

THE EFFECTS OF IMPLEMENTING STRATEGIC VOCABULARY ACTIVITIES
AND WRITING ACTIVITIES WITH REASONING STRATEGIES ON STUDENT
UNDERSTANDING OF EIGHTH GRADE EARTH SCIENCE CONCEPTS

by

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ABSTRACT

Research has shown there is a connection between vocabulary knowledge and student comprehension, though using vocabulary in constructed response questions often reveals a lack of understanding. This study examined the effect of implementing strategic vocabulary and writing activities with reasoning strategies based on the Universal Intellectual Standards to improve student comprehension of eighth grade earth science concepts. While resistance was encountered with implementation, valuable lessons were learned regarding future work in this area.

INTRODUCTION AND BACKGROUND

As a teacher of eighth grade Earth Science classes, it became evident that students struggled with written explanations of concepts they had learned. While they could explain ideas about the Earth system using hand gestures and creative wording, they struggled to recognize scientific terms when encountered in homework, assignments, or tests and to explain their understanding through short answers, brief essay responses, or longer writing assignments.

The middle school I worked in served grades 6-8. During the 2013-2014 school year, the school had 43.7% of students meeting or exceeding statewide performance guidelines. This is significantly lower than the statewide average of 66.9% and a sizeable drop from 54.5% of students who met or exceeded the state's performance guidelines during the 2013-2014 school year. Male students performed slightly better than the female students with 45.1% of male students and 41.7% of female students meeting the state guidelines (Report Card Download, 2014).

I identified two main areas that needed additional focus and could help students improve: vocabulary knowledge and writing skills. I also wanted to investigate the use of Universal Intellectual Standards, which refer to a list of ideals to measure one's reasoning against as published by Elder and Paul (2010), as a tool to improve students' critical thinking. These standards include evaluating ideas for clarity, accuracy, precision, relevance, depth, breadth, logic, and fairness. From there I wanted to understand how students felt about their learning as a result of the implemented activities. These thoughts helped me to frame my capstone project questions.

The focus question for my project was, “What are the effects of implementing a strategic vocabulary activity to the beginning of each unit and using written activities based upon the Universal Intellectual Standards reasoning strategies with the words throughout the unit on student understanding of middle school Earth Science concepts?” My project sub-questions were as follows: 1) What are the effects of strategic vocabulary and writing activities with reasoning strategies on students’ written explanations?; 2) What are the effects of using targeted vocabulary and writing activities with reasoning strategies on students’ perception of their understanding of concepts?; 3) What are the effects of using targeted vocabulary and writing activities with reasoning strategies on students’ perception of their ability to explain what they know?; and 4) What are the effects of implementing strategic vocabulary and writing activities with reasoning strategies on a teacher’s perception of teaching effectiveness and professionalism?

The ability to communicate effectively, through both oral and written means, is a skill that will benefit students throughout their lives. Regardless of career choice or future academic endeavors, the ability to understand new concepts and express themselves clearly will best prepare them for success in whatever capacity they find themselves. Implementing vocabulary and writing activities with reasoning strategies will train students to critically assess their understanding and express themselves clearly. This benefits the students by helping them form a solid understanding about concepts, providing the tools to express what they know, and helping them evaluate information they encounter outside of class. This is consistent with the district vision of having “every student a graduate prepared for a bright and successful future (About Us).”

The school in which this project was implemented is located in Springfield, OR and has an enrollment of 650 students. During the 2013-2014 school year, the school earned an overall state rating placing it between 15% and 44% of schools in the state in terms of academic success. More than 95% of students attend 90% or more school days and English language learners make up less than 5% of the student population. Of the student body, 44% are considered economically disadvantaged and roughly 10% have disabilities. There are two first languages spoken at this school, English and Spanish. The school's performance in science is 23.2% below state average for female students and 23.7% below state average for male students (Report Card Download, 2014). The school utilizes flexible enrichment/intervention class periods to target students who need additional help or enrichment in particular subjects.

The support team for my project consisted of Marci Rigby, a friend and former English teacher, and Emily Lamas, an undergraduate geology professor, who served as readers for my paper and offered invaluable suggestions for clarity; Committee Chair, Dr. Peggy Taylor, Montana State University Master of Science in Science Education (MSSE) Program Director; MSSE Capstone Advisor, Dr. Jewel Reuter; and MSSE Science Reader, Joe Bradshaw.

CONCEPTUAL FRAMEWORK

Research has shown that there is a very real connection between vocabulary knowledge and a student's comprehension and understanding (Misulis, 2011; Flanigan, Templeton, & Hayes, 2012). Vocabulary instruction is a key part of scientific curriculum (Cox, Jackson, & Tripp, 2011), and such instruction is usually approached having

students look up terms and copy definitions. Students often dread this task because it is neither fun nor educationally valuable (Pries & Hughes, 2012).

In a study conducted by Pries and Hughes (2012) with eighth-grade science students, groups of students rotated through various stations at two to five minute intervals. Each station had a word bank and objects, which demonstrated one or more of the new terms. Using a worksheet with separate sections for each station, students answered questions about the objects at each station. Students were encouraged to play with the provided objects and answer the worksheet based upon their prior knowledge. After rotating through all the stations, students had a group discussion about their observations as the teacher guided students to correct definitions for each term. Pries and Hughes found that encouraging students to play encouraged them to think more critically about the object and allowed for correcting preexisting misconceptions. According to Pries and Hughes (2012, p.67), “by trying to relate familiar objects to scientific terms, students begin to construct learning pathways to the new word.”

Based upon the constructivist theory of learning, learning something new requires us to reconcile it with our preexisting knowledge modifying what we believe or discarding information that is no longer relevant (Murphy, 1997). As students acquire new vocabulary they are changing their knowledge framework and setting the stage for increased understanding of unit concepts. In order to solidify new knowledge, vocabulary should be utilized frequently and in multiple applications, as understanding is achieved through regular opportunities to reinforce meaning (Misulis, 2011).

Once students understand the relevant vocabulary, it is easy to assume that they also understand the concepts well and are able to explain it in their own words. Often, constructed response questions reveal a lack of concept understanding (Yule, Wolf, & Young, 2010). Written assignments are, therefore, quite valuable in assessing students' true level of comprehension. It is important to emphasize tasks that require higher-order thinking skills and encourage creative reasoning strategies so that students have the chance to explore their own thinking and understand the content more thoroughly (Misulis, 2011). Research has shown that writing allows students to both reflect on existing knowledge and enables them to further develop new understandings (Yore, Hand, & Prain, 1999).

Some teachers in other schools have noticed an increase in the quality of students' science writing when implementing a foundation in the Universal Intellectual Standards published by Elder and Paul (2010) as indicated in a publication by Allen (2007). Through emphasis on writing skills, an environment can be created that fosters critical thinking and construction of important science concepts, and encourages students to challenge their own misconceptions (Baker et al., 2008). As teachers consistently implement writing activities, they demonstrate to students that writing is the norm in science (Baker et al., 2008), while effective writing instruction encourages students' motivation and engagement (Zumbrunn & Krause, 2012).

A study by Ulusoy and Dedeoglu (2011) that gathered data from 143 teachers of grades 1-8 in the middle Anatolian cities of Turkey found that while most teachers feel that content writing skills are necessary, very few feel qualified to teach them. While

more than half of the science teachers included in the study did not accept responsibility in teaching students writing due to time limitation, overloaded curricula, and lack of qualification, interview results showed that science teachers instead placed more emphasis on student comprehension. Despite not placing emphasis on writing skills in class, science teachers collectively expressed the feeling that all teachers have some responsibility to prepare students as good readers.

With an emphasis on clarity, accuracy, and relevance, among other things, teaching writing with a foundation in the Universal Intellectual Standards encourages students to become more self-directed, self-disciplined, self-monitored thinkers (Elder & Paul, 2010). A study by Van de Poel and Gasiorek (2012) with first and second year Flemish university students for whom English was a foreign language found that targeted writing strategies including talking about writing, providing feedback, peer review, and opportunity for practice dramatically increased students' self-reported perceptions of their effectiveness as academic writers. Over the course of the first year student writing assignments gradually increased in difficulty. Student feedback indicated that while students perceived the assignments as more difficult over time, they did not find them to be more frustrating. The results of Van de Poel and Gasiorek (2012) suggest that a writing program designed to teach relevant skills through hands-on experience might significantly increase students' self-efficacy as writers.

The impact on teachers who implement vocabulary and writing activities with reasoning strategies seems to be as varied as the teachers themselves. A qualitative study by Zumbrunn & Krause (2012) gathered data from seven experts in the field of writing,

as nominated by their peers, in order to determine what they felt were the most important methods of writing. The scholars agreed that writing teachers need to feel confident and prepared to teach writing effectively, which will allow them to be good role models of writing. It stands to reason then that teachers with high self-efficacy in writing will likely feel an increased sense of professionalism and effectiveness through inclusion of writing strategies in their classroom.

Clearly teachers have found a connection between a students' vocabulary knowledge and the use of writing to aid student comprehension of science topics. Science concepts cannot be adequately explained without proper vocabulary and written work can uncover the true level of a student's conceptual understanding. By focusing on these two areas students should be able to gain a more thorough content knowledge and be able to explain it more fully. Even though teachers generally acknowledge that emphasis on writing benefits the students, most feel unqualified to do so without formal training in writing education.

