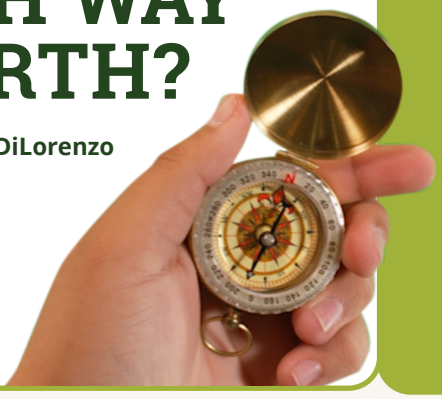
Into the Outdoors

Educational Partners:

WHICH WAY IS NORTH?

Teacher: Christina DiLorenzo



GRADE LEVEL: Upper middle or high school
TIMEFRAME: 2-3 lessons
MATERIALS:

- **Computer access for research and presentation, poster paper**
- **Compass or pictures of a compass**
- **Maps**
- **Bowl of water**
- **Strong magnet**
- **Styrofoam peanuts**

Key Words: Navigation, magnetic field, compass, magnetism, cardinal directions, magnetic declination, True North, Magnetic North, degrees

ACTIVITY SUMMARY

In this lesson, students will explore how to read a compass, the challenges of using a compass and a scenario of navigating using a compass.

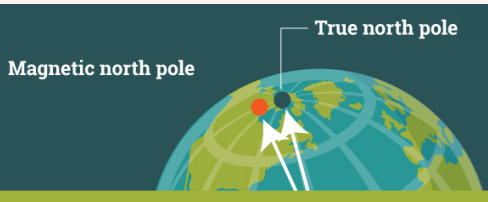
The lesson will begin with students

- The science of Earth's magnetic field
- Magnetism in general
- How a compass uses the Earth's magnetic field
- The difference between Magnetic North and True North and WHY they both exist
- The markings on a compass and what they mean (why north is 0/360 degrees, why is it measured in degrees, etc.)
- How to use a compass in a given scenario

LEARNING OBJECTIVES

Students will be able to:

- *Identify a compass, its uses, and explain how a compass works.*
- *Name the four cardinal directions, and use directions in navigation.*
- *Describe the connection between navigation technology (such as digital compasses) and scientific concepts such as magnetic declination.*



BACKGROUND INFORMATION:

Navigation is the act of accurately locating one's position on land, at sea, or in the air. When we are navigating on land we are able to use roads and landmarks to find our way. When we are navigating in the open seas or air additional tools are necessary. The compass is a tool used for navigation, location and direction. People use it to find their way, whether hiking a trail, in a new location, or navigating in the open ocean. It contains a magnet that aligns itself with the North Pole to indicate direction. Its relevance persists today, aiding waterway travel, aviation, shipping, outdoor recreation, travel and technology.

The science behind the compass is relatively basic, using The Earth's natural magnetic field. The Earth's magnetic field has a shape like a strong bar magnet placed near the center of the Earth with its S pole near the north geographic pole and its N pole near the south geographic pole. The Earth's magnetic field, which is three-dimensional, is inclined at about 11 degrees from its axis of rotation. A compass is composed of a suspended magnetic pointer that is attracted to the polarity of the North Pole. It can rotate freely. A compass points in a direction that lies along the magnetic field at the point. There is also a component of the magnetic field perpendicular to the surface of the Earth.

The compass is a precisely measured scale used to mark the directions, relative to the north. Through a slight left or right turn, a compass will accurately point to the North Pole and identify the angles of the other cardinal directions. Cardinal directions are directions that people around the world use. The four cardinal directions are north, south, east and west. These directions use the rising and setting of the sun as reference points. True north is a fixed point on the globe. Magnetic north is quite different. Magnetic north is the direction that a compass needle points to as it aligns with the Earth's magnetic field. What is interestiang is that the magnetic North Pole shifts and changes over time in response to changes in the Earth's magnetic core. A compass needle will point to the Magnetic North Pole – which is different from the geographic north, so depending on where and when you are, the variation between True North and Magnetic North will be different. This variation is called magnetic declination. Topographic maps are drawn in relation to True North while compasses point to Magnetic North.

