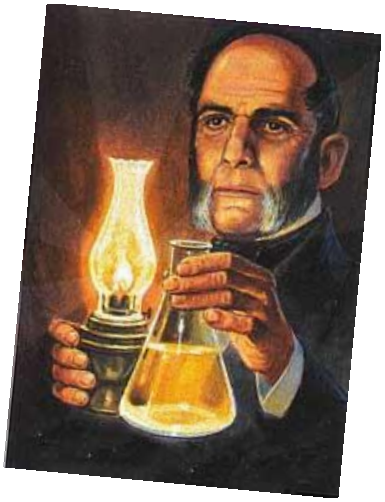
Historical Reading and Thinking: Abraham Gesner and the Discovery of Kerosene



Lesson Focus:

Lesson focuses on analyzing and evaluating visual images as part of historical research and critically reading historical text. Students will become familiar with the use visual clues as part of historical inquiry, coordinating with text and other artifacts to provide a more complete picture of a topic. In addition, students will understand how text evidence can be used to help explain the purpose and results of innovation leading to the discovery of kerosene.

Lesson Synopsis:

Teaching students to analyze visual images and historical text encourages them to think and work as historians by drawing meaning from the image and/or text and connecting their analysis to a larger historical landscape. By engaging in critical analysis of an image or text, students develop and enhance observational, interpretative, and critical thinking skills, which can then be combined with additional resources to provide a more complex understanding of historic relevance.

Teaching students to read critically requires that students become investigators of history. By understanding that time, place, audience, and purpose matter, and by asking questions of the image or text, students are given the opportunity to learn how to identify ambiguity and weigh evidence to make reasonable judgements regarding the validity of an author's claim.

Grade Level:

Grades 7 – 12

Essential Understandings:

Students will understand that…

* Zakariya Al-Razi, a Persian scholar, was the first person to record the distillation process in the 7th century.
* Whale oil was expensive, allowing only the wealthy access to this fuel source; Abraham Gesner developed a more affordable fuel, kerosene, used to fuel oil lamps.
* Abraham Gesner patented kerosene, but was not the original discoverer of kerosene.
* Abraham Gesner is considered a primary founder of the modern petroleum industry.
* Kerosene is a byproduct of crude oil that was discovered in 1846.
* Originally, kerosene was used for lighting and became the main fuel source for indoor lighting, automobile driving lamps, ship lanterns, street lamps, and lighthouses.
* Kerosene is also known as paraffin and lamp oil.
* By 1879, electricity surpassed kerosene as the most popular source for providing light in the United States; however in developing nations, kerosene is still used as the primary fuel for indoor lighting.
* Today, kerosene is the main component in jet fuel.

Objectives:

Students will:

* Observe and identify relevant details within visual images, allowing for an interpretation of past events
* Compare/contrast historic topics/periods using visual images and text
* Establish a purpose for reading
* Critically read and summarize historical text
* Clarify and extend ideas during discussion

Anticipated outcomes:

Students will be able to:

* Demonstrate the ability to interpret historical events/periods by identifying details/evidence in visual images and text
* Compare/contrast historic topics/periods using visual images and text
* Summarize text
* Make inferences and predictions from visual images and text

* Demonstrate understanding of visual images and text

Content Standards:

History:

8.1 Historical Analysis and Skills Development

- A. Evaluate chronological thinking
- C. Evaluate historical interpretation of events
- D. Synthesize historical research

8.3 United States History

- A. Interpret the interaction of cultural, economic, geographical, political and social reforms

Geography:

7.2 The Physical Characteristics of Places and Regions

- A. Analyze the physical characteristics of places and regions including the interrelationships among the components of Earth's physical systems

7.3 The Human Characteristics of Places and Regions

- D. Analyze the significance of human activity in shaping places and regions by their economic characteristics

7.4 The Interactions Between People and Places

- A. Analyze the impacts of physical systems on people

Economics:

6.2 Markets and Economic Systems

- D. Predict how changes in supply and demand affect equilibrium price and quantity sold

6.5 Income, Profit, and Wealth

- F. Assess the impact of entrepreneurs on the economy

Common Core – Reading:

8.5 Reading Informational Text

- A. Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole
- I. Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources

Common Core – Writing:

8.6 Writing

- A. Write arguments focused on discipline-specific content
- C. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose and audience

Lesson Activities:

Introductory Activity:

Examining and interpreting visual sources is a critical skill in history. Not always an easy process as visual images are often difficult to understand due to unfamiliar people, events, and/or symbols. In addition, the meaning of things included in the image might have changed over time. It takes time and practice to become proficient in successfully analyzing visual images.

