Contemporary data must be introduced, including seismic data, GPS/GIS data (documenting plate movement and rates of movement), robotic studies of the sea floor and further exploration of Earth’s interior.  
- Physical world maps, cross sections, models (virtual or 3D) and data must be used to identify plate boundaries, movement at the boundary and the resulting feature or event. The relationship between heat from Earth’s core, convection in the magma and plate movement should be explored. World distribution of tectonic activity of possible interest should be investigated (e.g., Ring of Fire, San Andreas Fault, Mid-Atlantic Ridge, Mariana Trench, Hawaiian Islands, New Madrid Fault System).  
- Volcanic activity, earthquakes, tsunamis, geysers, hot springs, faults, oceanic vents, island arcs, hot spots and rift valleys should all be included in the identification of plates and plate boundaries. Plate boundary identification (converging, diverging, transform) must be based on the resulting features or events. The focus must be on the cause of plate movement, the type and direction of plate movement and the result of the plate movement, not on memorizing plate names. |
| **8.ESS.3** A combination of constructive and destructive geologic processes formed Earth’s surface. | • The interactions between the hydrosphere and lithosphere are studied as they relate to erosional events (e.g., flooding, mass wasting). The characteristics of rocks and soil, the climate, location, topography and geologic process are studied.  
- Distinguishing between major geologic processes (e.g., tectonic activity, erosion, deposition) and the resulting feature on the surface of Earth is the focus of this content statement. It is important to build on what was included in the elementary grades (recognizing features), enabling students to describe conditions for formation. Topographic, physical and aerial maps, crosssections, field trips and virtual settings are methods of demonstrating the structure and formation of each type of feature. The use of technology (remote sensing, satellite data, LANDSAT) can be used to access real-time photographs and graphics related to landforms and features.  
- Factors that affect the patterns and features associated with streams and floodplains (e.g., discharge rates, gradients, velocity, erosion, deposition), glaciers (e.g., moraines, outwash, tills, erratic, kettles, eskers), tectonic activity (should include the features listed in the content statement above), coastlines, flooding and deserts should be studied. |
| 8.ESS.4 Evidence of the dynamic changes of Earth’s surface through time is found in the geologic record. | - The representation of the age of the Earth must include a graphic demonstration of the immensity of geologic time, as this is a very difficult concept to grasp. The different methods used to determine the age of the Earth are an important factor in this concept. In elementary grades, fossils are used to compare what once lived to what lives now, but the concept of Earth’s age and the age of the fossils were not included (the concept of billions or millions of years was not age-appropriate). In grade 8, the concept of index fossils is a way to build toward understanding relative dating. Superposition, crosscutting relationships and index fossils play an important role in determining relative age. Radiometric dating plays an important role in absolute age. The inclusion of new advances and studies (mainly due to developing technological advances) is important in learning about the geologic record.
- Uniformitarianism can be an important key in understanding how scientists have interpreted the environmental conditions that existed throughout Earth’s history. Fossil evidence also can indicate specific environments and climate conditions that help interpret the geologic record. Relating Earth’s climate history to present-day climate issues should include evidence from ice core sampling as well as evidence from the geologic record.
- Using actual data to generate geologic maps of local or statewide formations can connect to the real world. Field studies or geologic research (can be virtual/digital) can help identify local formations and interpret the environment that existed at the time of the formation. Analyzing and interpreting the data to draw conclusions about geologic history is an important part of this content statement.
- Note: This content is closely connected to LS grade 8 content pertaining to diversity of species as documented in the fossil record, tracing changes evident in the fossil record and relating this content to evolution. |
## Life Sciences