The compass looks similar to a clock but is number 0-360 to represent degrees. North is always represented as 0 or 360 degrees and the south is represented as 180 degrees. Degrees are the numeric designation of measurement to represent a circle (such as The Earth).

The compass is thought to have been originally designed in the second century in China, first used to align structural and building elements with the environment. The first compasses were lodestones—a naturally occurring magnetic ore—on small sticks placed in bowls of water. The simple device pointed to the pole star and was used for navigation by early mariners. Shortly after the first compasses were used, people discovered that an iron or steel needle that had been touched or rubbed with a lodestone would also align with the pole star.

In addition to navigation, the compass is a useful tool in building and construction for marking landmarks and borders, and to measure horizontal lines and vertical lines for maps. The compass is a valuable tool used in the U.S. military, as well as in mining to assist in underground navigation.

VOCABULARY:

CARDINAL DIRECTIONS- north, south, east and west.

MAGNETIC DECLINATION - the number of degrees between true north and magnetic north and whether they're to the east or west of true north.

TRUE NORTH - the physical north pole.

MAGNETIC NORTH - where the compass needle points. Controlled by the earth's magnetic field.

LEARNING PROCEDURE:

Instructor will say:
"Have you ever had to go somewhere that you didn't know how to get to? How did you find your way?"

Allow students time to answer aloud and list answers on the board or paper. Ask students follow up questions:

- What would you do if you were using phone GPS and your phone battery died?
- How would you use landmarks if you are unfamiliar with the area?
- If you are unable to use landmark navigation for getting around, how else could you navigate the wilderness, the waters, or an unfamiliar city?
- Why aren't you able to use landmark navigation in unknown areas like you would in familiar surroundings?

Show students a compass or picture of a compass and ask students:

"For what purpose is a compass used?" (Possible answers: To find an unknown location, to measure an object's location.)
"Who has used a compass before?"

Pair students and have them explore the compass (or picture) and brainstorm "How do you think this device will help you find your way?" Students will share their answers aloud.
We will learn how navigating with a compass is different from navigating with a map, or even your GPS.

ACTIVITY 1:

1. Provide pairs or groups of students with a compass. First let students explore the compass to try to determine how to use it for navigation. Ask students: "How does this help you find your way?"
2. What if you knew you needed to head north to get to a relative's house, but you do not know which way is north? How would you proceed? (Possible answers: Look at where you are going, use a map, use a compass.)
3. How does a compass locate directions? (Answer: A compass indicates the magnetic field on the surface of the Earth and determines the direction.) A compass is an excellent way to determine how to move in the direction you need to go.
4. Next, review cardinal directions by giving students a direction and have them find the direction using the compass. Ex.: Walk South
5. Have students practice using the compass to determine various directions. Ex. "When walking to the back of the classroom, which direction are you walking in? When heading towards the tree, which direction are you headed?"
6. Ask students: "How does it work? (Answer: A compass works by using the Earth's magnetic north pole and directional pulls to determine north, south, east and west directions.) Usually, we find locations using landmark navigation.
7. Find the Teacher Activity:
   - Divide the class into groups of two or more students each; the smaller the group, the better. Give each group one (or more, if available) compass.
   - Give students a few minutes to determine which direction the needle is pointing on their compass.
   - Instruct and demonstrate for students how to find a bearing on a compass - This tells you what direction (or bearing) you are facing or what direction a place is, such as a mountain or a tree. This skill is essential to anything one might do with a compass.
     1. Face an object, perhaps a tree, to which you want to know the direction.
     2. Open up your compass (if it opens), and rest it against your belly or belt, facing straight ahead of you.
     3. Rotate the rotating dial until the red end of the compass needle lies between the red arrow facing north.
     4. Read the bearing from the compass. Looking at the compass, this should be the number on the dial that is facing the front of the compass. Usually the compass has a little tick mark or might even say "READ
   - Give students 5 minutes to take a bearing. When they are done, ask them to verify what they have just done. (Answer: They took a bearing.) What is a bearing? (Answer: The direction of some object relative to them.) Have students explain how to find a bearing.
   - FIND THE TEACHER Next, give students 5 minutes to find the bearing of the teacher.
   - Have students compare their answers with other groups. If any answers are different from other groups, ask them why. (Answer: Because the bearing of an object is dependent on the location from which they took the bearing!)

