Atom Structure

Teacher's Guide

1.0 Summary

"Atomic structure" is the third activity to be done after the pre-test. This activity should take students approximately one class period.

2.0 Learning Goals

Driving Question: How do subatomic particles make an atom radioactive or ionic?

This activity provides an overview of the relationship between protons, neutrons and electrons in an atom. These particles combine in different quantities to make an atom radioactive or charged. Stable or non-radioactive atoms generally have about one proton for every neutron. Electrically neutral atoms have one electron for every proton.

Learning Goals

- Students will review the particles that make up an atom.
- Students will understand that the electron to proton ratio is 1:1 in electrically neutral atoms.
- Students will understand that stable atoms have about one neutron for every proton.
- Students will understand that radioactive atoms break down into different elements.
- Students will understand that radioactive elements give off energy when they break down.
- Students will learn to define a half-life.

Additional Teacher Background

Atoms are formed from protons, neutrons and electrons. Each of these particles contributes to the stability of an atom. The balance between protons and electrons contributes to the electrical stability of the atom. Atoms that are not electrically neutral tend to attract positive particles if they are negatively charged and negative particles if they are positively charged. This charged atoms are called ions and tend to be more reactive than neutral atoms. Since electrons have a negative charge, adding electrons makes the atom more negative. To calculate the charge on an atom use the following formula:
Protons-Electrons = Charge

Protons are held in the nucleus by the strong force. This is like superglue that holds the protons together. Normally they would break apart because of the like charges. Neutrons act as buffers against this repulsion. When there is about 1 neutron for every proton in the nucleus, the atom tends to be stable. If the atom has too few or too many neutrons the nucleus will break apart into a new atom. This breakdown of atoms is radioactivity. When this occurs you get smaller atoms and energy is released.

3.0 Standards Alignment

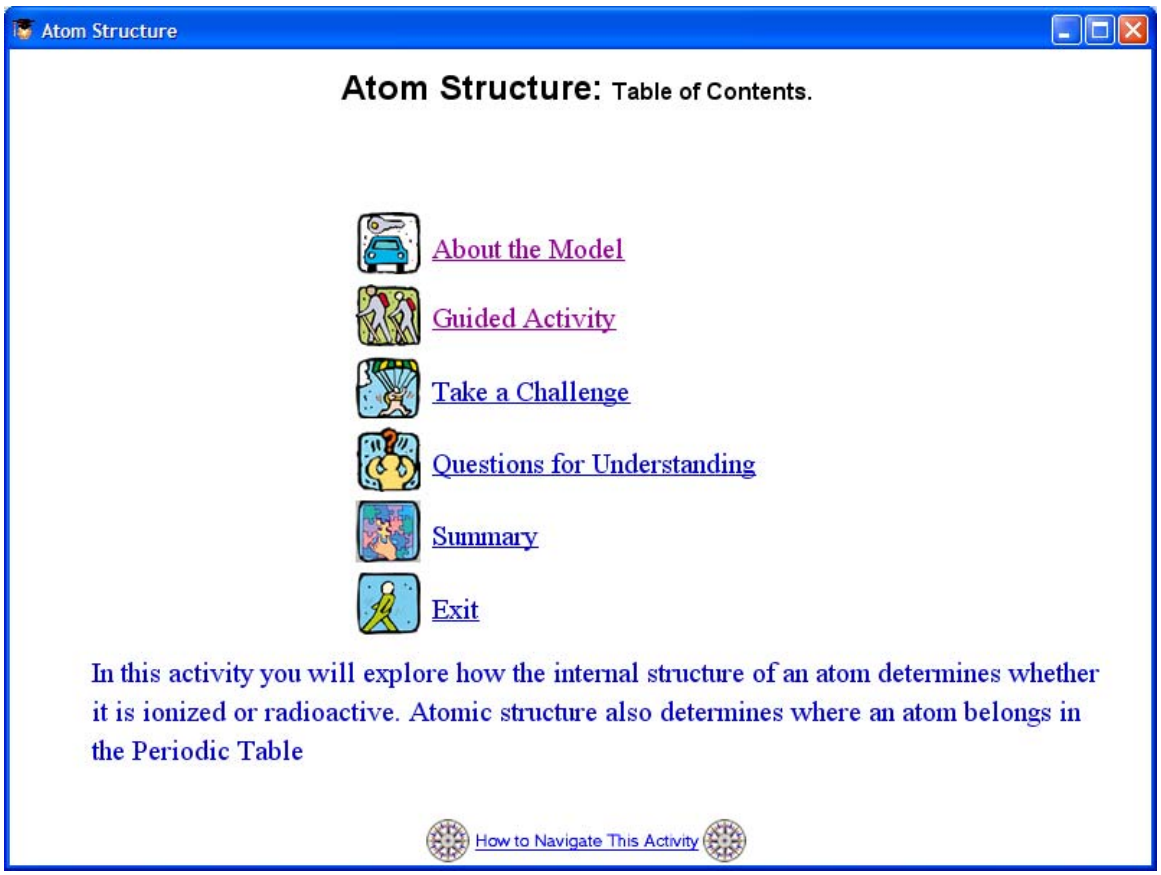
Alignment to National Math and Science Standards (NCTM or NSES)

Objective	Standards
Students will understand how the ratio between neutrons and protons affects radioactivity.	• Varies by state.
Students will understand how the number of protons and electrons affects the charge of atom.	• Varies by state.
Students will understand that unstable atoms are likely to be reactive.	• Varies by state.
Students will be able to understand half lives.	• Varies by state.