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<tr>
<th>Condensed Content Statement</th>
<th>Content Elaboration</th>
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| **8.LS.1** Diversity of species occurs through gradual processes over many generations. Fossil records provide evidence that changes have occurred in number and types of species. | - The fossil record documents the variation in a species that may have resulted from changes in the environment. The fossil record is contained within the geologic record (ESS grade 8). Combining data from the geologic record and the fossil record, Earth’s living history can be interpreted. Data and evidence from the fossil record must be used to develop further the concepts of extinction, biodiversity and the diversity of species.  
- Diversity can result from sexual reproduction. The sorting and combination of genes results in different genetic combinations, which allow offspring to be similar to, yet different from, their parents and each other. (This statement must be connected to the grade 8 Life Science content statement on reproduction and Mendelian Genetics.) These variations may allow for survival of individuals when the environment changes. Diversity in a species increases the likelihood that some individuals will have characteristics suitable to survive under changed conditions.  
- Evidence from geologic and fossil records can be used to infer what the environment was like at the time of deposition, the variations that exist in organisms can accumulate over many generations, so organisms can be very different in appearance and behavior from their distant ancestors.  
- Note 1: Molecular clocks are not appropriate at this grade level.  
- Note 2: The term “transitional form” should be used to describe parts of the fossil record that are incomplete. |
| **8.LS.2** Reproduction is necessary for the continuation of every species. | - An individual organism does not live forever. Reproduction is necessary for the continuation of every species. Most organisms reproduce either sexually or asexually. Some organisms are capable of both. In asexual reproduction, all genes come from a single parent, which usually means the offspring are genetically identical to their parent, allowing genetic continuity. Mitosis was investigated in grade 6. The end products of mitotic and meiotic cell divisions are compared as they relate to asexual and sexual reproduction. It is important that both mitosis and meiosis are addressed in preparation for future study of Mendelian genetics and embryology.  
- In sexual reproduction, a single specialized cell from a female (egg) merges with a specialized cell from a male (sperm). Typically, half of the genes come from each parent. The fertilized cell, carrying genetic information from each parent, multiplies to form the complete organism. The same genetic information is copied in each cell of the new organism. In sexual reproduction, new combinations of traits are produced which may increase or decrease an organism’s chances for survival. Investigations and experimentation (3-D or virtual) must be used to compare offspring to parents in sexual and asexual reproduction. |
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| **8.LS.3**  
The characteristics of an organism are a result of inherited traits received from parent(s). | • The traits of one or two parents are passed on to the next generation through reproduction. Traits are determined by instructions encoded in deoxyribonucleic acid (DNA), which forms genes. Genes have different forms called alleles. Introduce the principles of Mendelian genetics by reviewing Mendel’s work. Mendel’s two laws provide the theoretical base for future study of modern genetics. Mendel’s first law, the Law of Segregation, and his second law, the Law of Independent Assortment, should be demonstrated and illustrated in a variety of organisms. The concepts of dominant and recessive genes are appropriate at this grade level. Codominant traits such as roan color in horses and cows may be useful to provide further validation of the theory and to help dispel some misconceptions. Pedigree analysis is appropriate for this grade level when limited to dominant, recessive or codominance of one trait. The Law of Independent Assortment should only be explored in simple cases of dominance and recessive traits. Chi-square and dihybrid crosses are reserved for high school.  
• Conduct a long-term investigation to analyze and compare characteristics passed on from parent to offspring through sexual and asexual reproduction. Ask questions about the phenotypes that appear in the resulting generations and what they infer about genotypes of the offspring.  
• Note: Incomplete dominance is not suggested for this grade level to help avoid the misconception of “blending of traits.” Codominance is encouraged because both traits are expressed in the resulting offspring. |
## Physical Science