METHODOLOGY

Project Treatment

This project included both treatment and nontreatment units. The nontreatment unit covered the topic of Earth's atmosphere. During this unit vocabulary was taught through guided note taking as had been customary this school year. Two treatment units were then conducted on the subjects of Weather and Oceans. These units included targeted vocabulary activities and the introduction of the Universal Intellectual Standards to guide student writing. Using the standards, students evaluated their own work as well

as that of their peers. Students were given greater writing opportunities in the form of journal prompts, peer review, and written response questions on summative assessments. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

Prior to beginning the nontreatment unit, students completed a pretest covering key points from the nontreatment and treatment units. This pretest is included as Appendix A. During the nontreatment unit on Earth's atmosphere, students were introduced to the topic by filling in a guided note sheet from a combination of direct lecture and a PowerPoint presentation. The guided note sheet is included as Appendix B. After completing the guided notes, students observed demonstrations related to density, convection, and air having weight. Students then completed a virtual atmosphere lab to help further their understanding of altitude, density, and phenomena at varying altitudes (Appendix C). Next, students selected an article related to the atmosphere to read and completed an article review using a prepared form, included here as Appendix D. The second week of the unit included completing a mini-lab on forms of heat transfer (Appendix E), and a pencil and paper unit test (Appendix F).

The first treatment unit was on weather. At the very beginning of the unit, the Universal Intellectual Standards (Elder & Paul, 2010) were presented as a framework for students' written responses. A simplified version of the standards used for student writing evaluation is included in Appendix G. Students were given a short science question and answer statement to read and evaluate based upon the Universal Intellectual Standards.

The selection was found in an online discussion forum and chosen specifically to be an example of poor writing (Appendix H). After all students had evaluated the article we held a class discussion about how the response could have been improved based upon the Universal Intellectual Standards. At that point students were given an example of good science writing (Hickey, 2015 and Erdman, 2015) and asked to evaluate it against the same standards using a provided response sheet (Appendix I).

Students then used the Frayer Model in teams of 3-4 to learn pertinent vocabulary terms. In the Frayer Model, students work in small groups with each group defining one new vocabulary word. For each word, groups defined the term in their own words, provided examples, identified what the term is not, and described characteristics of the term. Students also provided a visual representation on the back of the page to help them remember the term. Students were expected to draw their own visual rather than use a computer image as I felt they were more likely to remember an image they generated on their own. Students used a form I created to log their definitions using this model. This form can be found in Appendix J. One person from each team then acted as a presenter and shared what they learned about the term with the rest of the class. As vocabulary items were shared, I helped them identify word parts to increase understanding of language morphology. Throughout the unit, students utilized a notebook to journal their experiences based on provided journal prompts. These journal prompts can be found in Appendix K.

It quickly became evident students were unfamiliar with basic concept of the water cycle so the unit was modified to include a water cycle model from NOAA

(Learning Lesson, 2014), a video from NASA discussing the water cycle (Meet Molecule Max, 2007), and a demonstration on how the water cycle works in order to aid student understanding. At the completion of the unit students completed a pencil and paper test (Appendix L).

The second treatment unit covered the topic of Earth's oceans. Students are familiar with ocean basics living an hour from the Oregon coast, so the unit began with a discussion of ocean circulation. Students observed a demonstration of movement based on density differences in either temperature or salinity and took guided notes. Students then diagrammed in their notes the parts of a wave and how water moves below the surface to create waves. Students then performed "the wave" in class in order to further understand the concept of wave energy moving primarily up and down rather than back and forth. Students also diagrammed the alignment of the Sun, Moon, and Earth that contributes to spring and neap tides as well as acting out the bulging of ocean water in response to the Moons gravity. To do this students formed a circle outside to represent the water on the surface of the Earth. One student acted as the Moon and "orbited" the rest of the class by running around the circle. As the Moon passed, students were to move to represent the bulge of water that forms in either the spring or neap tide, dependent on the position of the moon relative to the sun. Students then read an article of their choosing on oceans and evaluated it using the same article evaluation form from the previous treatment unit. Following the article review students once again used the Frayer Model to clarify the meaning of key vocabulary terms. Students created a poster to

review basic concepts about oceans in preparation for the unit test (Appendix M) and completed a brief pencil and paper quiz (Appendix N).

Two weeks after the unit on oceans was complete, which was the final treatment unit, students completed a delayed assessment (Appendix O) to allow insight into student content retention. In each treatment unit students used the Frayer Model to learn pertinent terms, writing activities using the terms, a starter question asking them to define the term, or a question requiring them to apply knowledge of the term throughout the unit. These tasks were completed as journal item, daily starters, or exit slips.

The Frayer Model was used to teach vocabulary in an effort to provide students the opportunity to construct term meaning and develop a visual. It was hoped that this broad look at each term would help alleviate misconceptions and aid retention. It was hypothesized that using the terms frequently would help to solidify student understanding, comprehension, and retention.

Data Collection Instruments

To gather data on the effectiveness of my teaching strategies I developed a triangulation matrix included as Table 1. The matrix utilized several assessment strategies including student journals, pre and postunit assessments, student surveys, and interviews. The student surveys, pre and postunit assessments and journal entries were completed using either students' science notebooks or printed forms provided to the students. Since not all data collected for this project was relevant to the students' grades, I used a spreadsheet to track data such as pre and postunit performance, general attitude changes, and student interview responses.

Table 1
Data Triangulation Matrix

Focus Question	Data Source 1	Data Source 2	Data Source 3
What are the effects of implementing a strategic vocabulary activity to the beginning of each unit and using written activities based upon the Universal Intellectual Standards reasoning strategies with words throughout the unit on student understanding of science concepts?	Pre and postunit assessment	Pre and posttreatment student surveys	Pre and postunit Student interviews
<i>Subquestions:</i> What are the effects of strategic vocabulary and writing activities with reasoning strategies on students written explanations?	Student peer review	Unit assessment essay question	Student science journals
What are the effects of using targeted vocabulary and writing activities with reasoning strategies on students' perception of their understanding of concepts?	Exit Slips	Pre and postunit interviews	Student science journals
What are the effects of using targeted vocabulary and writing activities with reasoning strategies on students' perception of their ability to explain what they know?	Pre and postunit Student surveys	Pre and postunit interviews	Student science journals
What are the effects of implementing strategic vocabulary and writing activities with reasoning strategies on a teacher's perception of their effectiveness teaching the unit and their professionalism?	Pre and postunit teacher surveys	Weekly reflection journaling	Colleague observation

Student journals were a valuable source of data for this project, as were my own reflective journals, student interviews, and student surveys. Student interviews were conducted among six students representing three levels of academic achievement by previous performance; high, middle range, and low level performance. These ranges were easy to identify based on naturally occurring subdivisions among class grade percentage. The high performing students had average class grades consistently between 88-100%, the middle range were consistently in the 70-85% range, and the low level performing

students were below 65%. The gaps represent score ranges that no students occupied. Students were initially grouped into levels by class average grade over the previous term. From there I used consistent attendance and general attitude to select a couple students from each group to interview. I had narrowed it down to a few potential students in each group and selected the final students based on availability and willingness to participate. Interview questions can be found in Appendix F. To record student responses I took brief notes during the interview, such as which words they struggled with, which concepts were hardest for the student, and how they felt about the instructional methods during the treatment. At the completion of the both treatment units, students completed a survey to indicate their feelings about the effectiveness of the unit and how they felt about the newly included activities. The survey is included as Appendix V. By gathering data in multiple ways, I hoped to get a true look at how the treatment units affected student learning and retention.

The nontreatment unit took place weeks one and two, from March 31, 2015 to April 10, 2015 with the treatment units taking place weeks three through six, April 15 to May 5 and weeks seven and eight from May 6-15, as outlined in Table 2. The nontreatment unit spanned the end of one quarter and the beginning of another. The first treatment unit included three class days of standardized testing for math April 27-29, which led to a five day gap in science instruction in the middle of week four.

Table 2
Treatment and Nontreatment Unit Timeline

Project Timeline			
Unit	Topic	Dates	Week
Pretest	Atmosphere, Weather, and Oceans	March 30, 2015	Week 1
Nontreatment Unit	Atmosphere	March 31-April 10	Weeks 1-2
Treatment Unit 1	Weather	April 15 - May 5*	Weeks 3-6
Treatment Unit 2	Oceans	May 6 - May 15	Weeks 7-8
Posttest	Atmosphere, Weather, and Oceans	June 1, 2015	Week 10

Note. April 27-29 8th grade students did not attend science.

DATA AND ANALYSIS

On the project topic of “What are the effects of implementing a strategic vocabulary activity to the beginning of each unit and using written activities based upon the Universal Intellectual Standards reasoning strategies with words throughout the unit on student understanding of science concepts?”, the first source of data was a pre and post unit assessment. Within the three unit topics of atmosphere, weather, and oceans, students performed highest in the weather unit with an average score of 60% on the pretest, compared to 30% in each the atmosphere and ocean topic areas (Figure 1). The same questions were asked two weeks following the completion of the final unit to measure retention and students scored an average of 59% in the atmosphere nontreatment unit, 69% in the weather treatment unit, and 68% in the oceans treatment unit. The highest percentage of academic gain took place within the treatment oceans unit with the lowest percentage of academic gain taking place within the Weather and Climate

treatment unit. The nontreatment unit showed academic gains in between that of the two treatment units.