8. Direct the group of students to line up in the front of the classroom. Then have the rest of the class shout out directions for the "compass" to point. After doing this with a few groups of different students, lead a class discussion asking students to share their observations on why or why not it was easy to determine directions.

ACTIVITY 2:

"What do we know about compasses?" List ideas on the board.

Pass out compasses to students. Ask students to review: "Why do you think your compass works? What do you think makes the needle move? What are the parts of your compass?" Add to the list on the board.

Ask: "How do compasses work? Do you think we can design a compass of our own?"
Today, you are going to make a simple compass that really works, one that you can make at home or use in an emergency situation.(Compasses can be created by first filling a petri dish with water, and then adding a steel or iron nail which has been stroked with a magnet and pushed diagonally through the piece of Styrofoam. One end can be painted with the red nail polish to distinguish north from south.)

1. Provide students with the materials outlined in the materials section (magnets, flat pieces of Styrofoam, pins, plastic petri dishes, and Ziploc bags filled with iron fillings) to create their own compasses.
2. Demonstrate and direct groups to make an X in the center of the outside bottom of the plastic bowl using electrical tape. Use the tape to determine the four cardinal directions.
3. Fill the bowl with enough water (about halfway) so the compass "needle" will be able to move freely.
4. Magnetize the needle (a pin) by rubbing it two dozen times with the magnet.
5. Stick the compass needle (pin) through the center of a packing peanut (the best way to do this is to crush the peanut into a small ball, and stick the pin or needle through the middle. It is okay if only a small bit of the needle is covered by the peanut since the peanut is only necessary as a floatation device for the needle). In some circumstances, more than one packing peanut may be needed.
5. Place the needle/peanut assembly into the bowl of water. What happens? (Answer: Expect the magnetized needle to rotate to be oriented north/south. Verify its orientation with a commercial compass.)
6. Now have students walk around the room with the compasses they made. What happens to the compass needle as you move about the room? (Answer: Expect it to rotate so that it always points north/south.)
7. Class discussion. "Why does the needle point to magnetic north until we bring it close to an iron or steel object?" In our experiment, the Earth's magnetic field is very strong compared to the magnetic field of the iron or steel object, so the Earth's field dictates the direction of the needle in most cases. However, the Earth's magnetic pole is far away, so when the needle is brought close to the iron or steel object, the field of that object dominates, since the needle and the object are in close proximity.

9. Additionally students can compare their compass readings to a real compass to see how accurate their compass is.
10. Take students outside the classroom, to a playground or front of school. Have them use their compass at several directional locations to find magnetic north. Once they have located north, ask them to separate and stand in various locations around the playground with their compasses flat in the palms of their hands. Have them all face the direction their red compass arrow is pointing. Expect them to notice that no matter where on the playground they are standing, they are all be facing the same direction.
11. Extension: Have students research the different types of compasses (that is, thumb compass, map compass, etc.) and their general uses. They should design and draw their own compass. Have students share and compare their research. he gallery walk should share their learning with the student who acted as the project representative.

ACTIVITY 3:

(Independent or team project)

Have a student pair create a treasure hunt by listing compass readings and distances from a starting point. For example: Starting at desk, walk 3 steps to the west. Next go south 4 steps. Then have another student pair try to follow those directions to find a secret treasure.

SCAVENGER HUNT MISSION

You are tasked to use a compass to create a scavenger hunt for one of your classmates to complete.

You must:	***Check!***
Have at least 10 directions for your classmate to go to.	
Place an item for them to find at the end of your hunt.	
Use all cardinal directions: North, East, South, West in your hunt.	
Include details of how far that person should go in that direction in order to move on.	