The following video is a great reference for understanding what visual literacy is and why it is important. The first half of the video is a classroom demonstration of analyzing a photograph in a social studies classroom.

https://www.youtube.com/watch?v=xF2amnCwuHA

Using the painting, Casa de la Sabiduría de Bagdad (included as Appendix A or at www.labrujulaverde.com), complete a preview by "jumping in" to the photo.

(If producing color copies is not an option, the image can be projected for students to view.)

Ask students to carefully view the painting and complete the following:

* Where and when might have this image taken place? How can you tell?
* Who might have created this painting? How do you know?
* If you were to enter the painting:
    - What would you see, hear, smell, feel?
    - Who might you want to talk to? Why?
    - What would you ask?
* Now take a walk around the image, looking at the top, bottom, foreground, background, people/objects:
    - What is happening in the painting?
    - How would you describe the people?
* Give an inventory of what you see in the painting.
    - What do you see in the painting that is similar to what you would see today?
    - What do you see in the paining that is different from what you would see today?

Discuss student responses as a class.

Activity 1: Images as historical evidence

Using the answers provided by students in the introductory activity above, student pairs will now be working to analyze and draw conclusions about the painting.

* Partner groups should begin by summarizing the scene the painting depicts.
* Next, partner groups should complete the following:
    - What does the painting tell us about the time period in which it was painted?

- What questions do you have about the painting?
- How does the artist impact our interpretation of the painting?
- How/where might you get more information about the painting and the time period that would help to further understand the painting?

Next, have two partner groups combine to form small groups of 4 students. Each small group will be given a copy of the images in Appendixes B and C, which depict the use of kerosene in different time periods and short biographies of Gesner and Al-Razi. The group should now complete the same questions for the new images.

Once the above questions have been completed for all three images, groups will complete the following:

* Which features stand out in each image?
* Have your conclusions about the original image changed based on what you have seen in the additional images and/or read in the text? Why/why not?
* What new conclusions can you draw from the three images as a group?
* What information did you gather from the images that you might not learn anywhere else?
* What other sources/evidence can you use to help you understand the themes/topics in the images?
* Create a caption for each image.

Lesson Extension:

Use student captions to create a word cloud using Tagxedo (http://www.tagxedo.com/).
Project word cloud for class.
Have student groups interpret the word cloud while looking at the photos:

What are the most important words?
Which words do you have questions about?
What other images are you reminded of?
What do you understand now that you didn't before?

Activity 2: Using Text Evidence to Interpret Historical Events

Students will be working with the section, "Price and Innovation" (pages 22 – 26) in Chapter 1: "Oil on the Brain: The Beginning" from *The Prize: The Epic Quest for Oil, Money & Power*, by Daniel Yergin. (Appendix D)

Working with pages 22 – 26, students will complete a "Talk to the Text" with the section by highlighting important information and annotating the passage with comments, connections, questions, unfamiliar vocabulary, etc. (Sample talk to text rubric included as Appendix E)

After reading the section, students will work in partner groups to develop two discussion questions about the passage.

Some examples might include:

* What motivated the quest for a whale oil substitute?
* Oil lamps created a new market. What is a more recent invention that has created a new market?
* If only the wealthy could afford to use whale oil, what would be the social impact of a more economical illumination fuel?

Partner groups will now create a timeline and "cast of characters" from the section.

Finally, each student will use the text and work from Activity 2 to write a constructed response for the following prompt:

How did the need for a cheaper illuminant lead to entrepreneurial innovations that also became examples of globalization?