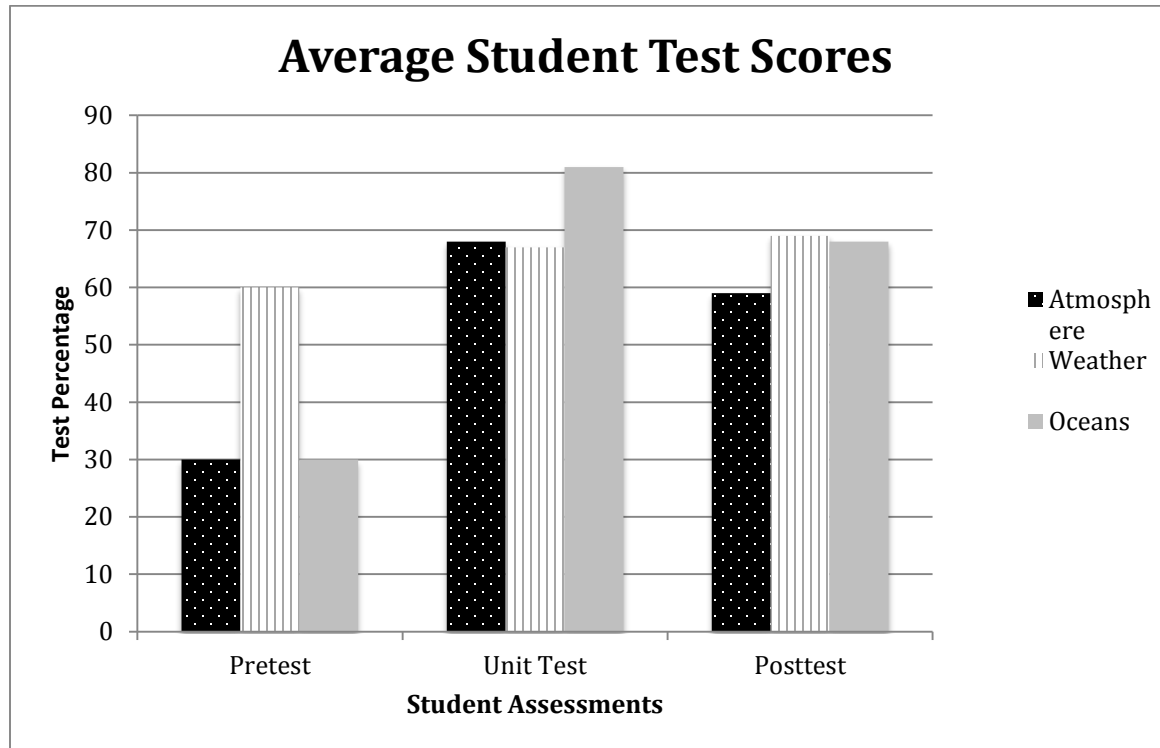


Figure 1. Student pre, during, and post unit scores, ($N=21$).

Student interviews conducted after the first treatment unit revealed that students among all performance levels found the Universal Intellectual standards to be overwhelming. High performing students were the only ones to complete the writing assignments while mid and lower level students ignored the task. When asked about it, one mid-level performing student said she found the standards to be confusing and they made her feel like she couldn't focus on the question because she was so worried about how to structure her answer. One lower level performing student claimed that he felt the standards were "too much" and then remarked about how they "do enough writing in language arts I don't want to do it here too. That's not science."

For the project subquestion of “What are the effects of strategic vocabulary and writing activities with reasoning strategies on students’ written explanations?”, I found data difficult to gather. Since writing assignments were only submitted by three students in the class, the planned peer review was not able to take place. The students who submitted their work had discussed the topic and worked together on the assignment, essentially performing peer review as part of the writing process. When I evaluated the test essay questions I found a similar conundrum, with one half of the class choosing to leave the essay question unanswered. Of those who answered the question, most ignored the provided guidelines, instead writing with poor grammar, incomplete sentences, and partial information while completely ignoring the Universal Intellectual Standards. The three students who did complete the writing assignment had the most gains in the essay portion of the unit tests, improving their average score on that section from 70% on the nontreatment test essay question to 90% on the treatment unit test essay questions following the same grading rubric for written assessment. An example of this is the test question “Compare ocean waves and currents.” Essay questions were worth five points each, and for this question it was divided as follows: one point for correctly explaining an ocean wave, one point for correctly explaining an ocean current, one point for identifying a difference between them, one point for writing at least five quality sentences, and one point for grammar and punctuation. I did give half points if a student was on the right track but not quite exactly right.

Student science journals provided evidence that on the day a topic was covered, comprehension was high and explanations were good. Every day that passed students

written explanations dropped in quality and thoroughness. For example, the day that we discussed how water moves to create waves, one student was able to correctly explain that water moves in a circular fashion, with those circles getting smaller with depth. Two days later this same student could not explain how water moves to create waves without reading her previous entry, and on the unit exam incorrectly stated that water moves back and forth across the ocean. I asked this student about the change in her explanation and she referenced a demonstration I did illustrating the difference between transverse and compressional waves. After explanations, videos, and kinesthetic activities, this student still returned to her initial perception of ocean waves being fully a back and forth motion.

For the project subquestion “What are the effects of using targeted vocabulary and writing activities with reasoning strategies on students’ perceptions of their understanding of concepts?”, student interviews were conducted among six students representing three levels of academic achievement by previous performance. Student pretreatment surveys revealed that the class varied greatly in perception of their ability to learn vocabulary. Of the class, 45% indicated that they are not confident in their ability to learn vocabulary, 27% felt very confident in their ability to learn vocabulary, and 28% felt neither confident nor unconfident. Of the students, 45% indicated that a general idea of vocabulary meaning is all they need to know. On the subject of writing in science, 66% felt that their science writing had room to improve. When asked about how writing helps them understand and retain information, 50% of the students said that writing does not help them remember the material while 10% felt that writing does help them retain information.

When asked how well they felt they understood the three topics, weather was the one most students felt least confident in and oceans was the topic students expressed the most confidence in. This is interesting since of the three, weather is the topic students scored highest in on the unit pretest. Lower performing students hesitated to express any sense of confidence regarding the three topics. On topic of oceans, the middle level and higher level performing students expressed a high level of confidence. As one middle level student said “my family heads out to the coast every month so it just makes sense to me.” As we discussed the emphasis on vocabulary, the same student stated, “it’s nice to know what you want us to say when you ask for a definition, but I would rather do another lab or something.” Other students expressed similar confidence in the topic, but responses were very mixed related to the helpfulness of the vocabulary emphasis. Both lower level students said they would rather be told what the definition is than have to construct the meaning themselves, while the middle level performing students seemed to appreciate the vocabulary emphasis the most. As one stated, “I liked having to figure out that the term wasn’t because it helped me know that I really got it.” One upper level student expressed that “the vocabulary focus felt really thorough, but I think we could have covered it faster another way. It got a little boring having to wait for the rest of the class when my group finished really quickly.”

The use of exit slips at the end of class to check for students’ perception of understanding showed that on the day of instruction, most students indicated they felt confident in their understanding of the day’s topic, 18 of 21 for atmosphere, 19 of 21 for weather, and 19 of 21 for oceans. The few students who indicated they didn’t understand

were the same students who had not completed the day's assignments or participated in the lesson. Two students claimed confidence but clearly misunderstood the concept of wave energy.

Student journals also showed a high level of confidence in student understanding. While journal prompts and discussions related to students' perception of their learning revealed a general confidence in their understanding, more specific questions about particular content topics revealed major gaps in comprehension. When prompted to write about how the sun is necessary for the creation of weather, not one student could explain it and several said that the sun was not necessary at all. After spending a day reviewing as a class for the weather unit test, an informal poll showed that the overwhelming majority of the class felt prepared and confident for the test. A similar informal poll taken at the completion of the test showed that student confidence had dropped dramatically, with only a few students confident about their performance on the test.

For the project subquestion "What are the effects of using targeted vocabulary and writing activities with reasoning strategies on students perception of their ability to explain what they know?" student opinions were measured using surveys, student interviews, and journal entries. In surveying the students about their feelings of using writing to aid their understanding, the overall general feeling of the class was that their science writing could definitely improve (Figure 2). On a scale of 1-5 with 1 being not at all like me and 5 being very much like me, students consistently rated their ability to improve their science writing at a 4. The area in which students felt was not at all like them was in their desire to know how their writing compared to their peers. This had the

lowest rating with the class average score being a 2 on the same 1-5 scale. While the majority of the class felt that their writing could improve and that they improve with practice, only 13% of the class submitted the first writing assignment and 9% submitted the second. This number did not increase with reminders, class time to work, or school-wide rewards for having no missing assignments in classes.