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<tr>
<th>Condensed Content Statement</th>
<th>Content Elaboration</th>
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| **8.PS.1** Forces between objects act when the objects are in direct contact or when they are not touching. | - A field model can be used to explain how two objects can exert forces on each other without touching. An object is thought to have a region of influence, called a field, surrounding it. When a second object with an appropriate property is placed in this region, the field exerts a force on and can cause changes in the motion of the object.  
- Electric fields exist around objects with charge. If a second object with charge is placed in the field, the two objects experience electric forces that can attract or repel them, depending on the charges involved. Electric force weakens rapidly with increasing distance.  
- Magnetic fields exist around magnetic objects. If a second magnetic object is placed in the field, the two objects experience magnetic forces that can attract or repel them, depending on the objects involved. Magnetic force weakens rapidly with increasing distance. Magnetic field lines can be seen when iron filings are sprinkled around a magnet.  
- Gravitational fields exist around objects with mass. If a second object with mass is placed in the field, the two objects experience attractive gravitational forces toward each other. Gravitational force weakens rapidly with increasing distance.  
- Every object exerts a gravitational force on every other object with mass. These forces are hard to detect unless at least one of the objects is very massive (e.g., sun, planets). The gravitational force increases with the mass of the objects, decreases rapidly with increasing distance and points toward the center of objects. Weight is gravitational force and is often confused with mass. Weight is proportional to mass, but depends upon the gravitational field at a particular location. An object will have the same mass when it is on the moon as it does on Earth. However, the weight (force of gravity) will be different at these two locations.  
- Electricity is related to magnetism. In some circumstances, magnetic fields can produce electrical currents in conductors. Electric currents produce magnetic fields. Electromagnets are temporary magnets that lose their magnetism when the electric current is turned off. Building an electromagnet to investigate magnetic properties and fields can demonstrate this concept.  
- Generators convert mechanical energy into electrical energy and are used to produce electrical energy in power plants. Electric motors convert electrical energy into mechanical energy. Motors are in blenders and washing machines. Both motors and generators have magnets (or electromagnets) and a coil of wire that creates its own magnetic field when an electric current flows through it.  
- Note 1: Magnetic poles are often confused with electric charges. It is important to emphasize the differences.  
- Note 2: Mathematics is not used to describe fields at this level.  
- Note 3: This content statement involves a basic introduction to the field model. Details about the field model are not required other than the |
idea that a field is a concept that is used to understand forces that act at a distance.

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<tr>
<th>8.PS.2</th>
<th>Forces have magnitude and direction.</th>
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<td>• Motion can be described in different ways by different observers (e.g., a pencil held in someone’s hand may appear to be at rest, but to an observer in a car speeding by, the pencil may appear to be moving backward).</td>
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<tr>
<td>• A force is described by its strength (magnitude) and in what direction it is acting. Many forces can act on a single object simultaneously. The forces acting on an object can be represented by arrows drawn on an isolated picture of the object (a force diagram). The direction of each arrow shows the direction of push or pull. When many forces act on an object, their combined effect is what influences the motion of that object. The sum of all the forces acting on an object depends not only on how strong the forces are, but also in what directions they act. Forces can cancel to a net force of zero if they are equal in strength and act in opposite directions. Such forces are said to be balanced. If all forces are balanced by equal forces in the opposite direction, the object will maintain its current motion (both speed and direction). This means if the object is stationary, it will remain stationary. If the object is moving, it will continue moving in the same direction and at the same speed. Such qualitative, intuitive understandings and descriptions of inertia must be developed through inquiry activities.</td>
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<tr>
<td>• Kinetic friction is a force that occurs when two objects in contact interact by sliding past one another. Drag is a force that opposes the motion of an object when an object moves through a fluid (e.g., gas, liquid). Kinetic friction and drag affect the motion of objects and may even cause moving objects to slow to a stop unless another force is exerted in the direction of motion. This phenomenon leads to the misconception that objects require a sustained force to continue moving. Experimentation with objects that have limited friction (e.g., a puck on an air hockey table, dry ice on a surface) can address the misconception that objects with a net force of zero naturally slow down.</td>
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<tr>
<td>• If the forces are not balanced, the object’s motion will change, either by speeding up, slowing down or changing direction. Qualitative, intuitive understandings of the influence of unbalanced forces on objects must be developed through inquiry investigations.</td>
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<tr>
<td>• Note 1: The concept of fields for objects that exert forces without touching is introduced at this grade level.</td>
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<td>• Note 2: The content description states that there will be acceleration when “the net force is greater than zero.” When positive and negative values are used to represent the direction of forces, this statement will need to be expanded. Any nonzero net force, including a negative net force, also may result in a change in speed or direction (acceleration).</td>
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<tr>
<th>8.PS.3</th>
<th>There are different types of potential energy.</th>
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<tbody>
<tr>
<td>• Gravitational potential energy is associated with the mass of an object and its height above a reference point (e.g., above ground level, above floor level). A change in the height of an object is evidence that the gravitational potential energy has changed.</td>
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</tr>
</tbody>
</table>
- Elastic potential energy is associated with how much an elastic object has been stretched or compressed and how difficult such a compression or stretch is. A change in the amount of compression or stretch of an elastic object is evidence that the elastic potential energy has changed.

