Subject: Chemistry
Topic: Atomic Structure (v24.04.01)
Level: Grade 7-8
Length: 40 min
Difficulty: Basic
Author(s): Katrin Soika, Joana Jõgela

Learning Goals: Understand how protons, neutrons and electrons contribute to the structure of atoms in the periodic table.
Study Results: After the lesson, the student will be able to describe the atomic structure; draw parallels between the position of an element in the periodic table and the atomic structure of that element; construct the electron configuration of an element based on the atomic number; describe an atom as an electrically neutral particle.
Terms: *protons, neutrons, electrons, periods, groups, atomic number, atomic mass, charge*.
Prerequisite Knowledge: A substance is made of molecules. A molecule is made of atoms. An atom is made of smaller particles.
Lesson Prerequisites: Setting up the learning space, VR devices, and Futuclass app.

Table of Contents:

Lesson Schedule - Individual VR Devices

Lesson Structure	Activity Description	Duration	Teacher's Actions	Student's Actions
1. Preparation ● Introduction. ● Getting attention. ● Motivating students, setting the goal. ● Figuring out their current knowledge about the topic. ● Going over prerequisite knowledge.	Start the lesson. Prepare the students for learning. VR device basics. Start the VR device and app, choose the correct module.	~5 min	Remind students of the basics that they have learned. Familiarize students with how to handle a VR device. Log in to portal.futuclass.com. Go to My Sessions. Select "Create" in top right to create a session based on this Module.	Listen. Listen. Wear the VR device. Start the Futuclass app. "Join Session" created by the teacher.
2. Learning ● Fulfills the goal of the lesson. ● Students achieve the needed study results.	Complete levels in the module. Complete the worksheet.	~25 min	Guide the students.	Wear the VR headset, understand the requirements of the atom that needs to be created, as well as the number of each particle currently on the board. Act accordingly.
3. Reflection ● Summarize the results of the lesson. ● Feedback, homework.	Summary.	~10 min	Summarize the topic learned during the lesson. Elicit feedback from students towards the VR experience.	Listen. Talk.

Lesson Schedule - Shared VR Devices

Lesson Structure	Activity Description	Duration	Teacher's actions	Student's actions
1. Preparation ● Introduction. ● Getting attention. ● Motivating. students, setting the goal. ● Figuring out their current knowledge about the topic. ● Going over prerequisite knowledge.	Start the lesson. Prepare the students for learning. Assign roles. VR device basics. Start the VR device and app, choosing the correct module.	~5 min	Remind students of the basics that they have learned. Assign initial roles to everyone in the group. Familiarize students with the VR device. Log in to portal.futuclass.com. Go to My Sessions. Select "Create" in top right to create a session based on this Module.	Listen. Listen. Wear the VR device. Start the Futuclass app. "Join Session" created by the teacher.
2. Learning. ● Fulfills the goal of the lesson. ● Students achieve the needed study results.	Complete the worksheet using the VR device, an internet-connected device and the periodic table at the back of the workbook.	~25 min	Guide the students. Switch the roles so that all students in the group would have the opportunity to try all roles during the lesson, if they wish.	Wear the VR headset to see the requirements of the atom that needs to be created, as well as the number of each particle currently on the board. Fill in the worksheet in cooperation with the student in VR.
3. Reflection. ● Summarize the results of the lesson. ● Feedback, homework.	Summary.	~10 min	Summarize the topic learned during the lesson. Elicit feedback from students.	Listen. Talk.