After you are finished with your mission to make sure to ask your classmates these questions (record answers on a separate piece of paper):

1. Was it hard or easy to complete?
2. Was it engaging and fun?
3. What can I do next time to make it more engaging?

Related Links
(3-5 links to partner sites or related educational content)

https://education.nationalgeographic.org/resource/compass/

https://www.nationalgeographic.com/podcasts/overheard/article/she-sails-the-seas-without-maps-or-compasses

https://mass.pbslearningmedia.org/resource/phy03.sci.phys.matter.zorient/using-a-compass-to-find-your-way/

Educational Standards

CCSS.ELA-LITERACY.RI.7.1	Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.W.7.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant con tent.
CCSS.ELA-LITERACY.W.7.1.B	Support claim(s) with logical reasoning and relevant evidence, using accurate, cred ible sources and demonstrating an understanding of the topic or text.
CCSS.ELA-LITERACY.W.7.1.C	Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), reasons, and evidence.
CCSS.ELA-LITERACY.W.7.2.D	Use precise language and domain-specific vocabulary to inform about or explain the topic.
CCSS.ELA-LITERACY.W.7.2.E	Establish and maintain a formal style.
CCSS.ELA-LITERACY.RI.7.1	Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
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CCSS.ELA-LITERACY.W.7.2.E	Establish and maintain a formal style.
CCSS.ELA-LITERACY.W.7.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.SL.7.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
CCSS.ELA-LITERACY.SL.7.1.C	Pose questions that elicit elaboration and respond to others' questions and com ments with relevant observations and ideas that bring the discussion back on topic as needed.
CCSS.ELA-LITERACY.SL.7.1.D	Acknowledge new information expressed by others and, when warranted, modify their own views.

8th Grade

Key Ideas and Details:

CCSS.ELA-LITERACY.RI.8.1	Cite the textual evidence that most strongly supports an analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.RI.8.2	Determine a central idea of a text and analyze its development over the course of the text, including its relationship to supporting ideas; provide an objective summary of the text.
CCSS.ELA-LITERACY.W.8.1.A	Introduce claim(s), acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
CCSS.ELA-LITERACY.W.8.1.B	Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.
CCSS.ELA-LITERACY.W.8.1.C	Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
CCSS.ELA-LITERACY.W.8.2	Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, **organization, and analysis of relevant con tent.**
CCSS.ELA-LITERACY.W.8.2.A	Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
CCSS.ELA-LITERACY.W.8.2.B	Develop the topic with relevant, well-chosen facts, definitions, concrete details, quota tions, or other information and examples.
CCSS.ELA-LITERACY.W.8.2.C	Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.
CCSS.ELA-LITERACY.W.8.2.D	Use precise language and domain-specific vocabulary to inform about or explain the topic.
CCSS.ELA-LITERACY.W.8.2.E	Establish and maintain a formal style.
CCSS.ELA-LITERACY.W.8.2.F	Provide a concluding statement or section that follows from and supports the infor mation or explanation presented.
CCSS.ELA-LITERACY.W.8.3	Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.
CCSS.ELA-LITERACY.W.8.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.SL.8.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

CCSS.ELA-LITERACY.W.8.7	Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
CCSS.ELA-LITERACY.SL.8.1.A	Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or is sue to probe and reflect on ideas under discussion.
CCSS.ELA-LITERACY.SL.8.1.C	Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.
CCSS.ELA-LITERACY.SL.8.1.D	Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.

9-10th Grades

CCSS.ELA-LITERACY.RI.9-10.1	Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
CCSS.ELA-LITERACY.RI.9-10.2	Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.
CCSS.ELA-LITERACY.W.9-10.1	Write arguments to support claims in an analysis of substantive topics or texts, us ing valid reasoning and relevant and sufficient evidence.
CCSS.ELA-LITERACY.W.9-10.1.A	Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among claim(s), counterclaims, reasons, and evidence.
CCSS.ELA-LITERACY.W.9-10.1.B	Develop claim(s) and counterclaims fairly, supplying evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level and concerns.
CCSS.ELA-LITERACY.W.9-10.1.C	Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reas ons and evidence, and between claim(s) and counterclaims.
CCSS.ELA-LITERACY.W.9-10.1.D	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
CCSS.ELA-LITERACY.W.9-10.1.E	Provide a concluding statement or section that follows from and supports the argu ment presented.
CCSS.ELA-LITERACY.W.9-10.2	Write informative/explanatory texts to examine and convey complex ideas, con cepts, and information clearly and accurately through the effective selection, orga nization, and analysis of content.