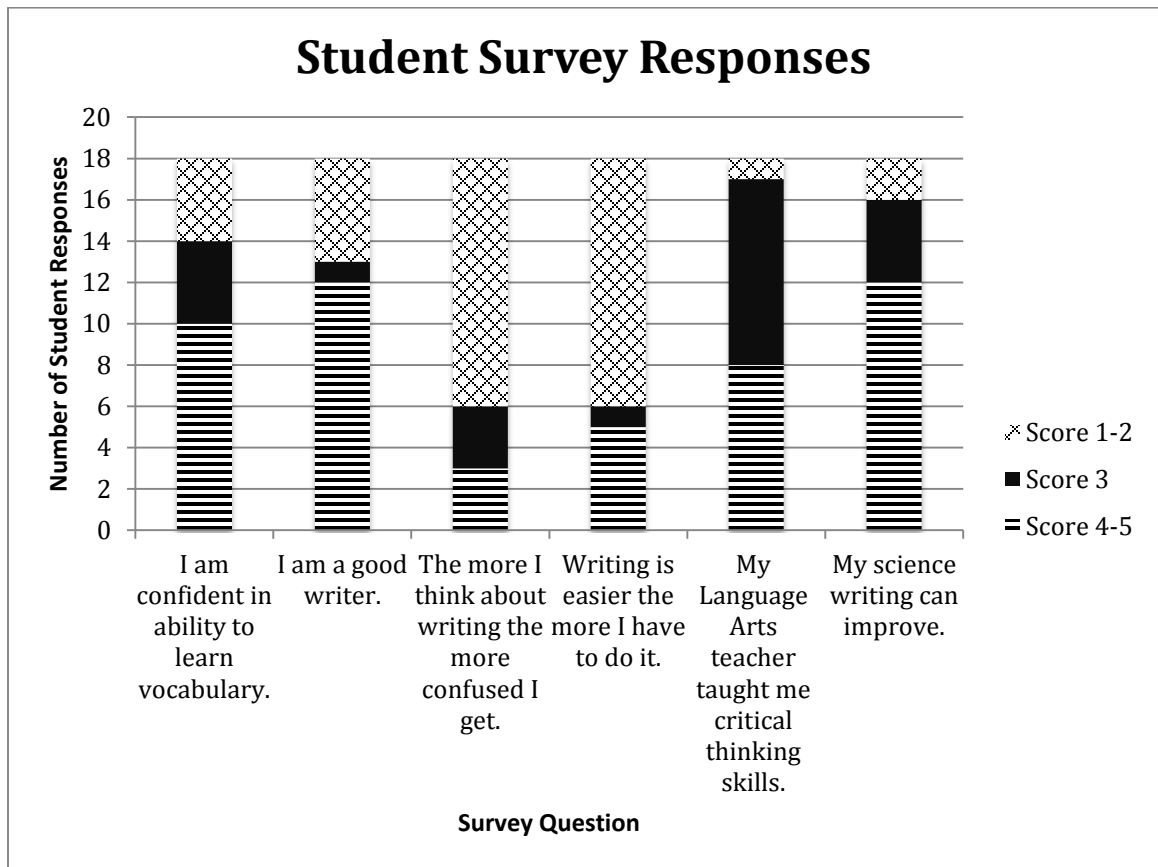


Figure 2. Student survey responses, (N=18).

Student science journals revealed that despite an awareness of their ability to improve science writing, most students expressed confidence in their ability to explain a science concept through writing. This confidence waned when faced with an actual writing task. One student said, “It seems like it’s easy to do. I mean, I get it. I just can’t

quite put it into words that make sense.” Another stated, “When you say to write a paragraph I panic and forget all the fancy words and then I don’t feel like I have any idea how to explain what’s going on in my head.” Another student, who represented the minority of opinion in the class, stated, “I don’t mind the writing. It’s not that hard for me, and it makes sense that we should have to do that sometimes. It can’t all be left up to guessing.”

For the project topic of “What are the effects of implementing strategic vocabulary and writing activities with reasoning strategies on a teacher’s perception of her effectiveness teaching the unit and her professionalism?”, I relied heavily on journaling throughout the units. This journaling, along with conversations with colleagues, show a major shift in perception of effectiveness and professionalism. During the nontreatment unit, my journals show that I was comfortable teaching the way I had been all year and was not looking forward to the added work of trying to teach writing and expanded vocabulary. One day I stated “There is so much science I want to cover and so little time to do so, taking time to emphasize critical thinking and writing skills feels foolish, even though I really do want to raise expectations for my students.” I expressed concern over what else would have to be eliminated from the units to make time for these new activities and if it would be worth it. During the first treatment unit, I expressed a major increase in my sense of efficacy at the time the Universal Intellectual Standards were introduced. I felt that I was challenging students to think differently and that excited me. At this time I stated, “I think I’m meeting them more at their level and it’s somewhat rebuilding my confidence.”

My feelings throughout the unit changed from the dramatic high of feeling I was teaching them something great to great discouragement at the resistance I encountered from the students. Upon the completion of the first treatment unit and getting feedback from student surveys I wrote, “I don’t understand. They say that they can improve and they like writing, yet so few of the class are willing to complete the writing assignments. How can I effect a change in their thinking and reasoning if they are unwilling to participate? Perhaps this approach is better suited to a high school setting than a middle school. These kids want only rote memorization and when I push them outside that realm they shut down.”

After the second treatment unit writing assignment I felt slight encouragement as it was met with less resistance, however the percentage of students who completed the work was dismal. In my journal I stated, “Today I gave the students another article to assess according to the Universal Intellectual Standards. While it would be a stretch to say they were thrilled, they didn’t protest the way they did with the last one. It seems we are making progress.” The encouragement disappeared once I had graded the assignments and recognized how few of them had been completed. My remarks at that time changed to “This is really depressing. I am just wanting to help change the way they think and look at the world but how can I do that if they won’t participate? I can’t help but think I’d get far better results if I had started teaching like this in the fall so it was normal to them rather than trying to get them to change all their habits this far into the year.”

INTERPRETATION AND CONCLUSIONS

One of the goals of this project was to increase student understanding. The nontreatment unit and second treatment unit showed the largest amount of gain based on raw test scores, so it is inconclusive if the vocabulary emphasis aided student comprehension. Data indicated that most students did not feel they needed the added vocabulary activities. A couple middle level students felt they benefitted from specifying what a term did not mean, but most students felt that the vocabulary activities were not necessary. Taking my own journal into consideration, I too felt that it was a very time consuming way of communicating a small amount of information.

Using the Universal Intellectual Standards appears to have been ineffective for increasing student comprehension. Most students found the standards to be confusing and overwhelming, ending with them choosing to not do the work at all. I do feel that I gave the students too much at once. Since this was our first time trying to evaluate writing against a set of guidelines, the students were uncertain what to do. I attempted to scaffold the process but it is clear that I asked them to strive farther than they were able at that time and as a result students mentally shut down and avoided the task. Considering the way it affected the students and their motivation, the use of the Universal Intellectual Standards was unsuccessful for this group of students at this time. One of my main goals was to see improvement in students' writing, but with so few students completing the written assignments or the essay portion of the test, I am unable to determine if any benefit came from using the Universal Intellectual Standards.

Student perception differed greatly from mine. Students continually claimed in journals and exit slips that they fully understood a topic, though the actual comprehension seemed to wane as days passed. I also found the journal explanations to be lacking, despite their confidence, and feel that student perception was not a very accurate measure of their true understanding. Before giving a unit exam I ask students how they are feeling with an informal “thumb up, thumbs down” survey. Before each exam the entire class indicated they felt confident and then moments into the exam students’ body language and questions revealed otherwise. Looking back at my survey questions, it is possible that my statements were worded above my students’ understanding and that it affected the reliability of their responses.

I have experienced a wide level of variance in my perceptions over the course of the project. I feel highly ineffective teaching the treatment units as I didn’t see the results I hoped for. The pretest and posttest data show growth in content knowledge for all three units, but one of my goals was to improve their ability to write and in that I feel unsuccessful.

It is difficult to face the student resistance I encountered through this project but I have come to understand a few of the elements that may have contributed to that. This was such a large departure from the way I had taught the rest of the year that it overwhelmed the students and took them out of their comfort zone. Our school operates on a math/science block system where students normally have the same teacher for both subjects, but these students had separate teachers for the two subjects. These students were struggling to get through the material in math and their confidence was shaken. The

administration occasionally asked me to reteach a math topic to help them get back on track. This block system has led to many teachers skipping science in order to focus more time on math. While that wasn't the case with this group of students during their eighth grade year, it was the case for them in sixth and seventh grade. They are not accustomed to being asked to work hard in science and associate the class with little more than fun projects. Implementing these methods of instruction made the level of work required in their science class far above what they have ever experienced.

Our classroom was ill equipped to teach science. I had one working power outlet, no gas or water connections, and shared the classroom with another teacher. I was teaching four separate classes all with different content, and at the completion of my classes, I had only four minutes to vacate the room and have everything a clean slate. This made lab experiences and hands on learning very difficult. Also, this project was unable to be implemented prior to fourth quarter. By that time the eighth grade students were ready for summer vacation and their transition to high school. With these variables, many which were outside of my control, it is no wonder that the students struggled to remain motivated during this quarter.

Despite feeling as though I did not affect student writing the way I hoped, I felt strongly that I put forth great effort on the part of my students. In that sense I am proud of the work I did and my willingness to try new approaches to teaching. I have long felt that good teachers continually learn and adapt, adding to their "bag of tricks." Doing that made me feel I was doing right by my students and being the kind of teacher I ought to be.