**One method of constructing a response to a prompt is R.A.C.E.

Restate the question at the beginning of your response.
Answer the question.
Cite evidence from the text to support your answer.
Explain how the evidence relates back to the question and/or explains how your answer is correct.

Lesson Extension:
Use additional sections from Chapter 1: "Oil on the Brain: The Beginning" from *The Prize: The Epic Quest for Oil, Money & Power*, by Daniel Yergin.to complete Activity 2.

Resources:

Online Resources:

J. Llewellyn et al, "Analysing images" at Alpha History, http://alphahistory.com/analysing-images/, 2014.

Video:

https://www.youtube.com/watch?v=xF2amnCwuHA

Helpful websites:

https://www.e-education.psu.edu/egee120/node/458

www.labrujulaverde.com
http://shahalahmed.wix.com/history#!use
http://www.tagxedo.com/

Print:

Yergin, Daniel. *The Prize: The Epic Quest for Oil, Money & Power*. London: Simon & Schuster, 1991. 22-26. Print.

PDF file of the book in its entirety:
http://arnosworld.free.fr/sustainability/Daniel%20Yergin%20-%20The%20Prize%20%20The%20Epic%20Quest%20for%20Oil,%20Money,%20&%20Power%20(1991).pdf

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Lesson plan developed for the Petroleum History Institute by Sara Jones, Social Studies teacher at Titusville High School in Titusville, PA. 2017. sjones@gorockets.org

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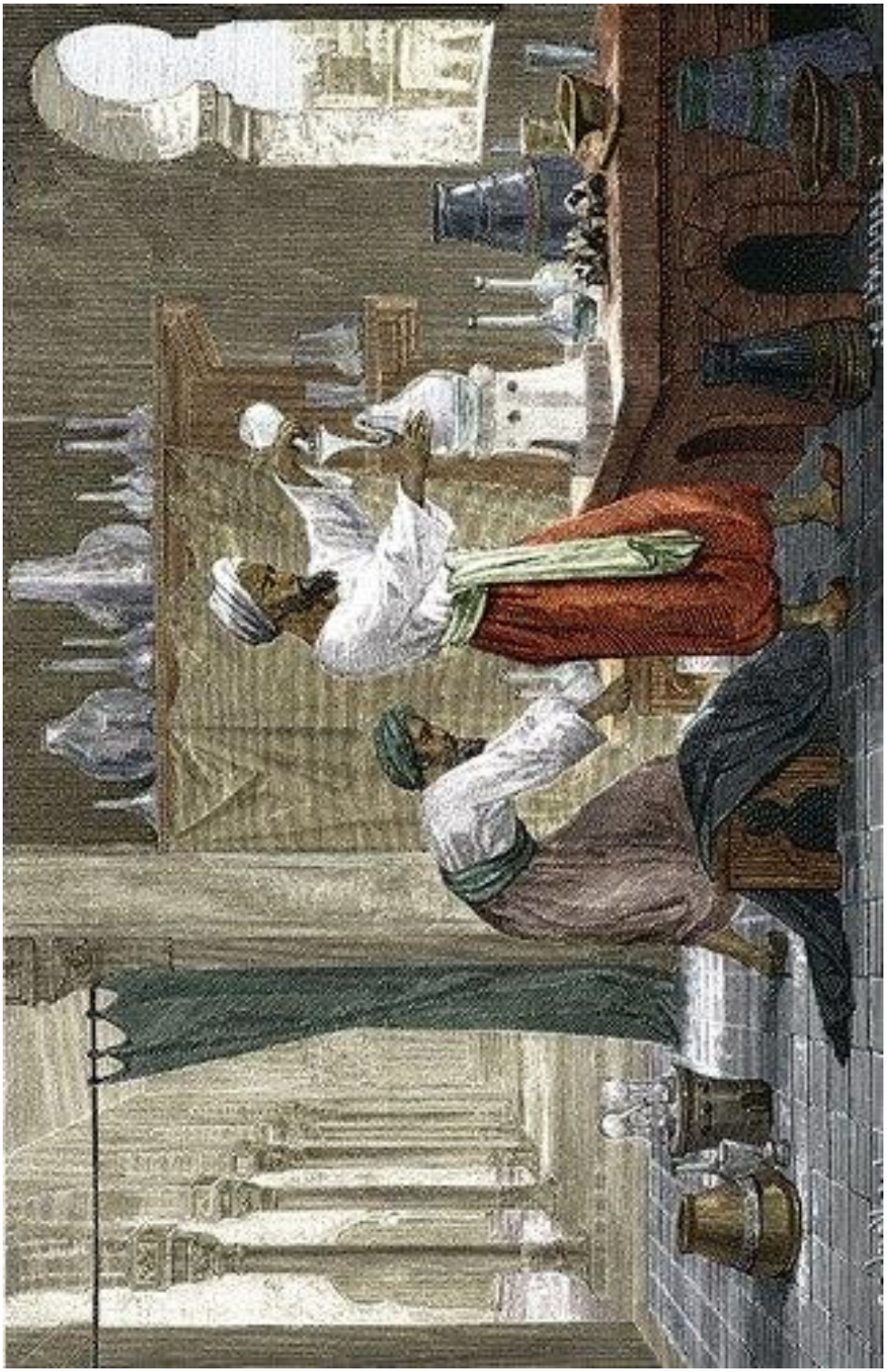
Appendix A