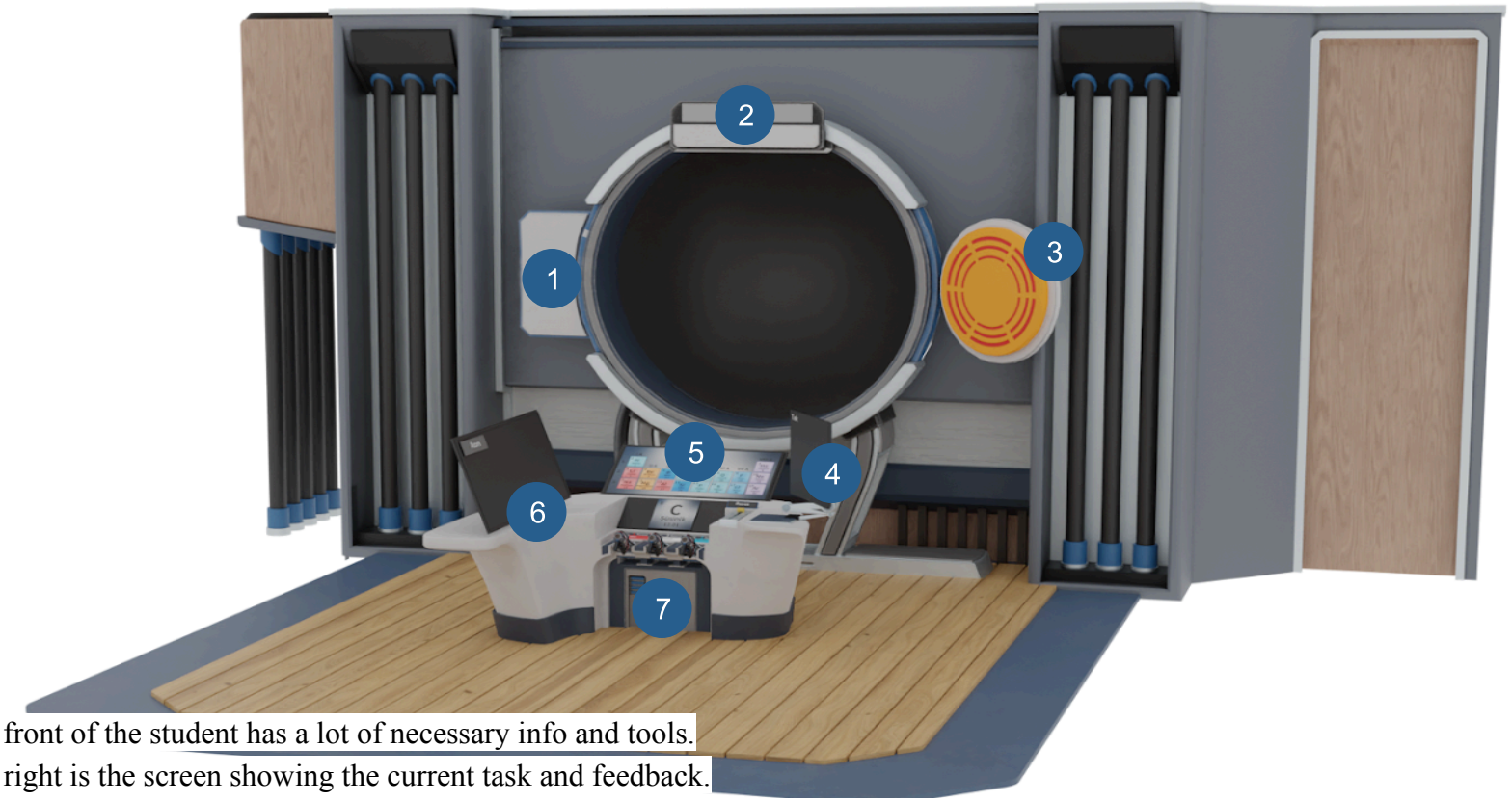
VR Lesson Contents

- In this VR lesson, the goal is to teach and practice the conceptualizing of the atomic structure and the periodic table.
- The student's task is to create planetary models of different atoms using the emitters of protons, neutrons and electrons.
- During the course of the lesson, the student will learn what an atom is made of, what are the organizing principles of the periodic table, and how to find the number of protons, neutrons, electrons and the atomic mass of an element.
- In case the student is not familiar with any term (such as proton, electron layer, period, group etc.) they can learn about it from a touch screen inside the game.
- The student will learn to conceptualize why an atom does not have a charge.
- Mastering the VR lesson requires the student to experiment, to observe the changes in an element's charge and mass number, and to refer to the in-game periodic table.
- In the VR lesson, the student is given different tasks. The goal of each task is to create an atomic model using different input parameters which may include: the atomic mass, proton count, neutron count, period, group, etc.
- Feedback to the student's successes and mistakes is given on the in-game screen.
- The student can at any moment in the game learn more information about these new concepts.
- The teacher can monitor the students' progress in VR using the Session function in Futuclass Teacher Portal at portal.futuclass.com on their phone, tablet or computer.

VR Lesson Layout

The following is an overview of the environment the student will be placed in and be able to experience.

- To complete the module, the student has to create the correct atoms according to the given instructions.
    1. To the left is the particle counter, counting all of the protons, neutrons and electrons.
    2. The large dark target in front of the student is where the atoms will be created. At the top is the current level indicator.
    3. To the right is the confirmation target. Shooting any particle at it will check if the atom created is the correct one.



- The station in front of the student has a lot of necessary info and tools.
    4. To the right is the screen showing the current task and feedback.
    5. In the middle is the periodic table. Below it, an indicator showing the element the student currently has created.
    6. To the left is a large touch screen displaying headings for various concepts. If the student needs more info, they can tap on a heading and the concept will be explained. The buttons will blink if they are relevant to the current level.
    7. At the lower most part are the particle guns with mode buttons (add/remove).

Questions & Answers in the VR Lesson

Correct answers are marked in bold.

#	Question	Answer 1	Answer 2	Answer 3	Answer 4
1.	What does an atom consist of?	**A positively charged nucleus and negatively charged electrons**	Positively charged protons and negatively charged neutrons	A negatively charged nucleus and positively charged electrons	Positively charged electrons and neutral protons
2.	Which positively charged particle count defines the element?	A neutron	A group	**A proton**	A period
3.	What is a subatomic particle with no electric charge, its count is found by subtracting its atomic number from the atomic mass, called?	**A neutron**	A group	A proton	An electron
4.	Which two particles determine the element's mass?	Protons and electrons	**Protons and neutrons**	Neutrons and electrons	Only protons
5.	What is a negatively charged subatomic particle, its count indicated by its atomic number, called?	A neutron	A group	A proton	**An electron**
6.	A row in the periodic table is?	A group	**A period**	An electron	An atomic number
7.	Acolumn in the periodic table is?	**A group**	A proton	A period	An atomic number
8.	What value is 28 for silicon?	The amount of neutrons	**The atomic mass**	The period	The atomic number
9.	What value is 7 for nitrogen?	The atomic mass	The electron count	The period	**The atomic number**

Solution Key

The following table describes what the student has to understand and do in order to complete each level in the VR lesson.

