**Instructor Guide : Integrating Leadership Skills, Data Science, Artificial Intelligence, Simulation and Google Tools to learn Chemistry**

Pankaj Mehrotra

1. Instructor at University of the People, California, United States of America
2. IDEAS STEM Fellow at BioQuest Consortium, United States of America

Email- mehrotra85pankaj@gmail.com and pankaj.mehrotra@uopeople.edu

# Abstract

Scientific, leadership and recent artificial intelligence skills are integral frameworks of the curriculum. All of them together or individually can enhance knowledge, critical thinking and creativity.Chemistry is a branch of science and a scientific discipline in which we study the properties of matter. The properties of matter impacts the behavior of matter. The matter is made up of atoms, molecules and ions which participate in chemical reactions to form chemical compounds through chemical bonds. Chemical molecules combine to form biological molecules. Biological molecules combine to form first life forms cells which are further from the biological systems. This lesson will highlight the nature of the atoms, molecules, elements and compounds to provide key concepts in chemistry.

# Description

In this lesson students will learn concepts of atoms, molecules and compounds. Further students will apply knowledge and skills to understand structure of atoms, molecules and compounds, apply and explore the role of atoms, molecules and compounds in biological processes. Students will be taught using powerpoint slides and videos. Students will engage in learning activities to advance knowledge and attain both transferable and transversal skills. Students will also participate in individual and group work taking up leadership roles, exploring simulations, and applying artificial intelligence tools to learn about biological chemistry. Students for engagement evidence will utilize Google tools.

| **Course Name** | **Chemistry** |
| --- | --- |
| Grade Level  | Senior |
| Prior Knowledge | Prior knowledge with AI, Web application and Simulations will be better |
| Learning Goals | **Chemistry : Atoms, Molecules, Elements and Biological Chemistry.** |
| Materials and Technology | Leadership Flashcard - Used to engage team members in group activity and Artificial Intelligence such as Copilot or Gemini to use prompts to obtain initial information The instructor will have example prompts to use to learn about Atoms, Molecules, Elements and Biological Chemistry.Guidance on citation etiquette and transparency of AI use?Simulation - PhET Simulation<https://phet.colorado.edu/en/simulations/build-an-atom><https://phet.colorado.edu/sims/html/build-a-molecule/latest/build-a-molecule_en.html><https://phet.colorado.edu/en/simulations/isotopes-and-atomic-mass><https://phet.colorado.edu/en/simulations/reactants-products-and-leftovers> |
| Estimates Time | 1h:30 min |

| **Phase I – Pre-implementation**  |   |
| --- | --- |
| Warm Up |  |
| Instructor will | Student will |
| Inquiry Based learning- engage students in stump your partner activity i.e. ask students to think and write a challenging question one without AI and another without AI. | TASK - Students will use the available resources like research articles ( available on NCBI Pubmed, Google Scholar), books, AI, and articles to think and search for a challenging question. |
| **Exploration** |  |
| Instructor will | Student will |
| Instructors will give instructions to students to identify the components and their function of PhET Simulations shared with students. | Students will independently and then in peer interaction will explore the simulations.  |
|  |  |
| **Explanation** |  |
| **Instructor will** | Student will |
| Instructor will conduct, one word and one-sentence summary by selecting a component of simulation and asking the student to describe its function. For example, one word story –instructor will engage the whole class or a group of students and start the process by announcing a term, say, “subatomic particles”, then one of the students can add another term, say “ atomic particles”, then next student may add, “element” and so on.After, the turn of every student is over for one word story, then each student will either say or write on google doc one sentence summary of any of the terms from one-word story. | Students will actively engage in adding words/terms first to one word story and later one sentence summary. |
|  |  |
| **Phase II - Implementation Phase** |  |
| **Elaboration** |  |
| **Instructor will** | **Student will** |
| Instructor will ask students in groups to explore first the atom PhET Simulation, then PhET Simulation on molecules, then PhET Simulation on Molecules and then on compounds, and then on elements and then finally the chemical reaction. Instructor will ask students to get involved in a real life example where students will create a table of everyday materials to understand the extrinsic and intrinsic properties of matter, research the atoms, elements and compounds in the selected matter and then possible chemical reactions which may occur due to interaction of the elements.Instructor will then explain how subatomic particles form an atom, atoms form elements and elements form compounds. And atoms, molecules and compounds form biological molecules, including their functions.. Then give a task to students to use all the simulations to predict how the compounds formed can form proteins to help digest the food they eat.Instructor will then ask students to use self-documentation google tools to create evidence of each member's learning outcomes. | Students in the group will open the simulation, create a list of all the components of two PhET Simulation and HHMI Click & Learn Type.Students will then get involved in real life discussion of what is the composition of materials they have selected in their immediate surroundings and then at their home. And which materials had the most percentage of sub-atomic, atomic, elements and compounds listed in the table. Also list possible chemical reactions which may occur when the matter will react with atmospheric compounds. Finally identify the component of food they ate - to list the biological molecules. Each student will create their own table and also do data science for the purpose of analysis.Students will then use simulations to understand how structure and function of atoms, molecules, compounds and biological molecules work (actually the enzyme) formed through usage of simulations.. Students will be asked individually to take a screenshot of each of four simulations when they play the simulation to show their understanding of atoms, molecules, compound and chemical reactions, application of chemistry in biological chemistry and then importance in everyday real life examples of biological chemistry in everyday life for example in lecture room, filed and home spaces. |
| **Post - Implementation Phase III** |  |
| **Evaluation** |  |
| **Instructor will** | **Student will** |
| Instructor will create a gallery walk so that students can submit their individual and group work.Instructor will then organize a mini- colloquium so that each group gets the opportunity to share their learning outcomes. For example if there were four groups then two groups present and two groups move to the group presenting to listen and ask questions. And then they move to the second group. Finally, the two groups which did not present – they get the opportunity to present and each group which presented earlier moves around to each group to ask questions to the presenting group. | Students will then submit their individual and group learning evidence to the teacher for presentation on board or power point slides to be shown on small screen television. Students will then present each member of the group and get the opportunity to say something in coherence.Students will then move to other groups to listen and ask questions.Student the phase of organizing a symposium will take different leadership roles to organize and also each group during the phase of work - i.e. presentation of materials for presentation, actual presentation and answering questions will take different roles to execute the group work as a Group presentation. |
| **Extension** |  |
| **Instructor will** | **Students will** |
| Instructor may give this work in classroom or out of classroom | Students can extend this activity by searching for research articles on NCBI PubMed and then discussing various diseases related to lack of elements & compounds and access of elements & compounds – use all the four simulations to understand the disease and identify the component which is missing in the disease but found on the simulation. |