Casa de la Sabiduría de Bagdad www.labrujulaverde.com

Appendix B

Source: Glenbow Archives, NC-39-146

Appendix C

Source: http://shahalahmed.wix.com/history#!use

Appendix D

Price and Innovation

The hopes pinned on the still mysterious properties of oil arose from pure necessity. Burgeoning populations and the spreading economic development of the industrial revolution had increased the demand for artificial illumination beyond the simple wick dipped into some animal grease or vegetable fat, which was the best that most could afford over the ages, if they could afford anything at all. For those who had money, oil from the sperm whale had for hundreds of years set the standard for high-quality illumination; but even as demand was growing, the whale schools of the Atlantic had been decimated, and whaling ships were forced to sail farther and farther afield, around Cape Horn and into the distant reaches of the Pacific. For the whalers, it was the golden age, as prices were rising, but it was not the golden age for their consumers, who did not want to pay $2.50 a gallon—a price that seemed sure to go even higher. Cheaper lighting fluids had been developed. Alas, all of them were inferior. The most popular was camphene, a derivative of turpentine, which produced a good light but had the unfortunate drawback of being highly flammable, compounded by an even more unattractive tendency to explode in people's houses.

There was also "town gas," distilled from coal, which was piped into street lamps and into the homes of an increasing number of middle- and upper-class families in urban areas. But "town gas" was expensive, and there was a sharply growing need for a reliable, relatively cheap illuminant. There was that second need as well—lubrication. The advances in mechanical production had led to such machines as power looms and the steam printing press, which created too much friction for such common lubricants as lard.

Entrepreneurial innovation had already begun to respond to these needs in the late 1840s and early 1850s, with the extraction of illuminating and lubricating oils from coal and other hydrocarbons. A lively cast of characters, both in Britain and in North America, carried the search forward, defining the market and developing the refining technology on which the oil industry would later be based. A court-martialed British admiral, Thomas Cochrane—who, it was said, provided the model for Lord Byron's *Don Juan*—became obsessed with the potential of asphalt, sought to promote it, and, along the way, acquired ownership of a huge tar pit in Trinidad. Cochrane collaborated for a time with a Canadian, Dr. Abraham Gesner. As a young man, Gesner had attempted to start a business exporting horses to the West Indies, but, after being shipwrecked twice, gave it up and went off to Guy's Hospital in London to study medicine. Returning to Canada, he changed careers yet again and became provincial geologist for New Brunswick. He developed a process for extracting an oil from asphalt or similar substances and refining it into a quality illuminating oil. He called this oil "kerosene"—from *Keros* and *elaion,* the Greek words, respectively, for "wax" and "oil," altering the *elaion* to *ene,* so that his product would sound more like the familiar camphene. In 1854 he applied for a United States patent for the manufacture of "a new liquid hydrocarbon, which I denominate Kerosene, and which may be used for illuminating or other purposes."