VALUE

The goal of this project was to implement strategic vocabulary activities and reasoning strategies for students to apply to written work in order to increase their comprehension and retention of science concepts. The implementation did not go as anticipated and the data show results different than I hoped for. Much of the data I hoped to rely on regarding observing the progress students made with their writing and ability to communicate scientific ideas was unavailable due to lack of student participation. Despite that, I think this project has made me a better teacher. While I feel that the goal was sound, the methods I planned were well suited to the previous school I worked at but poorly suited to my current set of students. The Universal Intellectual Standards overwhelmed them and the vocabulary approach was possibly too simplistic. This shows me the need to accurately understand the particular classroom that a teaching strategy will be used in when designing the implementation.

I would like to try using the Universal Intellectual Standards again, but this time I will simplify them down to three simpler guidelines; Does your writing make sense?, Is anything missing?, and Can you improve the grammar? This should be more useful for my students but still encourage them to stop and think about the quality of their writing. I also plan to implement it at the beginning of the school year so they get accustomed to the writing expectations early and it will be a normal expectation in my classroom. More opportunity to practice writing in this content area will help them to internalize this way of thinking and aid their ability to think critically.

Writing is how ideas are shared in science and students should be given opportunities to grow in that capacity. The most important bit of information I have taken from this project is that of tailoring the assignments and teaching strategies to the particular students who will be using them. It also bears emphasis that student perception of their understanding is often incorrect. While it is important that students feel confident, they also need a way to construct new meanings when they are mistaken.

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APPENDICES

APPENDIX A

ATMOSPHERE, WEATHER, AND CLIMATE PRETEST

Atmosphere, Weather, and Oceans - Pretest

1. The atmosphere consists of **how many layers?**
 - a. 4
 - b. 2
 - c. 6
 - d. 5
2. Atmospheric layers are determined by **a change** in:
 - a. Temperature
 - b. Density
 - c. Altitude
 - d. Color
3. Ozone is **good** when found in the:
 - a. Troposphere
 - b. Stratosphere
 - c. Mesosphere
 - d. Exosphere
4. Energy moves through the atmosphere by means of:
 - a. Radiation
 - b. Convection
 - c. Conduction
 - d. All of the Above
 - e. A & B
5. What is the **most abundant** gas in our atmosphere?
 - a. Argon
 - b. Water Vapor
 - c. Nitrogen
 - d. Oxygen
6. What is the **driving force** behind all weather?
 - a. The Sun
 - b. The Ocean
 - c. Mt. Everest
 - d. Plate Tectonics
7. Wind is air moving **from** _____ **pressure to** _____ **pressure.**
 - a. Higher, higher
 - b. Lower, higher
 - c. Higher, lower
 - d. Lower, lower
8. Humidity is:
 - a. The amount of water vapor in the air
 - b. The amount of air in the water
 - c. A measure of precipitation
 - d. The temperature when dew forms
9. Clouds are **classified** by:
 - a. Elevation
 - b. Shape
 - c. Composition
 - d. A, B, & C
 - e. None of the above
10. A large body of air that has properties **similar to the area it formed over** is a(an):
 - a. Front
 - b. Air mass
 - c. Tornado
11. Salinity is:
 - a. the amount of salt dissolved in sea water
 - b. a depression filled with water
 - c. water moving horizontally
 - d. saltier water sinking

12. Two **major types** of ocean currents are:
- Density and upwelling
 - The Gulf Stream and Surface
 - Surface and Density
 - Surface and Upwelling
13. To make waves, **water moves**:
- In circles
 - Up and down
 - Back and forth
14. Tides are caused by the **interaction of gravity** between:
- The Sun and Earth
 - The Moon and Earth
 - The Sun, Moon, and Earth
 - The Earth and Venus
15. Density of seawater can increase by:
- Increase in temperature
 - Decrease in salinity
 - Decrease in temperature
 - decrease in pressure

APPENDIX B

ATMOSPHERE GUIDED NOTES

EARTH'S ATMOSPHERE

Name: _____

____ / 30 pts.

Guided Notes

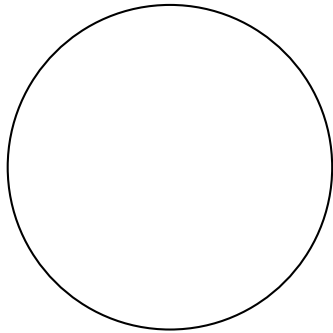
Earth's atmosphere is a _____

Earth's early atmosphere was made of _____

Oxygen in Earth's atmosphere came from _____

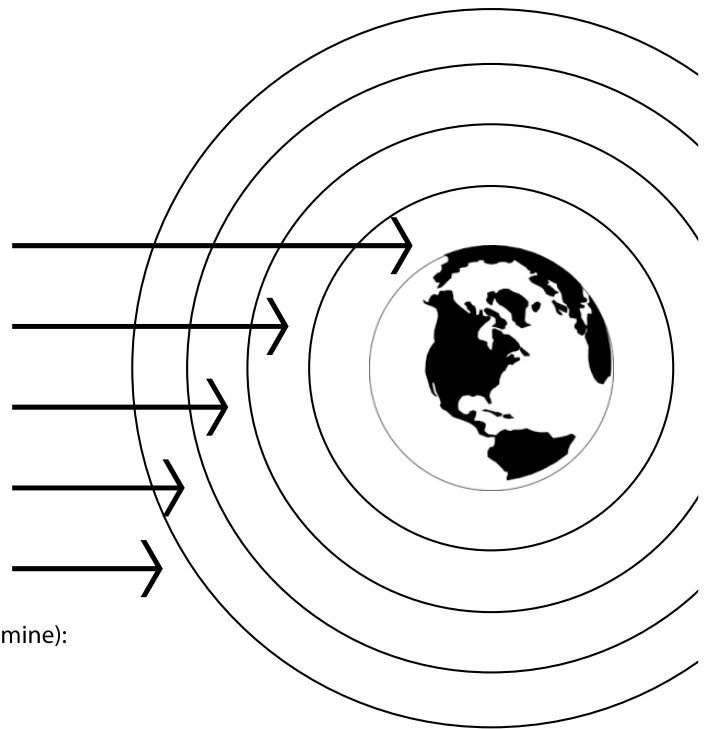
Today, Earth's atmosphere consists of primarily _____

Trace gases include: _____

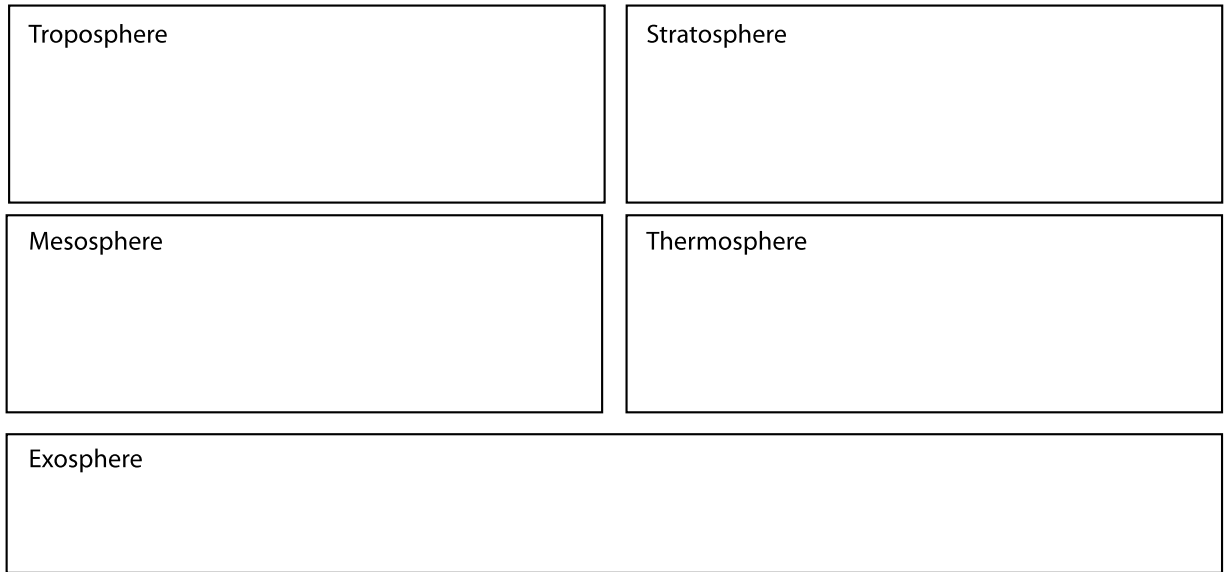


Create a pie graph that represents the percentage of gases that makes up the atmosphere.

Earth has _____ layers in it's atmosphere.

