A Web-Based Collaborative NGSS-Centered Chemistry Unit on the Topic of Atomic Structure

By

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PROJECT

This project aids in answering the research question: *What can a web-based, collaborative, NGSS-centered chemistry unit, on the topic of Atomic Structure look like?* These Next Generation Science Standards move teachers away from teaching science in the older ways. These ways meant students were just memorizing facts, definitions and concepts. These standards provide a way for students to learn more on applying their knowledge and prior knowledge to more complex problems and real world situations. These new standards can lead to improvement in learning, engagement and application of scientific concepts to the real world in high school science classrooms, specifically in chemistry.

This project is a web-based design resource for teachers all over the world to access and collaborate on NGSS-centered lesson plans. It is a way to provide teachers with a brief description of NGSS and then provide a unit plan focused on Atomic Structure. It will include a link to an atomic structure unit outline. Within that link will provide a schedule of 15 days worth of lesson plans and resources attached with them.

The intended audience for this project are high school chemistry teachers from around the world. The goal is to create a website where teachers have access to these NGSS-centered lesson plans and provide feedback on them. Teachers will be able to add feedback in a Google Form format and ask their own questions also. It is also intended for new teachers using NGSS and to learn more about NGSS and what NGSS-centered lessons look like.

The project format is a website using Google Sites. It provides a homepage titled: Next Generation Science Standards Chemistry Atomic Structure Unit. It then outlines a brief description of the project, as well as my contact information for any additional questions or feedback viewers may have. Within the website there are three separate pages titled: NGSS,

Lesson Plans and Feedback. The NGSS page provides a brief description of the NGSS and a link to their homepage. The Lesson Plans page provides a link to the unit outline. Finally, the Feedback page provides a Google Form with several questions pertaining to this project. These comments and suggestions will be used to further these lessons and edit them as needed.

WEBSITE LINK

Next Generation Science Standards Chemistry Atomic Structure Unit

Link to Atomic Structure Unit Outline

UNIT OUTLINE

Content	Activities	Time Allocated
What is chemistry?	First Day of Class	1 day
Phenomenon/NOS	Mystery boxes + cathode ray + gold foil (Teacher resource HERE for the mystery boxes) (Teacher notes HERE for the lesson)	1 day
Phenomenon/NOS	The extra piece + Modern atomic Theory (Teacher resource HERE for the extra piece puzzle) Scientist Project Introduction (Exemplar poster HERE)	1 day
EDIJ	Scientist Project work time	1 day
Lab Safety Intro + Bunsen Burner skills	Turn in scientist project Talk about lab safety Using the Bunsen Burner - Presentation Using the Bunsen Burner - Student	1 day
Introduction to Atomic Theory	Stars & Atomic Structure Lab Stars & Atomic Structure Presentation	1 day
Introduction to Atomic Structure: neutral atoms, ions, & isotopes	Teacher Slideshow Build an Atom pHet Atoms, Ions, & Isotopes	1 day
Average Atomic Mass & Mass Spectroscopy	Teacher Slideshow Atomic Mass and Mass Spectroscopy Calculating Atomic Mass	1 day
Formative Assessment	Formative #1	1 day
Organization of Periodic Table Electron Configurations	Teacher Slideshow Orbital Diagrams & Electron Configurations Teacher Slideshow (Slides 1-5) Periodic Families and Trends	2 days
Periodic Trends: Atomic Radii, Electronegativity, & Ionization Energy	Formative #2 Teacher Slideshow (Slide 6 onwards) Periodic Trends Practice Periodic Table Patterns	1 day
Review	Review Activity	2 days
Assessment	Final Assessment	1 day

REFERENCES

AACT. (2020). AACT. https://teachchemistry.org/

Active Learning | Center for Teaching Innovation. (2023). Teaching.cornell.edu.https://teaching.cornell.edu/teaching-resources/active-collaborative-learning/active-learning#:~:text=Active%20learning%20methods%20ask%20students

Andrews, D. A., Sekyere, E. O., & Bugarcic, A. (2020). Collaborative Active Learning Activities Promote Deep Learning in a Chemistry-Biochemistry Course. *Medical science educator*, *30*(2), 801–810. https://doi.org/10.1007/s40670-020-00952-x

Bączek, Zagańczyk-Bączek, M., Szpringer, M., Jaroszyński, A., & Wożakowska-Kapłon, B. (2021). Students' perception of online learning during the COVID-19 pandemic: A survey study of Polish medical students. Medicine (Baltimore), 100(7), e24821–e24821. https://doi.org/10.1097/MD.0000000000024821

Clark-Ibáñez, M., & Scott, L. (2008). Learning to teach online. *Teaching Sociology*, *36*(1), 34–41. https://doi.org/10.1177/0092055x0803600105