- Chemical potential energy is associated with the position and arrangement of the atoms within substances. Rearranging atoms into new positions to form new substances (chemical reaction) is evidence that the chemical potential energy has most likely changed. The energy transferred when a chemical system undergoes a reaction is often thermal energy.

- Electrical potential energy is associated with the position of electrically charged objects relative to each other and the amount of charge they have. A change in the position of charged particles relative to each other is evidence of a change in electrical potential energy.

- Magnetic potential energy is associated with the position of magnetic objects relative to each other.

- The different types of potential energy must be explored through experimentation and investigation that include the relationship of energy transfer and springs, magnets or static electricity.

- Note: Potential energy is often taught as “stored” energy. If the word “stored” means that it is kept by the object and not given away to another object, then kinetic energy also can be classified as “stored” energy. A rocket moving at constant speed through space has kinetic energy and is not transferring any of this energy to another object.
SCIENCE LABORATORY SAFETY CONTRACT

- I will act responsibly at all times during a laboratory experiences.
- When entering the lab classroom, I will wait for instructions before touching any equipment, chemicals, or other materials in the laboratory area.
- I will not eat food, drink beverages, or chew gum in the laboratory.
- I will not use laboratory glassware as containers for food or beverages.
- I will keep my area clean during a lab.
- I will wear appropriate safety glasses/goggles when working with heat, glass or chemicals and protective apron when necessary.
- I will know the locations and operating procedures of all safety equipment including the first aid kit, eyewash station, safety shower, fire extinguisher, and fire blanket. I know where the fire alarm and the exits are located.
- I will immediately notify a teacher of any accident (spill, breakage, etc.) or injury (cut, burn, etc.), no matter how trivial it may appear.
- I know my school's Emergency Response Team Plan and the people to contact in the event of an emergency.
- I know what to do if there is a fire drill during a lab period.
- I will handle all living organisms used in a lab activity in a humane manner. Preserved biological materials are to be treated with respect and disposed of properly.
- I will tie back long hair, remove jewelry and wear shoes with closed ends (toes and heels) while in lab/classroom.
- I will never work alone in the lab/classroom.
- I will not take chemicals or equipment out of the classroom unless instructed to do so.
- I will dispose of all chemical waste properly (according to teacher’s directions).
- All chemicals in the laboratory are to be considered dangerous. I will not touch, taste, or smell any chemicals unless specifically instructed to do so.
- I will not enter or work in the storage room unless supervised by a teacher.

AGREEMENT

I, ______________________________________, have read each of the statements in the Science Laboratory Safety Contract and understand these safety rules. I agree to abide by the safety regulations and any additional written or verbal instructions provided by the school district or my teacher. This contract ensures that students and the teacher know exactly what is expected of them.