4.0 Activity Sections

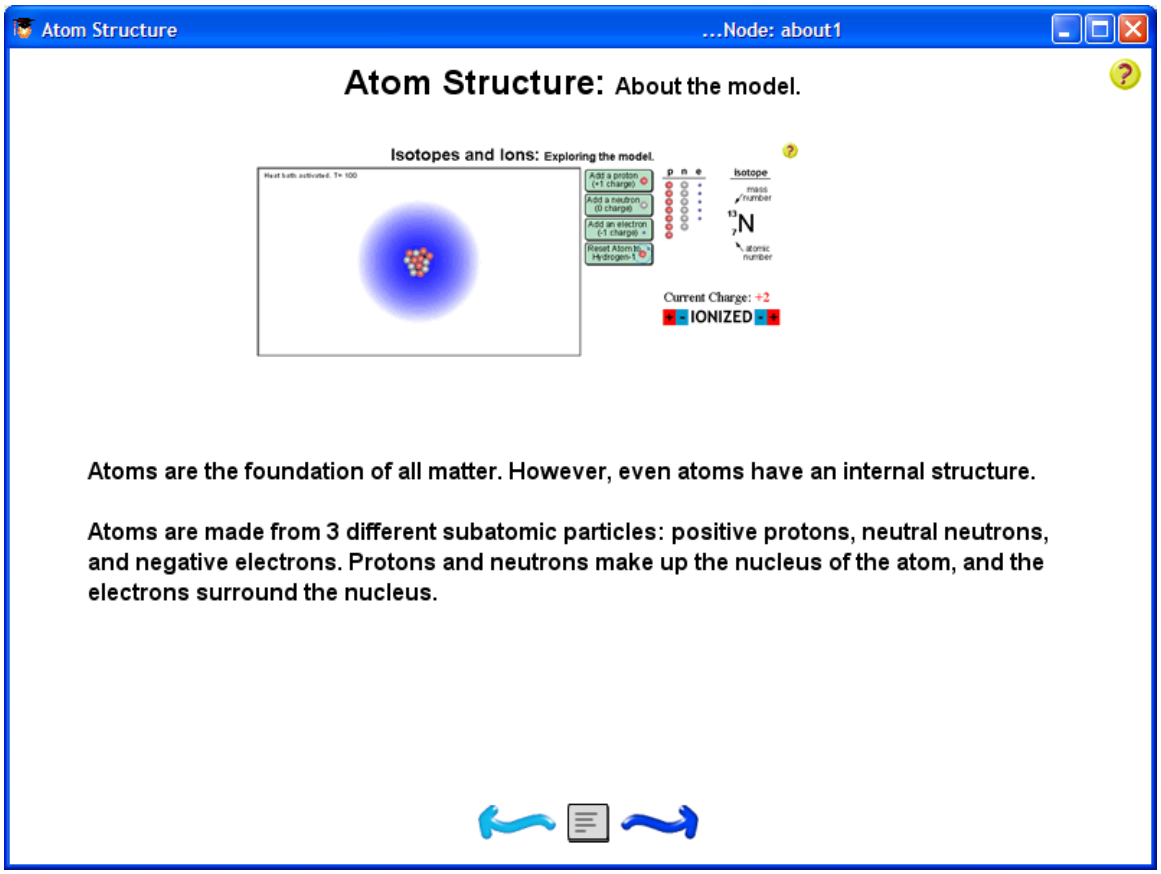
4.1 Table of Contents

This activity has 5 sections.

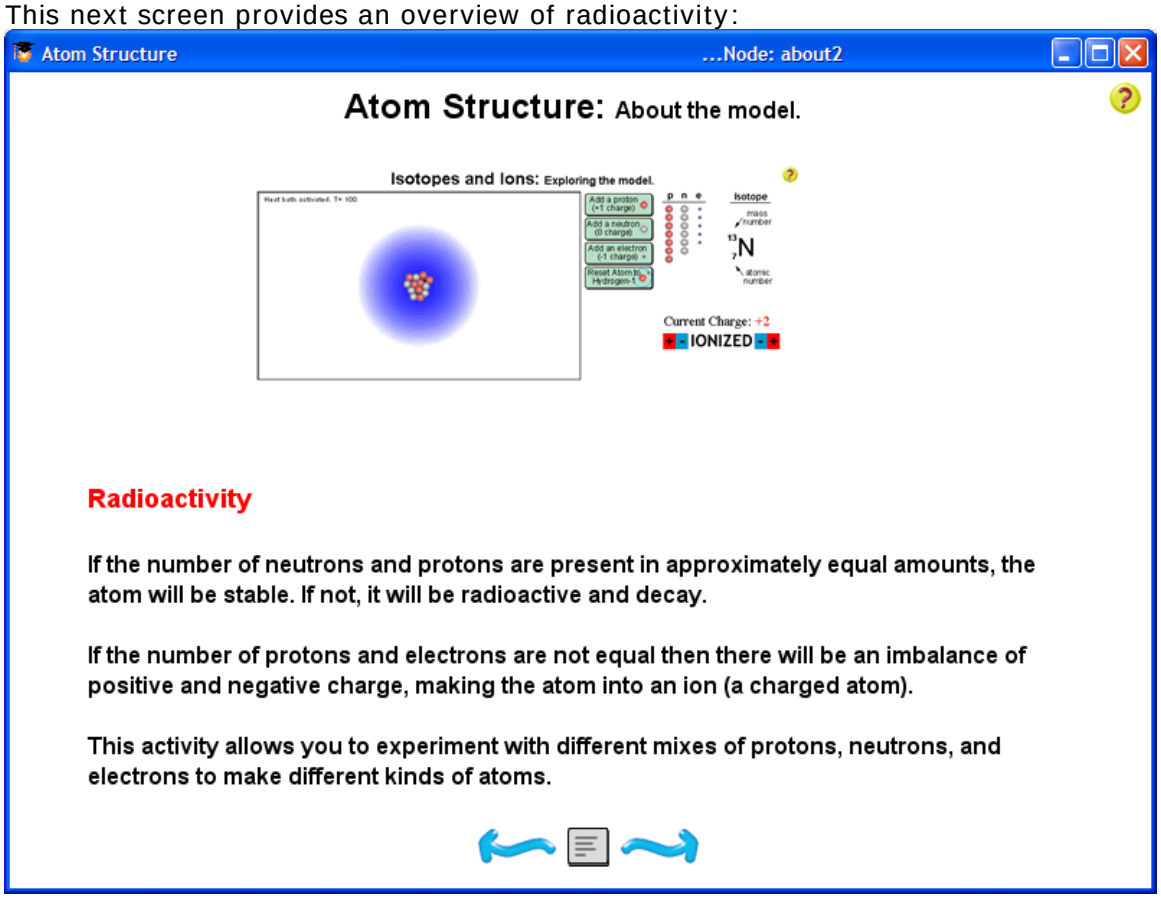


4.2 About the model

In this step students are reminded that atoms are made up of three different subatomic particles.:

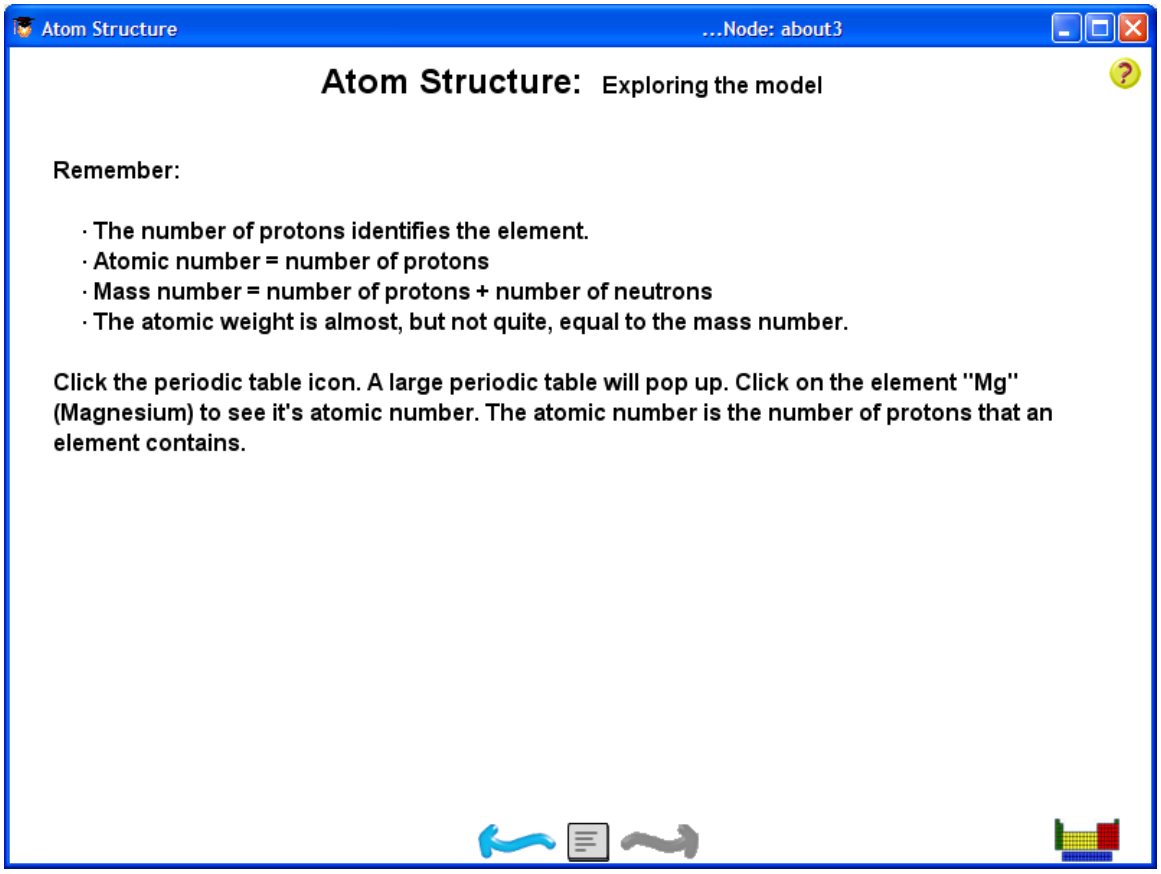


This next screen provides an overview of radioactivity:

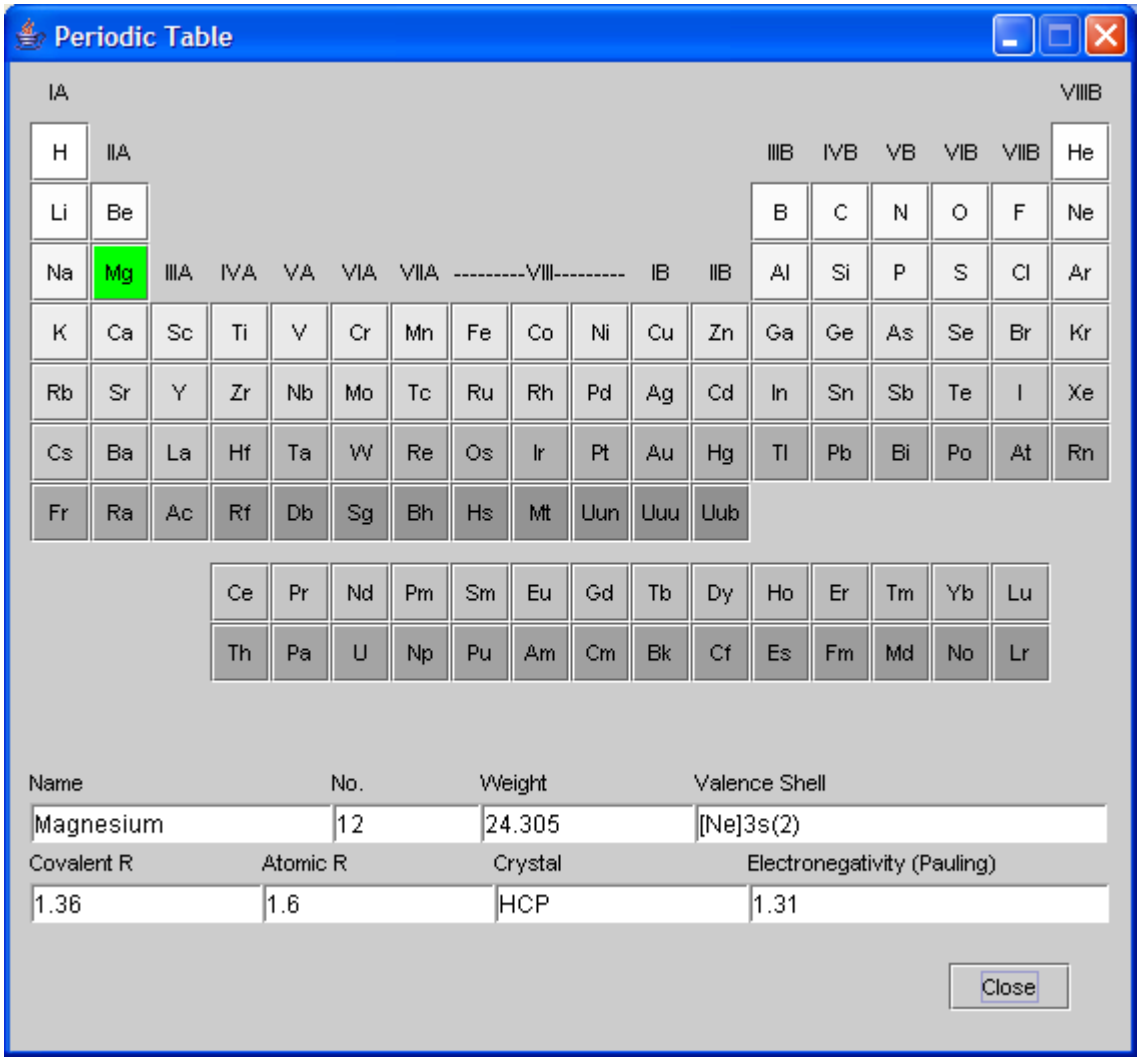


The third screen provides an overview of terms including:

- Atomic number
- The mass number
- Atomic weight



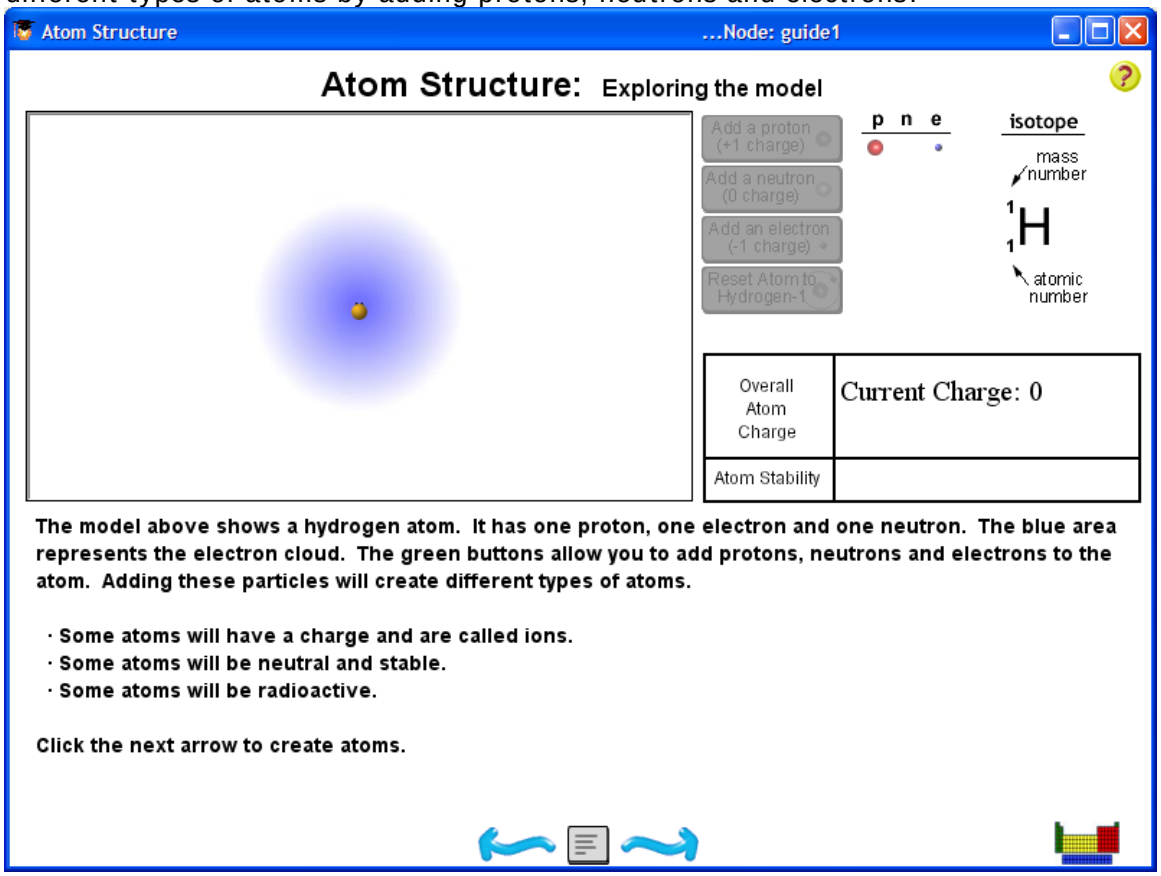
It is worth noting that the students need to click on the periodic table in the lower left hand corner to continue. This table will provide information about each element. This information via the table is available during the rest of the exercise. Students should be encouraged to use this table when they need the information:



Click on MG and then Close the window

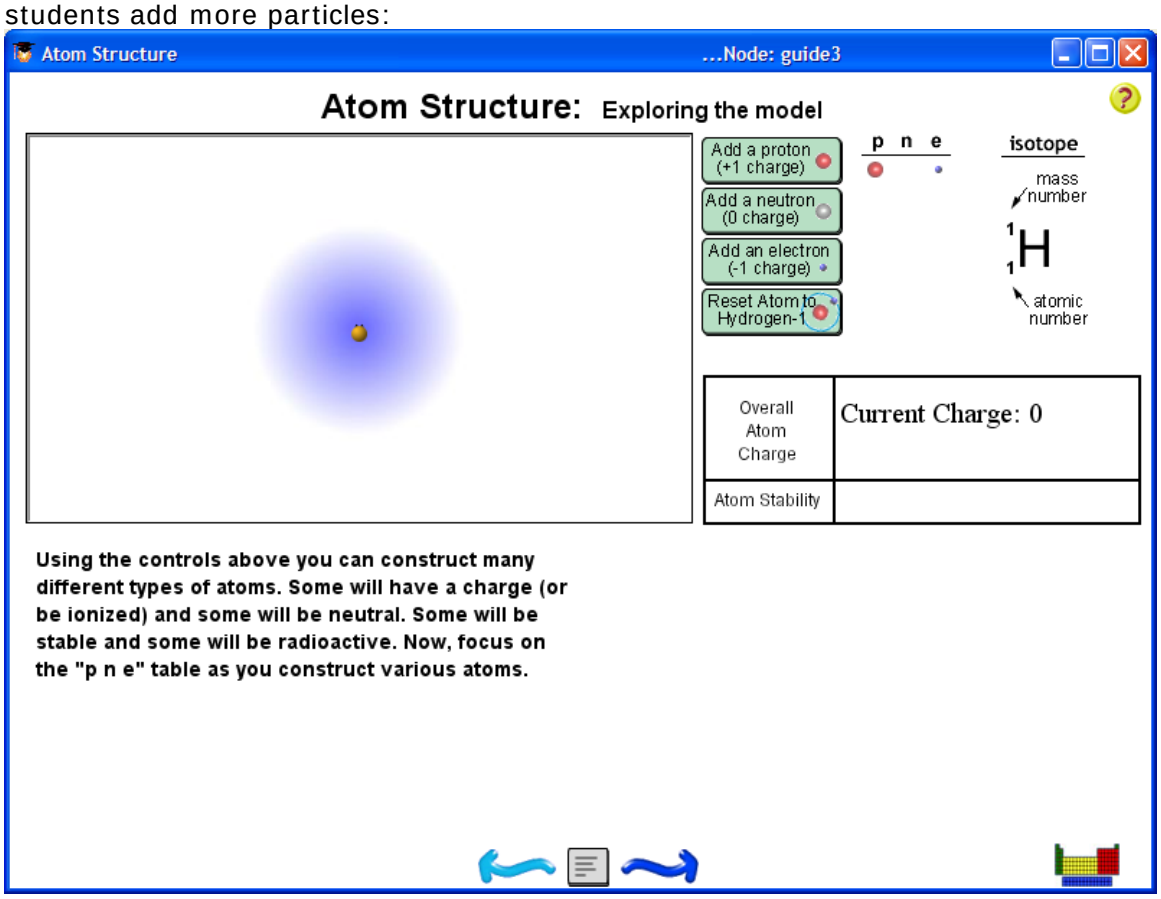
4.3 Guided activity

This section introduces the student to the model that allows the formation of different types of atoms by adding protons, neutrons and electrons:

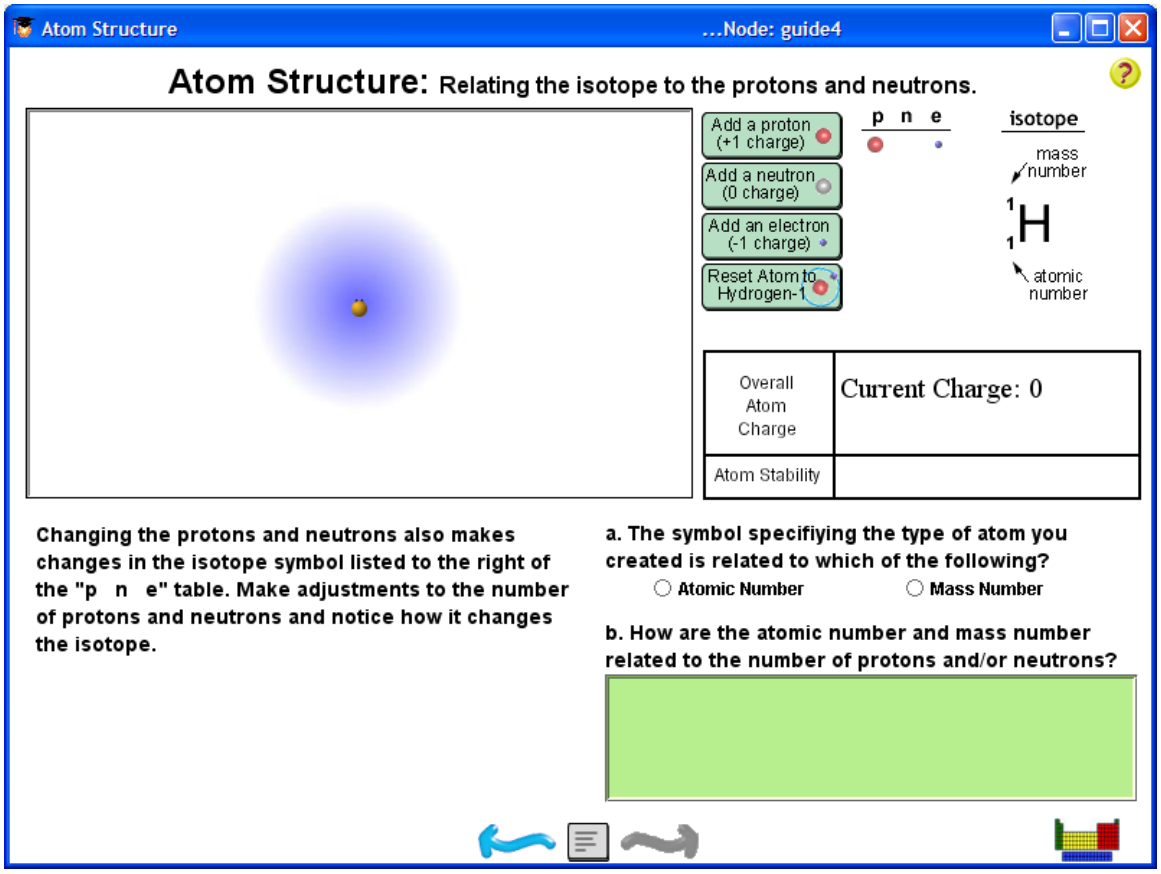


In the model students vary the number of each particle. It is worth noting that unstable atoms will break down if they are left too long. This simply resets the model back to hydrogen.

On the next page students are encouraged to play with the model. The subsequent page encourages more interaction by asking the students to look at the PNE table on the page. Please note that this table will change as the students add more particles:

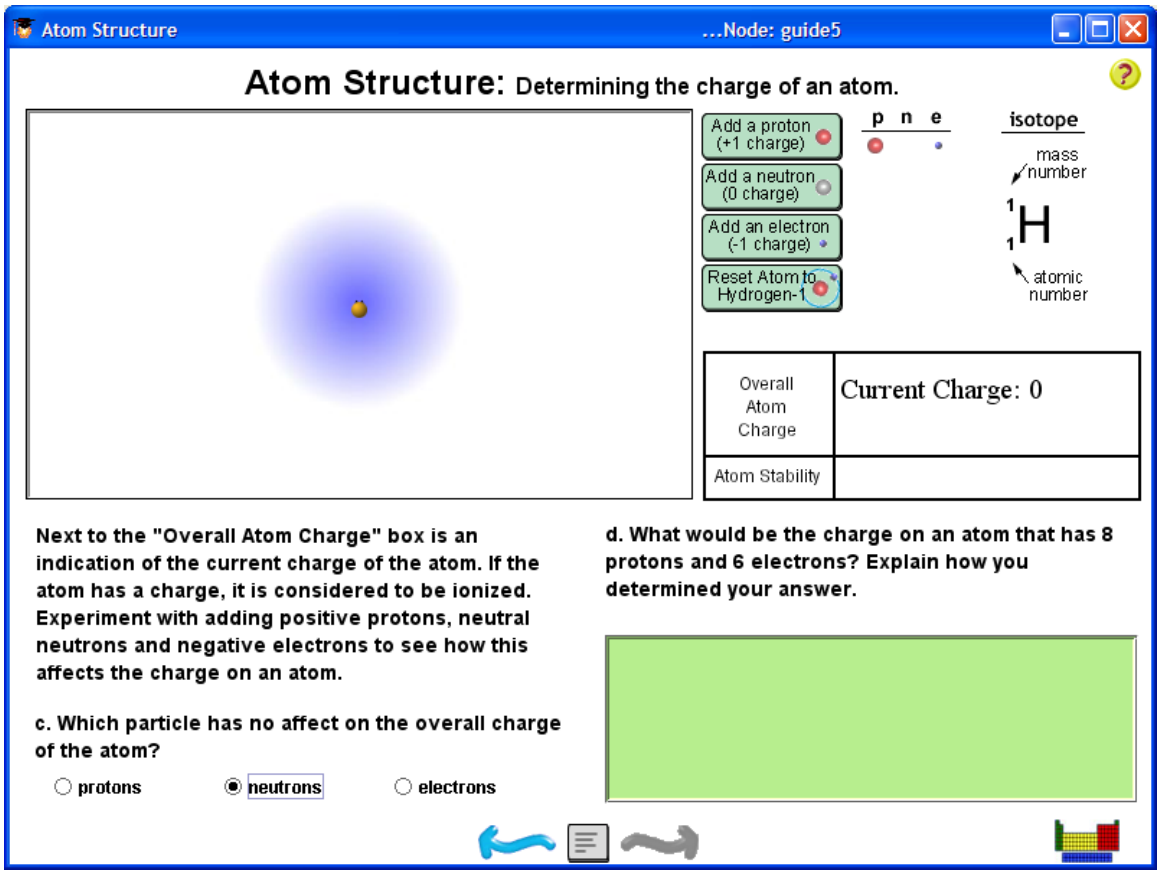


The next page asks students to use the model to uniquely identify the element. Please note that the atomic number uniquely identifies the element.
Atomic number = Number or protons
Mass number = Protons + Neutrons