Gesner helped establish a kerosene works in New York City that by 1859 was producing five thousand gallons a day. A similar establishment was at work in Boston. The Scottish chemist James Young had pioneered a parallel refining industry in Britain, based on cannel coal, and one also developed in France, using shale rock. By 1859, an estimated thirty-four companies in the United States were producing $5 million a year worth of kerosene or "coal-oils," as the product was generically known. The growth of this coal-oil business, wrote the editor of a trade journal, was proof of "the impetuous energy with which the American mind takes up any branch of industry that promises to pay well." A small fraction of the kerosene was extracted from Pennsylvania rock oil that was gathered by the traditional methods and that would, from time to time, turn up at the refineries in New York.

Oil was hardly unfamiliar to mankind. In various parts of the Middle East, a semisolid oozy substance called bitumen seeped to the surface through cracks and fissures, and such seepages had been tapped far back into antiquity—in Mesopotamia, back to 3000 B . C . The most famous source was at Hit, on the Euphrates, not far from Babylon (and the site of modern Baghdad). In the first century B . C . , the Greek historian Diodor wrote enthusiastically about the ancient bitumen industry: "Whereas many incredible miracles occur in the Babylonian country, there is none such as the great quantity of asphalt found there." Some of these seepages, along with escaping petroleum gases, burned continuously, providing the basis for fire worship in the Middle East.

Bitumen was a traded commodity in the ancient Middle East. It was used as a building mortar. It bound the walls of both Jericho and Babylon. Noah's ark and Moses' basket were probably caulked, in the manner of the time, with

bitumen to make them waterproof. It was also used for road making and, in a limited and generally unsatisfactory way, for lighting. And bitumen served as a medicine. The description by the Roman naturalist Pliny in the first century AD of its pharmaceutical value was similar to that current in the United States during the 1850s. It checked bleeding, Pliny said, healed wounds, treated cataracts, provided a liniment for gout, cured aching teeth, soothed a chronic cough, relieved shortness of breath, stopped diarrhea, drew together severed muscles, and relieved both rheumatism and fever. It was also "useful for straightening out eyelashes which inconvenience the eyes."

There was yet another use for oil; the product of the seepages, set aflame, found an extensive and sometimes decisive role in warfare. In the *Iliad,* Homer recorded that "the Trojans cast upon the swift ship unwearied fire, and over her forthwith streamed a flame that might not be quenched." When the Persian King Cyrus was preparing to take Babylon, he was warned of the danger of street fighting. He responded by talking of setting fires, and declared, "We also have plenty of pitch and tow, which will quickly spread the flames everywhere, so that those upon the house-tops must either quickly leave their posts or quickly be consumed." From the seventh century onward, the Byzantines had made use of *oleum incendiarum*—Greek fire. It was a mixture of petroleum and lime that, touched with moisture, would catch fire; the recipe was a closely guarded state secret. The Byzantines heaved it on attacking ships, shot it on the tips of arrows, and hurled it in primitive grenades. For centuries, it was considered a more terrible weapon than gunpowder.[4]

So the use of petroleum had a long and varied history in the Middle East. Yet, in a great mystery, knowledge of its application was lost to the West for many centuries, perhaps because the known major sources of bitumen, and the knowledge of its uses, lay beyond the boundaries of the Roman empire, and there was no direct transition of that knowledge to the West. Even so, in many parts of Europe—Bavaria, Sicily, the Po Valley, Alsace, Hannover, and Galicia, to name a few—oil seepages were observed and commented upon from the Middle Ages onward. And refining technology was transmitted to Europe via the Arabs. But, for the most part, petroleum was put to use only as the all-purpose medicinal remedy, fortified by learned disquisitions on its healing properties by monks and early doctors. But, well before George Bissell's entrepreneurial vision and Benjamin Silliman's report, a small oil industry had developed in Eastern Europe—first in Galicia (which was variously part of Poland, Austria, and Russia) and then in Rumania. Peasants dug shafts by hand to obtain crude oil, from which kerosene was refined. A pharmacist from Lvov, with the help of a plumber, invented a cheap lamp suited to burning kerosene. By 1854, kerosene was a staple of commerce in Vienna, and by 1859, Galicia had a thriving kerosene oil business, with over 150 villages involved in the mining for oil. Altogether, European crude production in 1859 had been estimated at thirty-six thousand barrels, primarily from Galicia and Rumania. What the Eastern European industry lacked, more than anything else, was the technology for drilling.