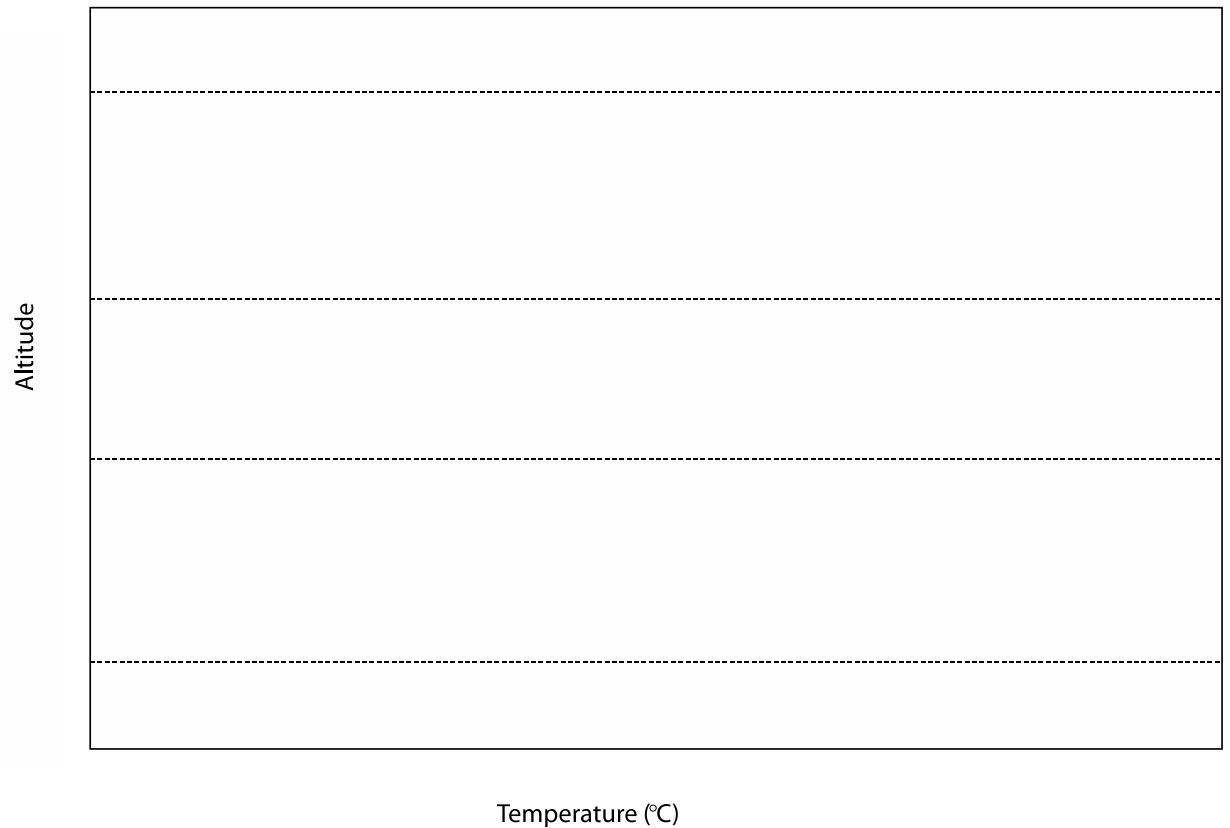


Create an acronym to remember the order (or use mine):

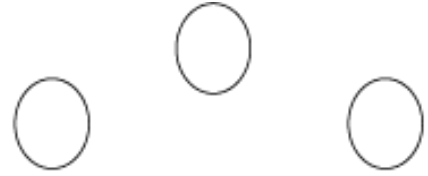


The division of the atmosphere into layers is mostly based on: _____

Draw the temperature profile of the atmosphere.



OZONE IS:



Ozone can be good or bad.

Why is ozone good in the _____

Why is ozone bad in the _____

What are CFC's?

Why are CFC's bad?

Draw how CFC's destroy ozone.

APPENDIX C

VIRTUAL ATMOSPHERE LAB

Name: _____

What is the Structure of Earth's Atmosphere?

Objectives:

- Describe the structure of Earth's atmosphere
- Investigate temperature, density, and pressure changes in layers of Earth's atmosphere.
- Identify meteorological and astronomical phenomena that occur in the layers of Earth's atmosphere.

Procedure:

1. Record Density, Pressure, and Temperature at sea level in your data table at sea level (0km)
2. Drag the red slider along the altitude measurement bar and select another altitude. If you select an altitude less than 30 km above sea level, a balloon will appear. If you select an altitude greater than 30 km above sea level, a rocket will appear. Rockets are used to collect atmospheric data at altitudes greater than 30 km above sea level because the low atmospheric pressure at high altitudes can cause balloons to burst.
3. Click the launch button to launch the balloon or rocket.
4. Observe the balloon or rocket being launched into Earth's atmosphere, peaking at the selected altitude, and then returning to Earth by parachute. Record the atmospheric data in your table.
5. If the Show Phenomenon button is enabled, click it to learn about a meteorological or astronomical phenomenon that occurs at or near the selected altitude. To see the phenomenon again, click its label.
6. Repeat the virtual lab until you have collected data in the table for each of the eleven altitudes. As you collect data, watch for trends in atmospheric pressure, density, and temperature within the four layers of Earth's atmosphere.
7. Complete the conclusion questions.
8. Click the reset button to start over.

Lab can be found at:

http://www.glencoe.com/sites/common_assets/science/virtual_labs/ES14/ES14.html

Conclusion:

1. Which layer of the atmosphere do you live in? What kinds of meteorological phenomena can be found in this layer?

2. If a rocket were launched to a height of 210 km above sea level, which layer of the atmosphere would it rise to? What kinds of meteorological and astronomical phenomena might the rocket encounter in that layer?

3. What is the ozone layer? In which layer of the atmosphere is it found? What is the importance of the ozone layer to life on Earth?

4. Describe the pattern of air density changes within layers of the atmosphere. Describe the pattern of air pressure changes within layers of the atmosphere. What is the relationship between air density and air pressure?

5. Describe the pattern of temperature changes within the layers of the atmosphere. Why do you think temperature changes follow this unique pattern?

Atmospheric Data Table

APPENDIX D
ARTICLE FOR REVIEW

Good Up High

What is ozone?

Ozone is a gas that occurs both in the Earth's upper atmosphere and at ground level. Ozone can be "good" or "bad" for your health and the environment, depending on its location in the atmosphere.

How Can Ozone Be Both Good and Bad?

Ozone occurs in two layers of the atmosphere. The layer closest to the Earth's surface is the troposphere. Here, ground-level or "bad" ozone is an air pollutant that is harmful to breathe and it damages crops, trees and other vegetation. It is a main ingredient of urban smog. The troposphere generally extends to a level about 6 miles up, where it meets the second layer, the stratosphere. The stratosphere extends upward from about 6 to 30 miles. The stratospheric or "good" ozone protects life on Earth from the sun's harmful ultraviolet (UV) rays.

What is Happening to the "Good" Ozone Layer?

Ozone is produced naturally in the stratosphere. But this "good" ozone is gradually being destroyed by man-made chemicals referred to as ozone-depleting substances (ODS), including chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl bromide, carbon tetrachloride, and methyl chloroform. These substances were formerly used and sometimes still are used in coolants, foaming agents, fire extinguishers, solvents, pesticides, and aerosol propellants. Once released into the air these ozone-depleting substances degrade very slowly. In fact, they can remain intact for years as they move through the troposphere until they reach the stratosphere. There they are broken down by the intensity of the sun's UV rays and release chlorine and bromine molecules, which destroy the "good" ozone. Scientists estimate that one chlorine atom can destroy 100,000 "good" ozone molecules.

Even though we have reduced or eliminated the use of many ODSs, their use in the past can still affect the protective ozone layer. Research indicates that depletion of the "good" ozone layer is being reduced worldwide. Thinning of the protective ozone layer can be observed using satellite measurements, particularly over the Polar Regions.

How Does the Depletion of "Good" Ozone Affect Human Health and the Environment?

Ozone depletion can cause increased amounts of UV radiation to reach the Earth which can lead to more cases of skin cancer, cataracts, and impaired immune systems. Overexposure to UV is believed to be contributing to the increase in melanoma, the most fatal of all skin cancers. Since 1990, the risk of developing melanoma has more than doubled.

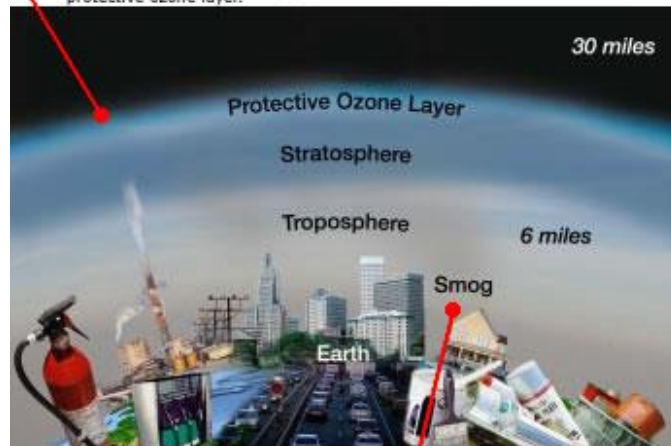
UV can also damage sensitive crops, such as soybeans, and reduce crop yields. Some scientists suggest that marine phytoplankton, which are the base of the ocean food chain, are already under stress from UV radiation. This stress could have adverse consequences for human food supplies from the oceans.

What is Being Done About the Depletion of "Good" Ozone?

The United States, along with over 180 other countries, recognized the threats posed by ozone depletion and in 1987 adopted a treaty called the Montreal Protocol to phase out the production and use of ozone-depleting substances.

EPA has established regulations to phase out ozone-depleting chemicals in the United States. Warning labels must be placed on all products containing CFCs or similar substances and nonessential uses of ozone-depleting products are prohibited. Releases into the air of refrigerants used in car and home air conditioning units and appliances are also prohibited. Some substitutes to ozone-depleting products have been produced and others are being developed. If the United States and other countries stop producing ozone-depleting substances, natural ozone production should return the ozone layer to normal levels by about 2050.