1. Please list any food or contact allergies (e.g. allergy to peanuts, plant, latex, etc.)

2. Please provide a daytime emergency contact:

   (Contact person) ___________________________ (Contact phone number) ___________________________

3. Student Signature ___________________________ Date ___________

4. Parent Signature ___________________________ Date ___________

Adapted from http://www.flinnsci.com/Documents/miscPDFs/Safety_Contract.pdf
Optimize
Classify
Communicate
Experiment
Predict
Problem Solving
Measure
Infer
Hypothesize
<table>
<thead>
<tr>
<th>Optimize</th>
<th>Classify:</th>
<th>Observe:</th>
</tr>
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<tbody>
<tr>
<td>To make the best or most effective use of (a situation, opportunity, or resource)</td>
<td>Group or organize objects or events into categories based on specific criteria</td>
<td>Use one or more of your senses to perceive properties of objects and events; can be done directly with the senses or indirectly through the use of simple or complex instruments</td>
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<thead>
<tr>
<th>Problem Solving:</th>
<th>Predict:</th>
<th>Experiment:</th>
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<tbody>
<tr>
<td>Build new mathematical or scientific knowledge through problem solving; solve problems that arise in mathematics, science and in other context; apply and adapt a variety of appropriate strategies to solve problems; and monitor and reflect on the process of mathematical and scientific problem solving</td>
<td>Anticipate outcomes of future events, based on patterns or experience</td>
<td>Design procedures for gathering data to test hypotheses under conditions in which variables are controlled or manipulated</td>
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<thead>
<tr>
<th>Hypothesize:</th>
<th>Infer:</th>
<th>Measure:</th>
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<tbody>
<tr>
<td>Pose a testable explanation for observations or events and state it as the expected outcome of an experiment</td>
<td>Use logical reasoning to make conclusions based on observations</td>
<td>Make quantitative observations using both nonstandard and standard measure</td>
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<tr>
<td>Control Variables</td>
<td>Interpret Data</td>
<td>Design</td>
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<tr>
<td>Representation</td>
<td>Reasoning and Proof</td>
<td>Constraints</td>
</tr>
<tr>
<td>Critique</td>
<td>Compare</td>
<td>Draw Conclusions</td>
</tr>
<tr>
<td>Design:</td>
<td>Interpret Data:</td>
<td>Control Variables:</td>
</tr>
<tr>
<td>--------</td>
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<tr>
<td>Develop procedures for gathering data to test hypotheses</td>
<td>Make observations of objects or events to make inferences or predictions; write down the observations on paper as notes or display the data in charts, tables or graphs; make predictions, inferences and hypotheses from a set of data</td>
<td>State or control factors that affect the outcome of an experiment</td>
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<thead>
<tr>
<th>Constraints:</th>
<th>Reasoning and Proof:</th>
<th>Representation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limitations or restrictions on a process or procedure.</td>
<td>Recognize reasoning and proof as fundamental aspects of mathematics and science; make and investigate mathematical and scientific conjectures; develop and evaluate mathematical and scientific arguments and proofs; and select and use various types of reasoning and methods of proof</td>
<td>Create and use representations to organize, record and communicate mathematical and scientific ideas; select, apply and translate among mathematical and scientific representations to solve problems; and use representations to model and interpret physical, social, mathematical and scientific phenomena</td>
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<thead>
<tr>
<th>Draw Conclusions:</th>
<th>Compare:</th>
<th>Critique:</th>
</tr>
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<tbody>
<tr>
<td>Interpret data to make conclusions; the final step of an investigation</td>
<td>Identify common and distinguishing characteristics among objects or events.</td>
<td>Evaluate (a theory or practice) in a detailed and analytical way.</td>
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Middle School
Science Lab Report Guidelines

Title: A descriptive complete sentence.

Introduction: This section should include an introductory paragraph discussing question(s)/problems in which you are trying to answer. This paragraph should also include preliminary observations or basic researched information about the subject as well as listing any formulas that will be used during the lab.

Hypothesis: This section requires you to write a possible solution for the problem found within the introductory paragraph. Make sure this solution is testable and written as a complete sentence.

Materials: Create a bulleted list of all items used in the lab

Safety Concerns: Create a list of all safety precautions/concerns within the lab.