CCSS.ELA-LITERACY.W.9-10.2.A	Introduce a topic; organize complex ideas, concepts, and information to make im portant connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
CCSS.ELA-LITERACY.W.9-10.2.B	Develop the topic with well-chosen, relevant, and sufficient facts, extended defini tions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
CCSS.ELA-LITERACY.W.9-10.2.C	Use appropriate and varied transitions to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts.
CCSS.ELA-LITERACY.W.9-10.2.D	Use precise language and domain-specific vocabulary to manage the complexity of the topic.
CCSS.ELA-LITERACY.W.9-10.2.E	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
CCSS.ELA-LITERACY.W.9-10.2.F	Provide a concluding statement or section that follows from and supports the infor mation or explanation presented (e.g., articulating implications or the significance of the topic).
CCSS.ELA-LITERACY.W.9-10.3	Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.
CCSS.ELA-LITERACY.W.9-10.4	Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
CCSS.ELA-LITERACY.SL.9-10.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persua sively.
CCSS.ELA-LITERACY.SL.9-10.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.
CCSS.ELA-LITERACY.SL.9-10.1.C	Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
CCSS.ELA-LITERACY.SL.9-10.1.D	Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and unders tanding and make new connections in light of the evidence and reasoning presented.
CCSS.ELA-LITERACY.W.9-10.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

11-12th Grades

CCSS.ELA-LITERACY.RI.11-12.1	Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text, including determining where the text leaves matters uncertain.
CCSS.ELA-LITERACY.RI.11-12.2	Determine two or more central ideas of a text and analyze their development over the course of the text, including how they interact and build on one another to pro vide a complex analysis; provide an objective summary of the text.
CCSS.ELA-LITERACY.W.11-12.1	Write arguments to support claims in an analysis of substantive topics or texts, us ing valid reasoning and relevant and sufficient evidence.
CCSS.ELA-LITERACY.W.11-12.1.A	Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organiza tion that logically sequences claim(s), counterclaims, reasons, and evidence.
CCSS.ELA-LITERACY.W.11-12.1.B	Develop claim(s) and counterclaims fairly and thoroughly, supplying the most r elevant evidence for each while pointing out the strengths and limitations of both in a manner that anticipates the audience's knowledge level, concerns, values, and possible biases.
CCSS.ELA-LITERACY.W.11-12.1.C	Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and rea sons, between reasons and evidence, and between claim(s) and counterclaims.
CCSS.ELA-LITERACY.W.11-12.1.D	Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
CCSS.ELA-LITERACY.W.11-12.1.E	Provide a concluding statement or section that follows from and supports the argu ment presented.
CCSS.ELA-LITERACY.W.11-12.2	Write informative/explanatory texts to examine and convey complex ideas, con cepts, and information clearly and accurately through the effective selection, orga nization, and analysis of content.
CCSS.ELA-LITERACY.W.11-12.2.A	Introduce a topic; organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
CCSS.ELA-LITERACY.W.11-12.2.B	Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and ex amples appropriate to the audience's knowledge of the topic.
CCSS.ELA-LITERACY.W.11-12.2.C	Use appropriate and varied transitions and syntax to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and con cepts.

CCSS.ELA-LITERACY.W.11-12.2.D Use precise language, domain-specific vocabulary, and techniques such as meta phor, simile, and analogy to manage the complexity of the topic.

CCSS.ELA-LITERACY.W.11-12.2.E Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.

CCSS.ELA-LITERACY.W.11-12.2.F Provide a concluding statement or section that follows from and supports the infor mation or explanation presented (e.g., articulating implications or the significance of the topic).

CCSS.ELA-LITERACY.W.11-12.3 Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

CCSS.ELA-LITERACY.W.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-LITERACY.W.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the in quiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

CCSS.ELA-LITERACY.SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persua sively.

CCSS.ELA-LITERACY.SL.11-12.1.A Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well-reasoned exchange of ideas.

CCSS.ELA-LITERACY.SL.11-12.1.C Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and cre ative perspectives.

CCSS.ELA-LITERACY.SL.11-12.1.D Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; an determine what additional information or research is required to deepen the investi gation or complete the task.

MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact. (Grades 6 - 8)