Too little there... Many popular consumer products like air conditioners and refrigerators involve CFCs or halons during either manufacture or use. Over time, these chemicals damage the earth's protective ozone layer.



Too much here... Cars, trucks, power plants and factories all emit air pollution that forms ground-level ozone, a primary component of smog.

APPENDIX E
HEAT TRANSFER MINI-LAB

Heat Transfer Mini Lab

Purpose:

- Define the terms conduction, convection and radiation in the context of heat transfer.
- Describe everyday examples of ways people try to cause or prevent heating and cooling by conduction, convection and radiation.
- Give examples of materials that serve well for heating by conduction, convection and radiation.

Supplies:

Birthday candle
Paper Cups (2)
Metal Spoon
Cup of Ice
Piece of aluminum foil

Background Information:

The concepts involved in heat flow are essential to many topics in science and engineering, ranging from the origins of weather patterns to regulating the rate of nuclear reactions in power plants. Knowledge of the fundamental principles of heat transfer by conduction, convection and radiation allows us to understand many of the physical and biological processes we see around us each day, and it also helps us design technological solutions to a wide variety of problems.

Conduction:

Convection:

Radiation:

Heat always transfers from _____ to _____.

<p>Trial 1:</p> <ol style="list-style-type: none"> 1. Light the birthday candle. 2. Hold the metal spoon with the tip either in the candle flame or just above it. 3. Describe what happens: <p>Where did the heat originate?</p> <p>Where did the heat travel?</p> <p>Which method of heat transfer does this represent?</p> <p>Where can we observe this method of heat transfer in everyday life?</p>	<p>Trial 2:</p> <ol style="list-style-type: none"> 1. Sit very still without talking. 2. Watch the smoke rising from the candle. It may be easier to see if you extinguish the flame and leave the tip of the wick glowing red. 3. Describe what you observe happening with the smoke. **Note: the smoke is not heat, but allows us to see the movement of the heat.** <p>Where did the heat originate?</p> <p>Where did the heat travel?</p> <p>Which method of heat transfer does this represent?</p> <p>Where can we observe this method of heat transfer in everyday life?</p>
<p>Trial 3:</p> <ol style="list-style-type: none"> 1. With the candle burning, use a toothpick to capture a drip of melted wax as it runs down the side of the candle. 2. Let the wax cool on the toothpick. 3. Move the toothpick slowly toward the flame, approaching from below. Do not let the wax tip touch the flame. 4. Describe what happens: <p>Where did the heat originate?</p> <p>Where did the heat travel?</p> <p>Which method of heat transfer does this represent?</p> <p>Where can we observe this method of heat transfer in everyday life?</p>	<p>Trial 4:</p> <ol style="list-style-type: none"> 1. Fill your cup (without the hole) at least halfway with ice. 2. Place the metal spoon in the cup. 3. After 1-2 minutes, grab the handle of the spoon. 4. Describe what happened. <p>Where did the heat originate?</p> <p>Where did the heat travel?</p> <p>Which method of heat transfer does this represent?</p> <p>Where can we observe this method of heat transfer in everyday life?</p>

APPENDIX F
ATMOSPHERE UNIT TEST

EarthS ATMOSPHERE

Unit Test

1. What is the most abundant gas in the atmosphere?
 - a. Oxygen
 - b. Water vapor
 - c. Argon
 - d. Nitrogen
2. What causes a brown haze near cities?
 - a. Conduction
 - b. Mud
 - c. Car exhaust
 - d. Wind
3. Which is the uppermost layer of the atmosphere?
 - a. Troposphere
 - b. Stratosphere
 - c. Exosphere
 - d. Thermosphere
4. What layer of the atmosphere has the most water?
 - a. Troposphere
 - b. Stratosphere
 - c. Mesosphere
 - d. Exosphere
5. What protects living things from too much radiation?
 - a. The ozone layer
 - b. Oxygen
 - c. Nitrogen
 - d. Argon
6. Where is air pressure the least?
 - a. Troposphere
 - b. Stratosphere
 - c. Exosphere
 - d. Thermosphere
7. How is energy transferred when objects are in contact?
 - a. Trade winds
 - b. Convection
 - c. Radiation
 - d. Conduction
8. Which surface winds are responsible for most of the weather movement across the united states?
 - a. Polar easterlies
 - b. Sea breeze
 - c. Prevailing westerlies
 - d. Trade winds
9. What type of wind is a movement of air toward water?
 - a. Sea breeze
 - b. Polar easterlies
 - c. Land breeze
 - d. Trade winds
10. What are narrow belts of strong winds near the top of the troposphere called?
 - a. Doldrums
 - b. Jet streams
 - c. Polar easterlies
 - d. Trade winds
11. What change determines where one atmospheric layer ends and another begins.
 - a. Temperature
 - b. Density
 - c. Atmospheric Pressure
 - d. Altitude
12. What is the source of all energy on Earth?
 - a. Heat from the Core
 - b. The Sun
 - c. Petroleum
 - d. Condensation
13. Which is NOT a way that energy is transferred in the Earth system?
 - a. Convection
 - b. Radiation
 - c. Conduction
 - d. Infiltration

Turn Over →

APPENDIX G

UNIVERSAL INTELLECTUAL STANDARDS STUDENT SHEETS

APPENDIX H
POOR WRITING EXAMPLE

Why does the weather matter?

Just a quick homework, geography question. i need stuff like global warming, and also why.

Thanks

Bam x

Best Answer: if the temperature of the earth increases there may be more droughts and less rain, which would mean that it would be harder to grow crops. this would mean there would be less essential food for us to eat (obviously).

weather is important as it controls our climate, for example if we had lots of hot weather across the globe, then the ice caps could melt. this could then cause more flooding in the world and destruction of settlements etc.

the sun can be very powerful and although we enjoy it when it's warm, if it is too powerful for too long, then it could damage our atmosphere. the sun radiates it's heat into space and could burn through our atmosphere if it became too powerful. this would mean that the earth is no longer protected against objects in space such as asteroids and meteors. the atmosphere usually burns these up so they don't damage the planet but if there was no atmosphere, it wouldn't happen, and they could damage the earth. also, gases that we use to breathe such as oxygen would be lost into space and we wouldn't be able to breathe.

the wind helps the seasons and climate and the gulf stream is air that keeps the climate warmer in certain places on the planet.

basicaly these are SOME reasons why weather is important.

hope this helps and sorry for it being long! :)

Source(s):I have studied geography at school :)

APPENDIX I

ARTICLE REVIEW UNIVERSAL INTELLECTUAL STANDARDS RESPONSE
SHEETS

Universal Intellectual Standards – Article Review

Read the article provided to you. Using the standards below, evaluate the article based upon the Universal Intellectual Standards. Be thorough and use FSA. Refer to your UIS card for guidance with each measurement.

List the article here:

1. Clarity: -

2. Accuracy: -

3. Precision: -

Relevance: -

4. Depth: -

5. Breadth: -

6. Logic: -

APPENDIX J
FRAYER MODEL SHEETS

Term:	Characteristics:
Definition:	Examples:
	Non-examples:

Term:	Characteristics:
Definition:	Examples:
	Non-examples:

APPENDIX K
STUDENT JOURNAL PROMPTS

Journal Prompts

Nontreatment Unit – Atmosphere

1. On a scale of 1-5, 5 being high, how well do you feel you could explain the layers of the atmosphere to another student? Please explain why you gave yourself that rating.
2. On a scale of 1-5, 5 being high, how do you rate your understanding of way the atmosphere is divided? Please explain why you gave yourself that rating.
3. Describe the way we decide where one layer begins and another ends.
4. Explain what gases make up our atmosphere. How do you feel about Oxygen being such a small percentage?

Treatment Unit 1 – Weather

1. On a scale of 1-5, 5 being high, how well do you feel you could explain the major forces that affect weather to another student? Please explain why you gave yourself that rating.
2. On a scale of 1-5, 5 being high, how do you rate your understanding of way weather is created? Please explain why you gave yourself that rating.
3. Describe how the Sun is necessary for the creation of weather.
4. How do you feel about the Universal Intellectual Standards? Explain why you feel that way.
5. How well do you feel you can explain what you know about weather? Why?

Treatment Unit 2 – Oceans

1. On a scale of 1-5, 5 being high, how well do you feel you could explain the role of oceans in the Earth system to another student? Please explain why you gave yourself that rating.
2. On a scale of 1-5, 5 being high, how do you rate your understanding of way water moves in the oceans to create waves? Please explain why you gave yourself that rating.
3. Why is it important that we have different densities of water?
4. Now that you've used them more, how do you feel about the Universal Intellectual Standards? Explain why you feel that way.
5. How well do you feel you can explain what you know about oceans? Why?