Procedure: This section will be numerically listed (1, 2, 3…) step by step list of instructions to complete the lab exercise. These steps must be written so that another person can use the directions to complete the activity.

Results/Data: This section should include all observations or additional notes you make during the lab. It must include appropriate labeled tables, graphs and charts needed to simplify your data. Add color when appropriate.

Conclusion: The conclusion section of your lab should be at least a paragraph long. Your conclusion should begin with restating your hypothesis. Then you need to either support or reject your hypothesis based on your results and analyzed data taken from your lab. Explain why you supported or rejected your hypothesis-support your decision with facts from your lab. Additionally state one thing you learned from the lab and describe how it applies to real-life situations.

Diagram/Illustration (if necessary): Examples: Draw a visual representation of your lab set up describing what occurred/draw what you saw under the microscope/before and after illustration of the lab results. This will be determined by your teacher.

* Lab reports should be written using Third Person. However, use your best judgment when it concerns your students. (Modeling will help.)
Procedure:
1. ____________________________________________
2. ____________________________________________
3. ____________________________________________
4. ____________________________________________
5. ____________________________________________
6. ____________________________________________
7. ____________________________________________
8. ____________________________________________
9. ____________________________________________
10. ____________________________________________

Results/Data:

Optional: Attach Graph
Inquiry Design Cycle
Teacher Explanation

**Define the Problem:** The students will identify what needs to be done. They will come back to this stage each time they encounter a problem throughout the design process. Be sure that students are documenting changes on the Inquiry Design Challenge page or the Science Notebook.

**What students are doing during this stage:**
- Making observations
- Listing all driving questions

**Develop the Solution:** This stage involves brainstorming, drawing, modeling, and building. Students are actively engaged in the solving of or discussion of the problem. During this time students will often switch back and forth between Defining the problem and Optimizing their design. They may not realize they are doing it so remind them to document ideas and modifications.

**What students are doing during this stage:**
- Collaborating and writing down every idea that may be the solution (brainstorming)
- Sketching what the solution may look like
- Research if anyone else has asked the same or a similar question
- Labeling drawings and selecting material
- Evaluating each idea with the assessment criteria and scoring rubric
- Selecting the best solution based on the criteria and scoring rubric
- Creating a prototype to test

**Optimize/Improve:** Students are challenging their own solutions and making their product better in response to the problem. This is where real learning occurs. Working through difficulties and learning “grit” or persistence is an important characteristic to success in any field.

**What students are doing during this stage:**
- Testing the solution and recording what works or additional problems
- Redrawing a simpler sketch
- Labeling details of the sketch
- Testing different materials
Inquiry Design Cycle

**Define the Problem:**
What is the problem you want solved?

**Develop the Solution:**
Sketch possible solutions/choose the best idea.

**Optimize/Improve**
Test the solution: Does it solve the problem? Can you explain the solution? Can it be made simpler?
Inquiry Design Challenge

1) Define the problem. While observing, what were the questions that came to your mind?

2) Brainstorm several ways that may solve the problem. Sketch ideas or write out. What do you want the solution to do? Scientific Hypothesis: each solution should be testable. The final solution will be modified and optimized several times after repeated testing.

3) Develop the solution. Pick ONE of your brainstorm ideas. Explain why it will work the best. Scientific Hypothesis: Would this solution answer the problem? Is this the simplest solution?
4) Constraints. Identify materials needed to build your solution. How much time will be required? Where will you obtain the materials? List any safety concerns.

5) Design. Draw a picture of your design. Label each part. Identify the materials used. Describe how it will be created or assembled.

6) Build your prototype. Stick to the design and record all modifications.
7) Critique. Did your prototype work as you expected it would?

8) Optimize. Can it be made simpler or with less materials?

9) Define the Problem. Does the solution create any additional problems that need addressed?

Return to Step 1
What phase of the design cycle were you using today? Explain what you did for the design challenge today.

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Draw a picture of how you contributed.

