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FOR EXCELLENCE IN MIAMI-DADE PUBLIC SCHOOLS

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Molecules That Shaped History

Molecules that Changed History

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Goals and Objectives

As a teacher I frame my classes around the idea that chemistry is not a singular subject, but explains that nature of the world around us and the history that has shaped said world. Throughout the year, I introduce students to various compounds and how they relate to our lives. This is a culminating project in which students have the opportunity to learn the history behind a molecule that interests them and take their research a step further.

The book, *Napoleon's Buttons*, discusses seventeen molecules that have been vital to shaping the events of the past several thousand years. It goes in depth into the molecules and their derivatives. Not only is there a thorough explanation of the science, synthesis and discovery behind these important compounds, but events that they affected that have changed the course of history.

While this project is geared towards my AP students, who have a better understanding of more advanced topics, it can be introduced to almost any chemistry class. At the end of the year, students have been taught a host of concepts that involve reaction types, isomers, lab safety, and basic organic structures. This will help them understand the various topics presented in each chapter and give the autonomy to choose the chapter that best interests them.

From the chosen chapter, students are required to annotate and create a vocabulary list of the terms and words that are given to them. These words should be essential to understanding the topic. As they go through the book, they should write a summary of the chapter to show understanding and any questions that have come up with.

Next, the students need to write a research paper about a molecule related to their chapter and the current uses for it. It is critical that students are able to read and analyze academic texts, a skill that is used in college and beyond. The second part of the paper is to find a new and developing molecule that could further shape our future.

As all of this is done in a chemistry course, it would not be complete without labs to emphasize two of these important molecules. Both labs can be purchased through Flinn Scientific for a nominal cost and gives students the opportunity to use their

tactile skills that they have been developing throughout the year. The first is the synthesis and analysis of Aspirin and the other is a demo on the synthesis of Nylon.

Many different Florida state standards are covered in the duration of the unit. The most obvious are which are chemistry strands involving reactions and molecules. They will apply this knowledge to understand the human impact on history and current events and use this information to research and write a paper using an academic voice. Finally, depending on the intensity of the lab write up, students will analyze the data from both labs to write a high level lab report.

Florida Standards

SC.912.P.8.8 - Characterize types of chemical reactions, for example: redox, acid-base, synthesis, and single and double replacement reactions.

SC.912.P.8.7: Interpret formula representations of molecules and compounds in terms of composition and structure.

SC.912.N.4.1 - Explain how scientific knowledge and reasoning provide an empirically-based perspective to inform society's decision making.

SC.912.N.4.2 - Weigh the merits of alternative strategies for solving a specific societal problem by comparing a number of different costs and benefits, such as human, economic, and environmental.

SC.912.P.8.13: Identify selected functional groups and relate how they contribute to properties of carbon compounds.

LAFS.1112.RST.1.2: Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

LAFS.1112.RST.1.3: Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

LAFS.1112.RST.3.8: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

LAFS.1112.RST.3.9: Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

LAFS.1112.WHST.3.8: Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience;

integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.

Unit Overview

Each day is completed in block scheduling of 90 minute periods. Most work is completed at home or independently. This project is given at the end of the year during testing season. Most students are not seen every class period, but it is worked on in class when possible.

First term – Molecule of the Week (teacher)

Begin by highlighting a new molecule every week. Show the historical importance and have students start understanding the structures and important functional groups.

Second term – Start of Project – Molecule of the Week (student)

Students should know have an understanding of what information to present. Have a different student each week pick a molecule, explain the basic synthesis and history of it and the chemical structure. This can be done on a poster, a short video, or a powerpoint.

Week 1 – Introduction to *Napoleon's Buttons*

Students can either be given a chapter to read from the book throughout the year or they can choose a chapter based off the summary. Students must write a vocabulary list and summary of the introduction and their chosen chapter as a homework assignment. Synthesis of Aspirin Lab is completed.

Week 2 – Draft Proposal

Students write a one page draft proposal of chosen molecule and new molecule including a bibliography.