Collaborative learning approaches. (2023). https://educationendowmentfoundation.org.uk/education-evidence/teaching-learning-toolkit/collaborative-learning-approaches#:~:text=Technical%20Appendix-

Hamline University. (2023). Web Design Tips. https://docs.google.com/document/d/15UrzucNxbt4Wxg60Pl4uhDeVgj2a3ixS1I3o5IHQsLM/edit?usp=sharing

Klymkowsky M. W. (2007). Teaching without a textbook: strategies to focus learning on fundamental concepts and scientific process. *CBE life sciences education*, *6*(3), 190–193. https://doi.org/10.1187/cbe.07-06-0038

Krueger, J. (2014, July 23). *Pros to Next Generation Science Standards*. StratoStar. https://stratostar.com/pros-to-next-generation-science-standards/#:~:text=The%20focus%20of%20the%20ideas

Long, C. (2023, March 30). *Standardized Testing is Still Failing Students | NEA*. Www.nea.org. https://www.nea.org/advocating-for-change/new-from-nea/standardized-testing-still-failing-students

Major, W. (2014, Fall). Contagion in the classroom: or, what empathy can teach us about the importance of face-to-face learning. *Liberal Education*, *100*(4), 66+. https://link-gale-com.ezproxy.hamline.edu/apps/doc/A422901653/MSIC?u=clic_hamline&sid=bookmark-MSIC&xid=19e547fb

Maqableh, & Alia, M. (2021). Evaluation online learning of undergraduate students under lockdown amidst COVID-19 Pandemic: The online learning experience and students' satisfaction. Children and Youth Services Review, 128, 106160–106160. https://doi.org/10.1016/j.childyouth.2021.106160

McElrath, K. (2021, December 21). *Nearly 93% of households with school-age children report some form of distance learning during COVID-19*. Census.gov. Retrieved March 7, 2023, from https://www.census.gov/library/stories/2020/08/schooling-during-the-covid-19-pandemic.html

McInerney. (2012). Instructional strategies for online high school chemistry: Impact on student learning, success on labs, and active engagement. ProQuest Dissertations Publishing.

Next Generation Chemistry. (2014). Next Generation Chemistry. Retrieved July 24, 2023, from https://tanyakatovich.wordpress.com/

Next Generation Science Standards. (2000). *Next generation science standards*. Nextgenscience.org. https://www.nextgenscience.org/

Nguyen, K. A., Borrego, M., Finelli, C. J., DeMonbrun, M., Crockett, C., Tharayil, S., Shekhar, P., Waters, C., & Rosenberg, R. (2021). Instructor strategies to aid implementation of active learning: a systematic literature review. *International Journal of STEM Education*, *8*(1). https://doi.org/10.1186/s40594-021-00270-7

Robinson, C. C., & Hullinger, H. (2008). New benchmarks in higher education: Student engagement in online learning. *Journal of Education for Business, 84*(2), 101–108.

San Francisco Public Schools / SFUSD. (2023). www.sfusd.edu. https://www.sfusd.edu/

Sarfraz, Hussain, G., Shahid, M., Riaz, A., Muavia, M., Fahed, Y. S., Azam, F., & Abdullah, M. T. (2022). Medical Students' Online Learning Perceptions, Online Learning Readiness, and Learning Outcomes during COVID-19: The Moderating Role of Teacher's

Readiness to Teach Online. International Journal of Environmental Research and Public Health, 19(6), 3520–. https://doi.org/10.3390/ijerph19063520

Strain, R., & Pearce, K. (2001). Active Learning in the Lab: Positively influencing student attitudes toward chemistry. *The Science Teacher*, *68*(2), 30–32. http://www.jstor.org/stable/24154488

The Next Generation Science Standards | NSTA. (n.d.) https://www.nsta.org/nstas-official-positions/next-generation-science-standards

Tyler, B., Britton, T., Iveland, A., Nguyen, K., & Hipps, J. (2018). Engaged and Learning Science: How Students Benefit from Next Generation Science Standards Teaching. Evaluation Report #6. In *ERIC*. WestEd. https://eric.ed.gov/?id=ED596827

U.S. Dept. of Health and Human Services. (2006). *Research-based web design & usability guidelines.* U.S. G.P.O. https://www.usability.gov/sites/default/files/documents/guidelines_book.pdf

Zaitun, Z., Hadi, M. S., & Harjudanti, P. (2021). The Impact of Online Learning on the Learning Motivation of Junior High School Students. *Jurnal Studi Guru Dan Pembelajaran*, *4*(2), 263-271. https://doi.org/10.30605/jsgp.4.2.2021.569