Describe 3 things you learned about science or engineering from what you did today.

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Collins Writing Program

Features

Five Types of Writing
Type One

- Gets ideas on paper – brainstorming in printed form
- Timed
- Requires a minimum number of lines
- Develops fluency, comfort and confidence
- One draft

Type Two

- Writing that shows the writer knows something about a topic
- It is a correct answer to a specific question
- Can be a quick quiz
- One draft

Type Three

- Writing has substantial content
- Identifies three specific standards called focus correction areas
- Read aloud by writer to listen for fluency and self correct
- Reviewed to see if draft meets certain criteria
- One draft

Type Four

- Writing that is Type Three writing that is read out loud by another person
- Critiqued by that person
- Rewritten with corrections made
- Two drafts

Type Five

- Writing that is of publishable quality
- Multiple drafts
Writing Program Reasoning

To demand more writing and thinking, especially writing, requires more teacher work in an unending cycle of assessment. How do we get students to do more writing and thinking without overwhelming the teacher?

The Collins Writing program being recommended is not designed to turn all teachers into English teachers. The program is designed to help teachers in all content areas achieve their goals by requiring students to think on paper.

Frequent, usually short, writing assignments can be used to increase students’ involvement in lessons, check on their understanding of concepts, and promote their thinking about content.

The program can be used to encourage students to take responsibility for their own learning.

The program can be used to refine listening and speaking skills. Some types of assignments require that the students read their writing out loud and listen critically to writing that is being read to them.
Why is Writing Important in Science Classes?

• Writing helps students to synthesize knowledge by improving the learning of content.

• Writing helps students organize their thoughts.

• Writing is a memory aid that entails a higher degree of involvement than listening or reading.

• We write to discover what we know and what we need to learn.
General Guidelines for Teachers Using Type One and Type Two Writing Assignments

- Post the definitions for Type One and Type Two writing in a conspicuous place or places in the classroom.
- Always tell students what type of writing they will be doing.
- Have the students label Type One and Type Two assignments on the top line, left-hand side of the paper.
- Skip lines for all body text.
- Give a quota for the number of lines

- Student should write the entire time.
- Give a limited amount of time for trying.
- Have students underline key words.
Advantages and Disadvantages of Type One Writing

Advantages:

- Spontaneous – requires little preparation by teacher.
- Takes little class time to complete.
- Very easy to evaluate, produces effort or participation grade.
- Provides opportunity for all students to stop and think, to review prior knowledge, and to develop questions.
- When used before instruction, provides opportunity for teacher to assess student knowledge and make decisions about what to teach.
- Special advantage to quiet, less verbal students.
- Promotes writing fluency.

Disadvantages:

- Does not directly improve specific writing skills (sentence variety, organization, word choice, etc.).
Advantages and Disadvantages of Type Two Writing

Advantages:

- Spontaneous – requires little preparation by teacher.

- Quick assessment of student knowledge resulting in quiz grade.

- Promotes active learning by requiring student to produce information rather than simply identify information produced by others (e.g., objective test)

- Promotes content-rich writing.

- Promotes writing fluency.

Disadvantages:

- Does not directly improve specific writing skills (sentence variety, organization, word choice, etc.).
Quick Write: Type One Example

Word Splash

Tell me everything you know about these words:

- Observation
- Inference
- Variable
- Control

Quick Write: Type Two Examples

Who did the variable effect the dissolving candy?

What were three of the most important points from today’s class discussion?
Type One Writing

✓ Quick write
✓ Generating ideas
✓ Getting those ideas on paper
✓ No right or wrong answer
✓ Self edit
✓ Minimum number of lines written
✓ Time limit
✓ Keep writing until time is up
✓ Checked for writing minimum number of lines
Type Two Writing

✓ Quick write
✓ Writing that shows you know something about the topic given
✓ Correct answer to a specific question
✓ Graded as a quiz
✓ Can have a minimum number of lines written
✓ Should include vocabulary that applies to the given topic
Exit ticket and Quick write forms for your students.