APPENDIX L
WEATHER UNIT TEST

WEATHER AND CLIMATE

Unit Test

1. Which type of air has a relative humidity of 100%?
 - a. Humid
 - b. Temperate
 - c. Dry
 - d. Saturated
2. What is a large body of air that has the same properties as the area over which it formed called?
 - a. Air mass
 - b. Station model
 - c. Front
 - d. Isotherm
3. At what temperature does water vapor in air condense?
 - a. Dew point
 - b. Station model
 - c. Front
 - d. Isobar
4. Which type of precipitation forms when water vapor changes directly into a solid?
 - a. Rain
 - b. Hail
 - c. Sleet
 - d. Snow
5. Which type of the following clouds are high feathery clouds made of ice crystals?
 - a. Cirrus
 - b. Nimbus
 - c. Cumulus
 - d. Stratus
6. Which type of front may form when cool air, cold air, and warm air meet?
 - a. Warm
 - b. Cold
 - c. Stationary
 - d. Occluded
7. Which is issued when severe weather conditions exist and immediate action should be taken?
 - a. Front
 - b. Watch
 - c. Station model
 - d. Warning
8. Which term means the amount of water vapor in the air?
 - a. Dew point
 - b. Precipitation
 - c. Humidity
 - d. Relative humidity
9. What does an anemometer measure?
 - a. Air pressure
 - b. Relative humidity
 - c. Wind speed
 - d. Precipitation
10. What is a large, swirling storm that forms over warm, tropical water called?
 - a. Hurricane
 - b. Tornado
 - c. Blizzard
 - d. Hailstorm

11. Making connections! Which layer of the atmosphere does weather take place in?
- a. Thermosphere
 - b. Mesosphere
 - c. Stratosphere
 - d. Troposphere

12. How are clouds named?
- a. By shape
 - b. By height
 - c. By location
 - d. Both A & B

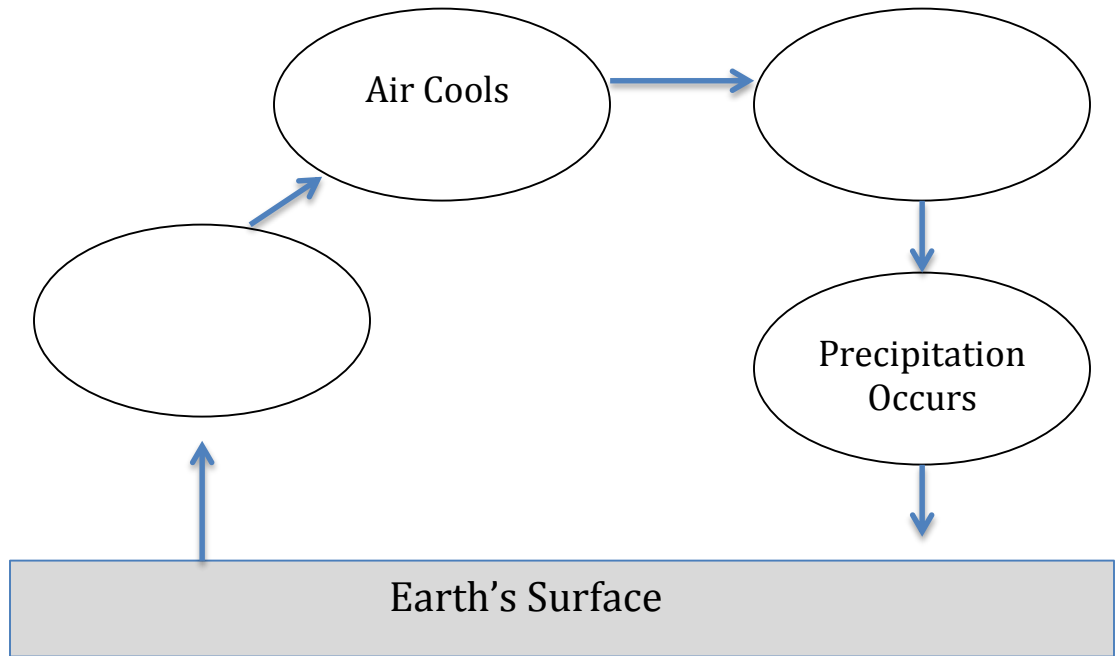
For the next three questions, provide your answer in FSA. Think of the Universal Intellectual Standards as you respond.

13. Describe how air, water, and the Sun interact to cause weather. (5pts.)

14. Explain why northwest Washington often has rainy weather and southwest Texas is dry. (5pts.)

15. Why don't hurricanes form in Earth's polar regions? (5pts.)

16. Complete the sequence map below showing how precipitation forms. (2pts.)



APPENDIX M
OCEANS UNIT POSTER REVIEW

Ocean Unit Review

In a small group, create a visual explanation of our brief ocean unit. You can create a poster, a brochure, an infographic, etc. What I care about is that the following information is included, and that everyone in your group participates. Have fun with it, but be realistic in how much time you spend. We will only have today to work on this.

Some key points:

- You may be as artistic as you like, but all information needs to be included.
- Number each item as you include it.
- Make sure your names are on the paper.

Your visual should include the following information:

1. Draw the way water moves **beneath the surface** to create waves. Describe that movement in words.
2. Describe salinity. Draw an example of what happens to water if salinity increases.
3. Tides are formed by the interaction of gravity from three sources. Draw the arrangement that creates a neap tide vs. a spring tide. Include the water bulges on the Earth's surface.
4. There are **two major types of currents in the ocean**. Surface currents are created by wind. Density currents are created by differences in density. Explain two ways that the density of ocean water can be changed.

APPENDIX N
OCEANS UNIT QUIZ

Earth's Oceans

Quiz



Salinity is:

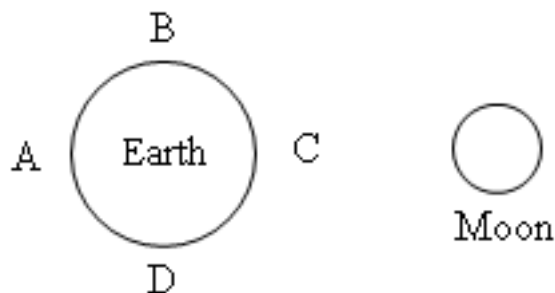
- a. The amount of salt dissolved in seawater
 - b. A depression filled with water
 - c. Water moving horizontally
 - d. Saltier water sinking
2. Two major types of ocean currents are
 - a. Density and upwelling
 - b. The gulf stream and surface
 - c. Surface and density
 - d. Surface and upwelling
 3. To make waves, water moves:
 - a. In circles
 - b. Up and down
 - c. Back and forth
 4. Tides are caused by the interaction of gravity between:
 - a. The sun and earth
 - b. The moon and earth
 - c. The sun, moon, and earth
 - d. The earth and venus
 5. Density of seawater can increase by:
 - a. Increase in temperature
 - b. Decrease in salinity
 - c. Decrease in temperature
 - d. Decrease in pressure
 6. Cargo spills at sea have helped us learn:
 - a. How ocean currents work
 - b. How density affects the ocean circulation
 - c. Where salt comes from
 - d. Free stuff is awesome (not it)

7. Draw the way water moves beneath the surface to create waves.

8. On the tide diagram below, add the Sun.

9. Based on where you drew the Sun, add the ocean water bulges that would be created.

10. Based on the positions of the Sun and Moon, does your picture represent a Spring tide or a Neap tide?



APPENDIX O

ATMOSPHERE, WEATHER, AND CLIMATE POSTTEST

Atmosphere, Weather, and Oceans – POSTTEST

1. The atmosphere consists of **how many layers?**
 - a. 4
 - b. 2
 - c. 6
 - d. 5

2. Atmospheric layers are determined by **a change** in:
 - a. Temperature
 - b. Density
 - c. Altitude
 - d. Color

3. Ozone is **good** when found in the:
 - a. Troposphere
 - b. Stratosphere
 - c. Mesosphere
 - d. Exosphere

4. Energy moves through the atmosphere by means of:
 - a. Radiation
 - b. Convection
 - c. Conduction
 - d. All of the Above
 - e. A & B

5. What is the **most abundant** gas in our atmosphere?
 - a. Argon
 - b. Water Vapor
 - c. Nitrogen
 - d. Oxygen

6. What is the **driving force** behind all weather?
 - a. The Sun
 - b. The Ocean
 - c. Mt. Everest
 - d. Plate Tectonics

7. Wind is air moving **from _____ pressure to _____** pressure.
 - a. Higher, higher
 - b. Lower, higher
 - c. Higher, lower
 - d. Lower, lower

8. Humidity is:
 - a. The amount of water vapor in the air
 - b. The amount of air in the water
 - c. A measure of precipitation
 - d. The temperature when dew forms

9. Clouds are **classified** by:
 - a. Elevation
 - b. Shape
 - c. Composition
 - d. A, B, & C
 - e. None of the above

10. A large body of air that has properties **similar to the area it formed over** is a(an):
 - a. Front
 - b. Air mass
 - c. Tornado

11. Salinity is:
 - a. the amount of salt dissolved in sea water
 - b. a depression filled with water
 - c. water moving horizontally
 - d. saltier water sinking

12. Two **major types** of ocean currents are:

- a. Density and upwelling
- b. The Gulf Stream and Surface
- c. Surface and Density
- d. Surface and Upwelling

13. To make waves, **water moves**:

- a. In circles
- b. Up and down
- c. Back and forth

14. Tides are caused by the **interaction of gravity** between:

- a. The Sun and Earth
- b. The Moon and Earth
- c. The Sun, Moon, and Earth
- d. The Earth and Venus

15. Density of seawater can increase by:

- a. Increase in temperature
- b. Decrease in salinity
- c. Decrease in temperature
- d. decrease in pressure