Level	Learning Goal and Required Task
1	Understanding that the number of protons defines the element. *Add protons to create the required element.* (Neutrons and electrons are auto-added.)
2	Understanding that neutrons change the mass but don't change the element. *Add neutrons to create the required element.* (Protons and electrons have been preset.)
3	Understanding that both protons and neutrons contribute to the mass of the atom. *Add protons and neutrons to create the required element. Observe the atomic mass.*
4	Understanding that the number of protons and electrons has to be the same. *Create an element based on how many protons, neutrons and electrons it has.*
5	The number of electron layers corresponds to a row in the periodic table. *Create an element from a specific period.*
6	Number of electrons on the last layer (for group A elements) corresponds to a column in the periodic table. *Create an element from a specific group.*
7	Combine your knowledge of atomic mass and the number of electron shells. *Create an element of a specific period given the constraint on the atomic mass.*
8	Combine your knowledge of atomic mass and electrons on the outer shell. *Create an element of a specific group given the constraint on the atomic mass.*

Worksheets - Shared VR Devices

The student wearing the VR headset can see the requirements for the atom which needs to be created, as well as the number of each particle currently on the board. Other students fill in the worksheet in cooperation with the student in VR.

General

1. What is the charge of the following particles?

    a. Electron ……
    b. Proton ……
    c. Neutron ……
    d. Atom ……
    e. Atomic nucleus ……

2. Fill in the gaps to formulate the following laws:

    a. The number of protons in an atom is equal to the number of .....
    b. The number of protons and neutrons makes up .....
    c. The nuclear charge is equal to the number of .....
    d. The atom as a whole has a ..... charge because ..... the number of ..... and ..... are equal.
    e. Chemical elements are arranged in the periodic table according to the increasing .....

Levels 1-4

Element Name	Element Symbol	No of Protons	No of Neutrons	No of Electrons	Atomic Mass

Levels 5-6
Draw two elements next to the table atomic model. Be sure to add a legend as well.

Element Symbol	**Electron Shells**	**Electrons on the Outer Shell**	**Two Element Drawings**

Levels 7-8

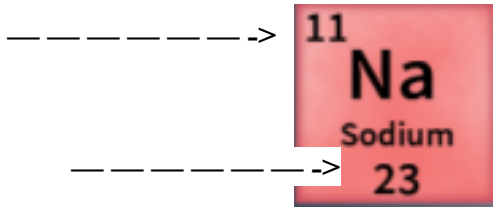
Element Symbol	Instructions on the Panel	Electron Configuration

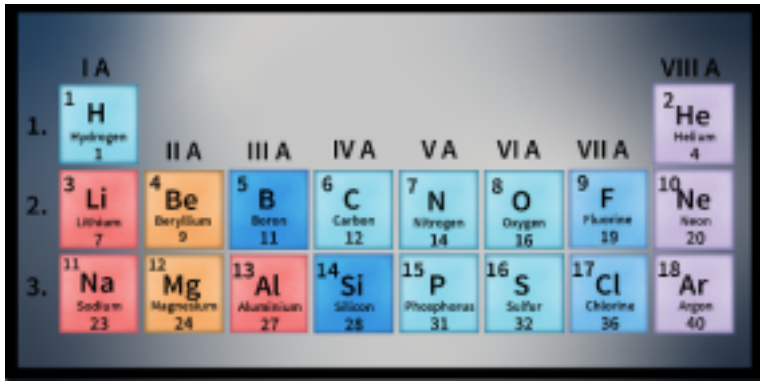
Reflection

1. Write the correct term after each explanation. The correct terms are listed below.
   - A positively charged subatomic particle, the count of which is indicated by the atomic number, is called a ___
   - A negatively charged subatomic particle, the count of which is indicated by the atomic number, is called an ___
   - A subatomic particle with no electric charge, the count of which is found by subtracting the atomic number from the element's atomic mass, is called a ___
   - A row in the periodic table is called a ___
   - A column in the periodic table is called a ___

   Choice of terms (two of them redundant): electron, atomic number, group, neutron, period, proton, molecule.

2. Write on the lines what the numbers in the box represent. *Use the terms: number of protons, number of electrons, number of electrons in the outer layer, atomic mass, number of nuclei, number of electron layers.*





3. Use the periodic table to decide which element is being described. Answer by writing the symbol of the correct element.
   - Which element has 4 protons?
   - Which element has a mass number of 24?
   - Which element has 3 electron layers and a mass number less than 24?
   - Which element has 3 electrons in the outer layer and a mass greater than 15?

Take this test online:
https://forms.gle/iMZaVQLZr9Nn8Pwp7