In the 1850s, the spread of kerosene in the United States faced two significant barriers: There was as yet no substantial source of supply, and there was no cheap lamp well-suited to burning what kerosene was available. The lamps that did exist tended to become smoky, and the burning kerosene gave off an acrid smell. Then a kerosene sales agent in New York learned that a lamp with a glass chimney was being produced in Vienna to burn Galician kerosene. Based upon the design of the pharmacist and the plumber in Lvov, the lamp overcame the problems of the smoke and the smell. The New York salesman started to import the lamp, which quickly found a market. Though its design was subsequently improved many times over, that Vienna lamp became the basis of the kerosene lamp trade in the United States and was later re-exported around the world.

Thus by the time that Bissell was launching his venture, a cheaper quality illuminating oil—kerosene—had already been introduced into some homes. The techniques required for refining petroleum into kerosene had already been commercialized with coal-oils. And an inexpensive lamp had been developed that could satisfactorily burn kerosene. In essence, what Bissell and his fellow investors in the Pennsylvania Rock Oil Company were trying to do was discover a new source for the raw material that went into an existing, established process. It all came down to price. If they could find rock oil—petroleum—in sufficient abundance, it could be sold cheaply, capturing the illuminating oils market from products that were either far more expensive or far less satisfactory.

Digging for oil would not do it. But perhaps there was an alternative. Salt "boring," or drilling, had been developed more than fifteen hundred years earlier in China, with wells going down as deep as three thousand feet. Around 1830, the Chinese method was imported into Europe and copied. That, in turn, may have stimulated the drilling of salt wells in the United States. George Bissell was still struggling to put his venture together when, on a hot day in New York in 1856, he took refuge from the burning sun under the awning of a druggist's shop on Broadway. There

in the window, he caught sight of an advertisement for a rock oil medicine that showed several drilling derricks—of the kind used to bore for salt. The rock oil for the patent medicine was obtained as a byproduct of drilling for salt. With that coincidental glimpse by Bissell—following on his earlier ones in western Pennsylvania and at Dartmouth College—the last piece fell into place in his mind. Could not that technique of drilling be applied to the recovery of oil? If the answer was yes, here at last was the means for achieving his fortune.

The essential insight of Bissell—and then of his fellow investors in the Pennsylvania Rock Oil Company—was to adapt the salt-boring technique directly to oil. Instead of digging for rock oil, they would drill for it. They were not alone; others in the United States and Ontario, Canada, were experimenting with the same idea. But Bissell and his group were ready to move. They had Professor Silliman's report, and because of the report they had the capital. Still, they were not taken very seriously. When the banker James Townsend discussed their idea of drilling, many in New Haven derided it: "Oh Townsend, oil coming out of the ground, pumping oil out of the earth as you pump water? Nonsense! You're crazy." But the investors were intent on going ahead. They were convinced of the need and the opportunity. But to whom would they now entrust this lunatic project?

Rubric - Annotations

Interaction with the Text

1	2	3	4
Little evidence of true <u>interaction with text</u>: • lots of underlined text with few accompanying margin notes, • margin notes are overly obvious, or rushed	Evidence of some <u>interaction with text</u>: • intentionally marking text with accompanying margins notes / symbols • margin notes are often rushed and obvious but present	Evidence of strong <u>interaction with text</u>: • occasionally rereads passages as needed • asking and answering questions, • writing and revising summaries as needed, • Generally writes margin note and/or symbol when marking text	Evidence of thorough interaction with text <u>including reading</u>: • reread passages as needed • asking and answering questions, • writing and revising summaries and inferences as needed, • identifying, defining unknown, important vocabulary, • Consistently writes margin note and/or symbol almost every time text is underlined.

Close Reading:	
Annotation Quantity	~ 5 – 8
Annotation Quality	4 in each strand
Substantial markings on the text give detailed evidence your reading process & comprehension.	