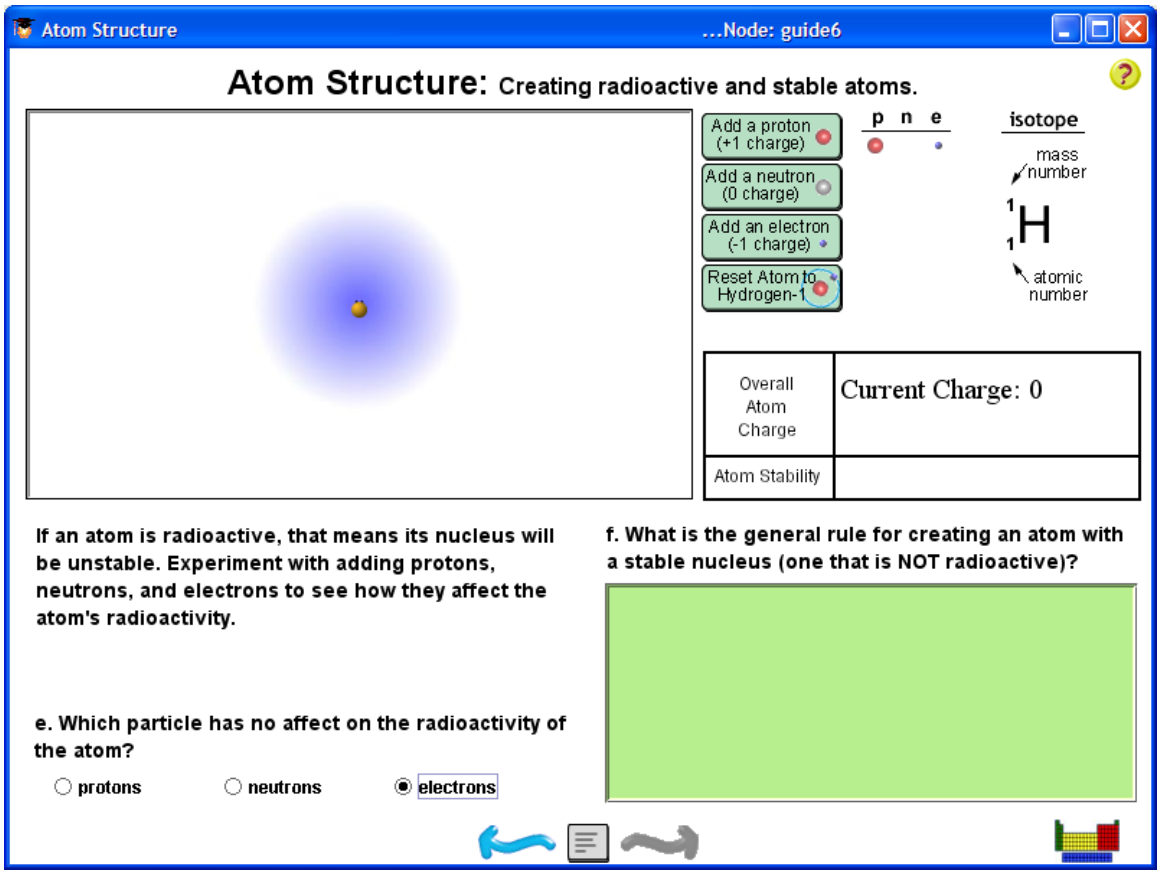


The next page asks students to observe that neutrons have no affect on the overall charge of the atom:

Then, once they have answered that question, the students must use the formula:
Protons – electrons = Charge. In this case, 8-6 =2.

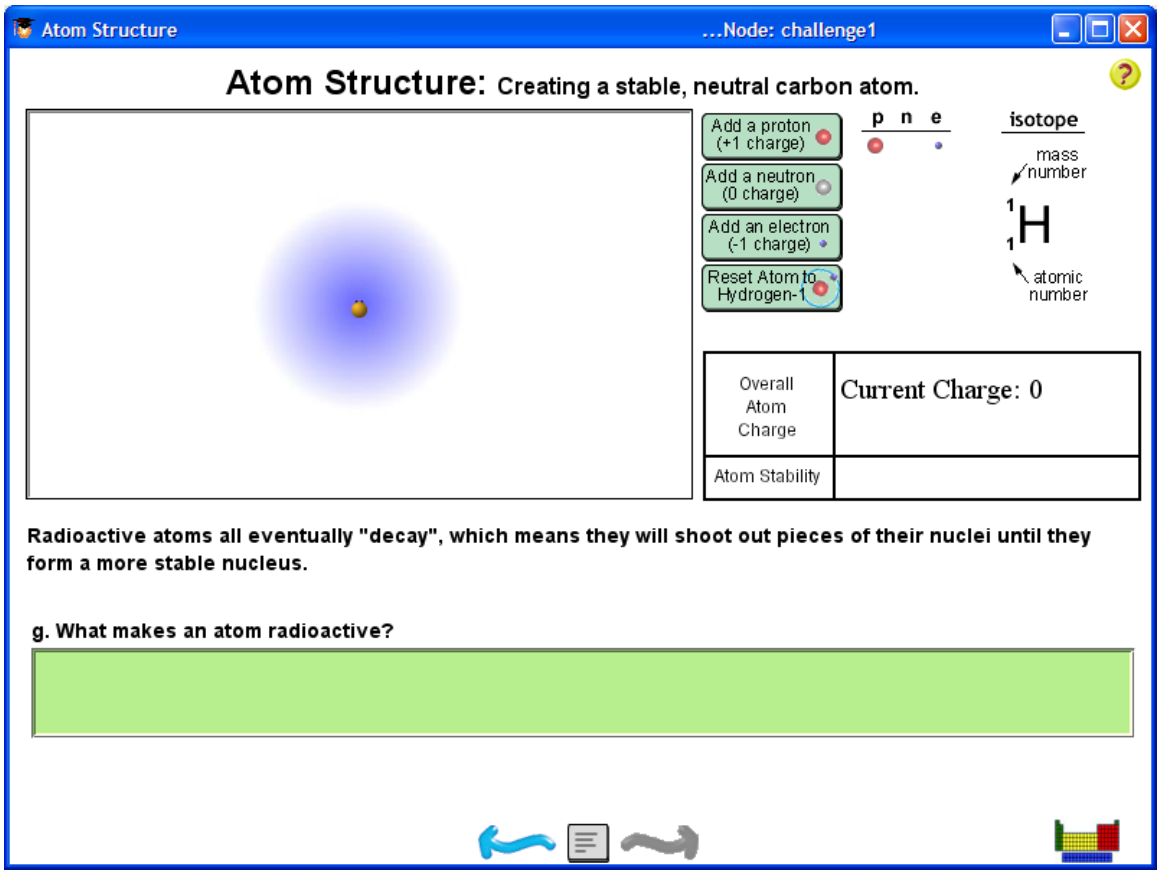


On the next page students choose the particle that does not impact radioactivity (the electron) and should be able to observe that atoms which have one proton for each neutron tend to be stable:

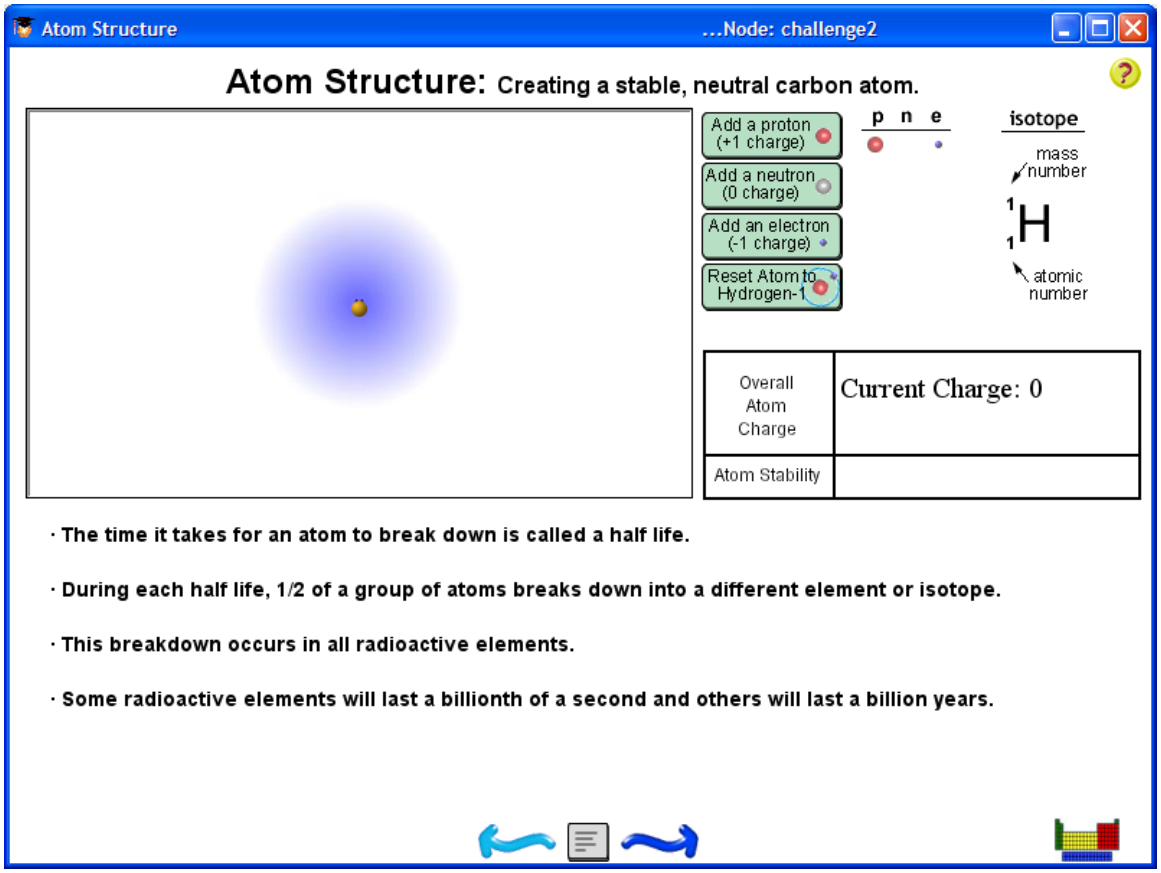


4.4 Take the challenge

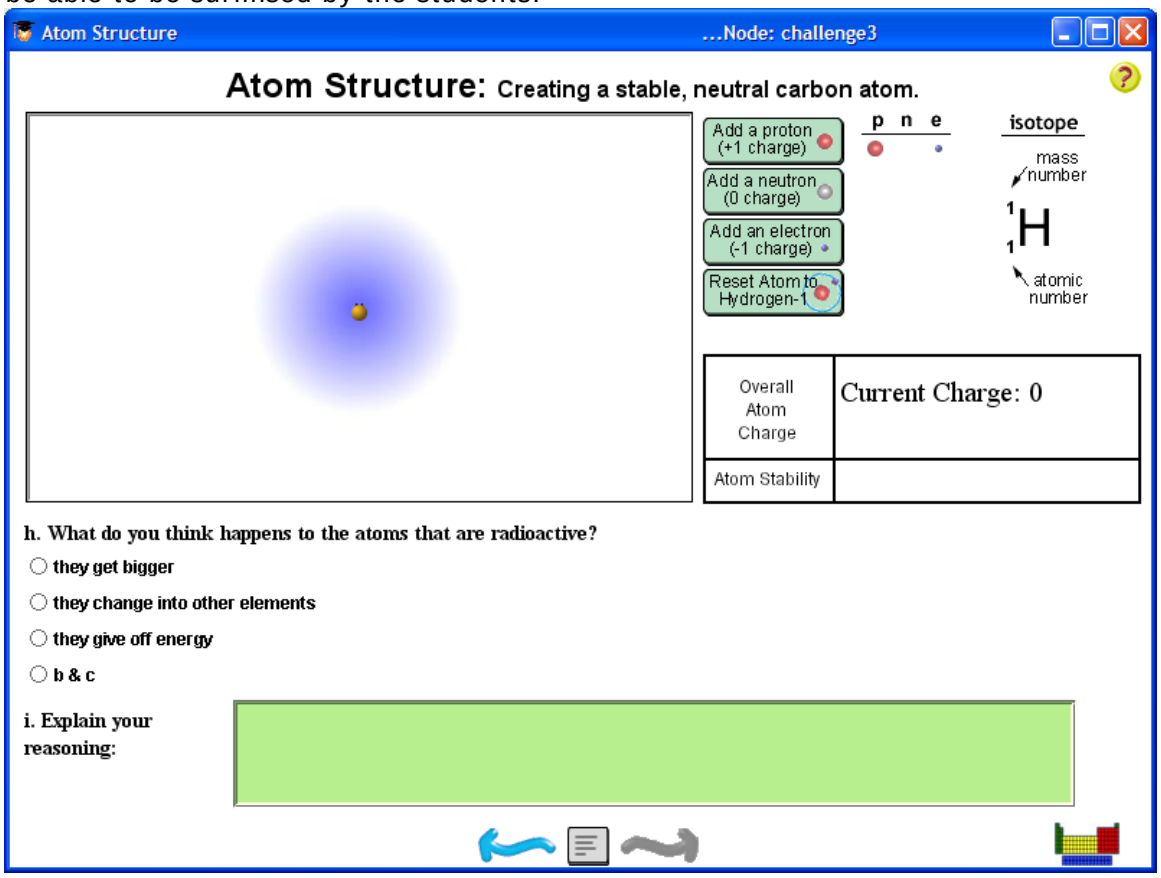
In this first screen students are asked to ponder radioactivity. Radioactive atoms tend to break down because their nuclei do not have a correct number of neutrons (either too many or too few).