Week 3 – Visual Presentation

Continue working on research paper. Create a poster, video or powerpoint of research that has been completed. Nylon Demo is completed in class

Week 4 – Final Presentations

Present findings to the class.

Term 1 – Molecule of the Week

Each week highlight an important molecule that may be familiar to students. They should be relevant to the time of year. For example, pumpkin spice during fall or mercury when learning about elements. There are many great infographics that illustrate these concepts at http://www.compoundchem.com/infographics/

Source - http://cen.acs.org/articles/94/i32/Periodic-Graphics-Russian-doping-scandal.html

Mid-Year – Molecule of the Week

Students sign up at the beginning of the year of when they would like to present. One student per week is best, though it may not be feasible due to the size of the classroom. They should pick molecules that are interesting and relevant, but not too complicated based on their current understanding of chemistry. Students should have

a working knowledge of the molecule and should be able to field questions from the instructor and other students.

Presentations can be done on the board, accompanied by short videos, or as powerpoints. The information should include the molecular name, common names, structure, and facts about its relevance. They should include at least two references.

Week 1

Read the Introduction and assigned chapter. Annotate both as it is read, which can be done in the book or in printed PDFs.

Create a list of terms from your chapter and try to get definitions for them, using the book, a chemical dictionary or a reputable web site.

Write a summary of assigned chapter from annotations and notes. This should consist of bullet points listing main points or ideas. Should be written in the student's own words.

Re-read your summary, then write one sentence that summarize the entire chapter.

Write out 3-4 questions that you have after reading the article. These will help guide the student in writing the research paper.

Complete Synthesis of Aspirin Lab. Write lab report as previously done.

Week 2

1) Write a draft proposal stating the topic of your research paper - This is a one-page, double-spaced, explanation of the compound that you have researched. You should

include some information about the compound including its historical and scientific significance.

2) Develop a reference list of research that will serve as a work cited page for your research paper

3) Write a 3-4 paged research paper in APA format on the following topic:
    a. Choose a historically significant molecule that was not described in the book and write a research paper on how it had an impact on the history of human civilization. Be sure to give chemical AND historical information including, but not limited to the following topics:
        i. How was the compound formed? (scientist who discovered, chemical reaction, compound structure, etc.)
        ii. What impact did the discovery of this compound have on history?
        iii. How might our world have been different had this compound not been discovered?
        iv. Is there any controversy surrounding this compound? Discuss.

    b. Research a molecule that has only recently begun to affect our world in the same class as the chosen chapter. It may be a well-known molecule whose useful properties are only just being realized, or a new molecule recently created in a laboratory. Speculate on how this molecule may affect history in the years to come. Support your speculations with research on similar molecules of the past. Be sure to give chemical AND historical information on the compound.

Week 3

Assemble a poster, powerpoint and/or model. Visuals, including model(s), maps, diagrams of how the compound acts, etc. should figure prominently on the poster.

Writing should be limited to text that will help the visitor to your poster see what your compound is and understand how your visuals indicate its significance.

Nylon Synthesis Demo is shown.

Week 4

Come to the science final poster or finished powerpoint, any additional props necessary, and all other completed work from the previous three weeks.

Students will need to give a 2-3 minute overview of the molecule, this will be followed by 5 minutes of questions from a chemistry teacher.

Resource List

Brunnig, Andy. "Compound Interest." *Compound Interest*. N.p., 2015. Web. 05 May 2017.

Brunnig, Andy. *The Russian Doping Scandal*. Digital image. *Periodic Graphics: The Russian Doping Scandal*. C&en, 2 Aug. 2016. Web.

Couteur, Penny Le, and Jay Burreson. *Napoleon's Buttons: 17 Molecules That Changed History*. New York: Jeremy P. Tarcher/Penguin, 2004. Print.

"Nylon Mystery Factory." *Chem Fax*. Flinn Sci, 2017. Web.