YOUR “KEY” OUT

Name: _________________________________    Date: ____________________

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SCIENCE Exit Ticket

Name ___________________________ Date ________________

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Bonus

______________________________________________

Name ___________________________ Date ________________

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Bonus
Graph Title: ____________________________________________

CONCLUSION

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
1 centimeter grid
## Index Graphic Organizers

### Benefits of graphic organizers
- Focus attention on key elements
- Help integrate prior knowledge with new knowledge
- Enhance concept development
- Enrich reading, writing and thinking
- Aid writing by supporting planning and revision
- Promote focused discussion
- Assist instructional planning
- Serve as assessment and evaluation tool

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### Websites for other Graphic Organizers

Compare/Contrast

Comparison/Contrast is used to show similarities and differences.

Key frame questions: What are being compared? How are they similar? How are they different?

Clustering

Clustering is a nonlinear activity that generates ideas, images and feelings around a stimulus word. As students cluster, their thoughts tumble out, enlarging their word bank for writing and often enabling them to see patterns in their ideas. Clustering may be a class or individual activity.
Chain of Events

Chain of Events is used to describe the stages of an event, the actions of character or the steps in a procedure.

Key questions: What is the first step in the procedure or initiating event? What are the next stages or steps? How does one event lead to one another? What is the final outcome?

**Series of Events Chain**

Initiating Event

```
Event 1
  ↓
Event 2
  ↓
Final Event
  ↓
Event 3
```

Continuum

Continuum is used for time lines showing historical events, ages (grade levels in school), degrees of something (weight), shades of meaning, or rating scales (achievement in school).

Key frame questions: What is being scaled? What are the end points or extremes?

**THE BLOGGING CONTINUUM**

1. Posting class work (Not blogging)
2. Blogging (Not blogging)
3. Descriptive information with links (Not blogging)
4. Analysis with links that give context to the discussion (Simple blogging)
5. Reflections, metacognitive writing and/or summarizing (Simple blogging)
6. Analysis and reflection, including links to a particular subject, audience in mind (Moderate blogging)
7. Design, synthesis, connecting previous posts, links and comments (Complex blogging)
Cycle

A depiction of a Cycle attempts to show how a series of events interacts to produce a set of results again and again, such as the life cycle or a cycle of poor decisions.

Key frame questions: What are the main events in the cycle? How do they interact and return to the beginning again?

Problem/Solution

Problem/Solution requires student to identify a problem and consider multiple solutions and possible results.

Who

Problem

What

Why

Solution

Attempted Solutions

1.

2.

Results

1.

2.

End Results
**Prior Knowledge Topic Survey**

**Anticipation/Reaction Guide**

*Instruction: Respond to each statement twice: once before the lesson and again after reading it.*

- Write A if you agree with the statement
- Write B if you disagree with the statement

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Fishbone Mapping

A Fishbone Map is used to show the causal interaction of a complex event (an election, a nuclear explosion) or a complex phenomenon (juvenile delinquency, learning disabilities, etc)

Key frame question: What are the factors that cause X? How do they interrelate? Are the factors that cause X the same as those that cause X to persist?

K-W-L-H Technique

The K-W-L-H teaching techniques is a good method to help students activate prior knowledge. It is a group instruction activity developed by Donna Ogle (1986) that serves as a model for active thinking during reading.

K- Stands for helping students recall what they know about the topic
W- Stands for helping student determine what they want to learn.
L – Stands for helping students identify what they learn as they read.
H- Stands or how we can learn more (other sources were additional information on the topic can be found).

Students complete the “categories” section at the bottom of the graphic organizer b asking themselves what each statement in the “L” section (What We Learned) describes.

They use these categories and the information in the “H” section (How Can We Learn More) to learn more about the topic. Students also can use the categories to create additional graphic organizers. They can use the organizers to review and write about what they’ve learned.