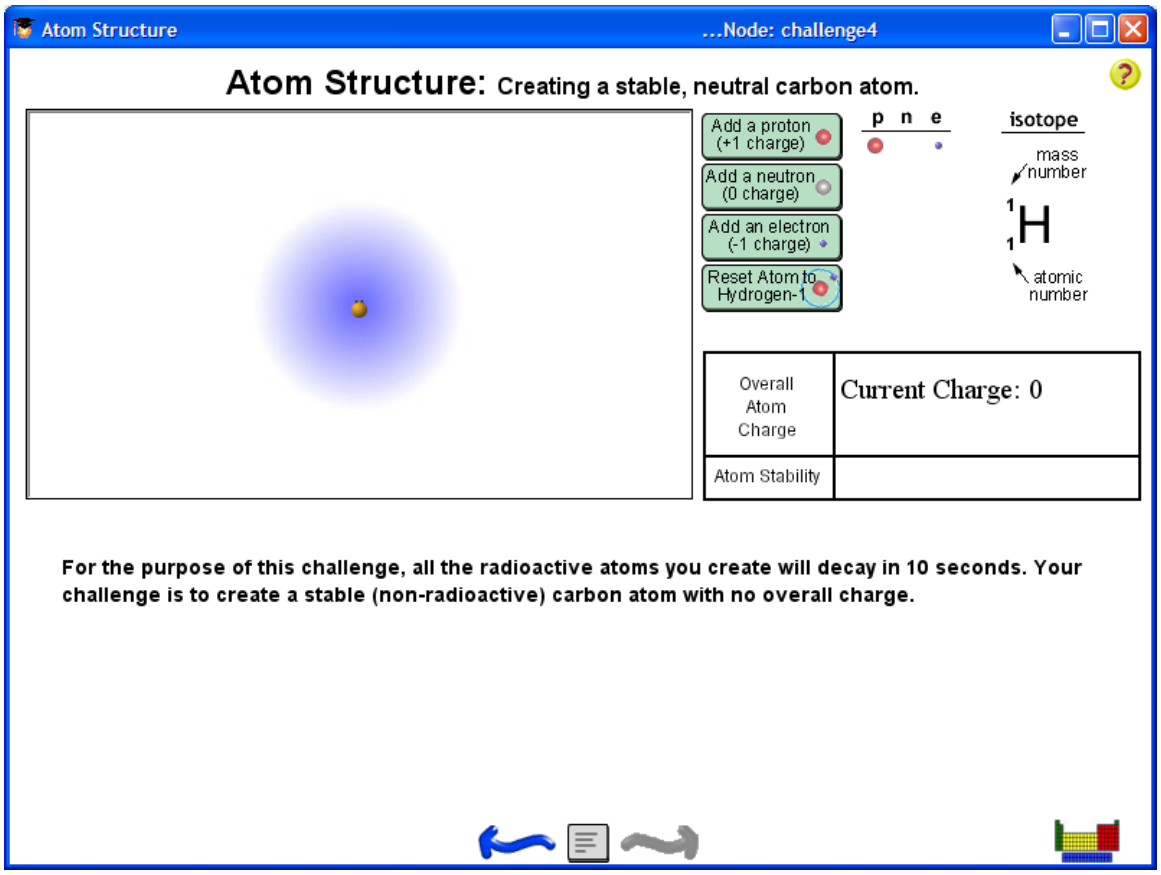
The next screen provides on overview of half-lives:



The next screen asks students to draw some conclusions about radioactive elements. When an atom breaks down it forms a new element and gives off energy. Students should see that energy is released when the atoms break down. The change into a new element is less visible, but nevertheless should be able to be surmised by the students.



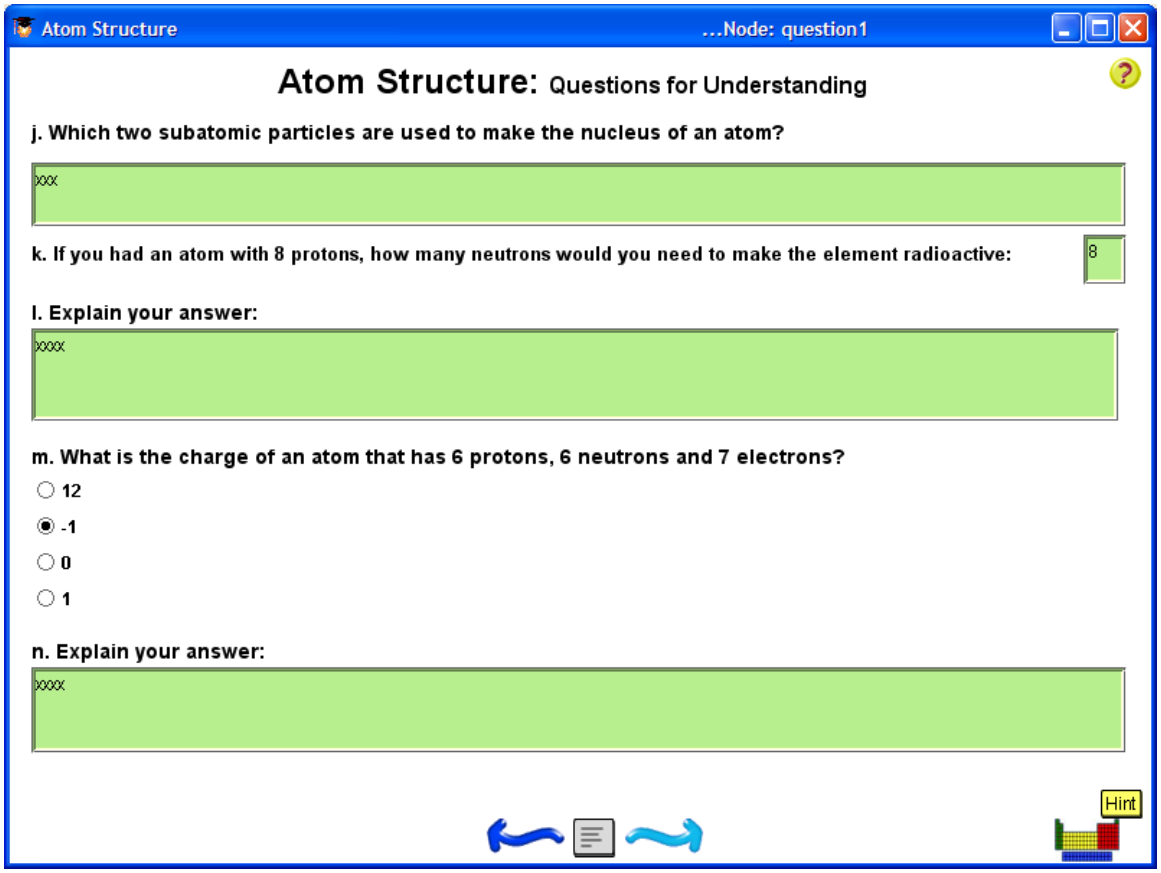
The next screen will ask students to make a stable carbon atom. It must be done in 10 seconds or the atom will break down. Students may need to refer to the periodic table in the lower left hand corner to look up the atomic number of carbon. It is important that particles are added evenly; otherwise the atom will break down.



Students will then be asked to make an Oxygen ion with a -2 charge. This will mean that the atom will need 8 protons, 8 neutrons and 10 electrons. The extra electrons will generate the minus 2 charge on the atom, making it an ion. When the atom is complete, students should choose the “check atom” button.

4.5 Questions for understanding

This section asks the students a series of questions.
Question j: The nucleus is made up of protons and neutrons.
Question K: Assuming a 1:1 ratio of protons to neutrons, an atom with 8 protons would need 8 neutrons to be non-radioactive.
Question m: using the formula protons- electrons, this would give us a charge of -1.



4.6 Summary

This section shows the answers to all the questions. There is an icon on the lower left that will print each student's answers.

5.0 Student Reports

Your students' work with the Orbital activity is logged and viewable on the MAC Project Web Portal at http://mac.concord.org. For each student, you can view a report containing questions and answers.

The next activity in the Chemica sequence is "Electric Fields and Orbitals."