"Synthesis of Aspirin." *Chem Fax* 7096 (2011): n. pag. *Loyola Science*. Flinn Scientific. Web.

Supplies Needed

Mystery Nylon Factory – Demonstration Kit (Flinn Scientific - $29.80)

Synthesis of Aspirin – Student Laboratory Kit (Flinn Scientific - $53.85)

Class Set of *Napoleon's Buttons: 17 Molecules That Changed History* (Amazon - $12.57/each)

Appendix A

Grading

Step 1 – Read and summarize the Chapter 25% of grade

Students needs to show an annotated chapter (return to student straight away)

Hand in a summary on the due date

Vocabulary list
Bullet point list of main points (paragraph by paragraph)
Single sentence the summarizes the chapter
3-4 questions

Grading Rubric for Step 1

Annotated article: /10

- article has been annotated
- use of a key to denote vocab, questions, etc

Vocabulary List: /10

- Has a vocabulary list
- Each word has a meaning
- A comprehensive list

Questions: /10

- Has 3-4 questions
- Questions reflect in depth analysis of the article

Summary /10

- has a list of bullet points of important notes
- has an overall statement summarizing the article
- identifies a topic connected to their molecule

Total /40

Step 2 – Research **25% of grade**

Grading Rubric for Step 2

Questions: /10

- Has 5 – 9 questions with bullet point answers
- Each bullet point has a footnote

Bibliography: /10

- Student has a Bibliography
- Bibliography is linked to notes
- Student follows MLA style

Answers: /10

- Write a 3-4 paged research paper in APA format on the specified topic

Sources: /10

- Student has at least 4 sources
- Sources are appropriate
- at least 3 articles, one book reference, and one reference to *Napoleon's Buttons.*

Total /40

Step 3- Poster/display **25% of grade**

Poster includes most of the following elements

- A map showing historical links
- Model or diagram showing the chemical structure of the molecule(s).

- Information on its impact on the modern world and political issues
- A timeline
- A title
- Text that is easy to read
- A clean and concise layout
- Not too much text
- Relevant equations
- Poster is free standing (student is free to talk without having to hold up the poster)

Grading Rubric for Step 3

Visual Impact: /10

- Clear title
- Good use of color
- poster shows a hierarchy of information
- good use of images

Historical Context: /10

- Map or timeline shows impact of molecule on history
- Origin / synthesis of the molecule
- significance of the molecule

Use of Text: /10

- Font size varies for title, sub headings, regular text
- Text can be read from a distance
- Use of color enhances understanding
- Images linked to text
- Very little text

Science Content /10

- Correct use formulae, terminology, and equations
- Visual representation of the molecule/structure
- any other important /significant aspects to your molecule

Total /40

Step 4 – Presentation **25% of grade**

Student comes to presentation on time
Student stays for the full hour and looks at other displays

Student gives a 2 minute talk summarizing their molecule
Student can answer 4-5 questions
Student make correct use of terminology
Student demonstrates mastery of the topic
Student can link their molecule to a major unit covered in class this year

-

Grading Rubric for Step 4

Verbal communication: **/5**
1. Speaks with a clear voice
2. Looks at the teacher
3. sounds confident

2 minute talk: **/10**
1. Talk is concise and factual
2. Covers the main points

Use of props: **/5**
1. Makes good use to any props like a poster or model

Questions: **/20**
1. Can answer simple questions
2. can answer complex questions

/40

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- Open to all K-12 M-DCPS teachers, counselors, media specialists
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- Grant recipients recognized at an Awards Reception

To apply, you must contact the teacher who developed the idea before submitting your application. Contact can be made by attending a workshop given by the disseminator, communicating via email or telephone, by visiting the disseminator in their classroom, or by having the disseminator visit your classroom.

Project funds are to be spent within the current school year or an extension may be requested. An expense report with receipts is required by Friday, June 1, 2018.

APPLICATION DEADLINE: December 13, 2017

Apply online at educationfund.org

For more information, contact:

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