

## THE ATOM AND BONDING

**Task 1: Which of the terms connected with atom from the last lesson do you remember? In your pairs, try to come up with as many as possible**

**Task 2: Listening - Jiggling atoms**

**Watch the video and note down the examples Richard Feynman uses to describe atoms.**

**Task 3: Models of the Atom**

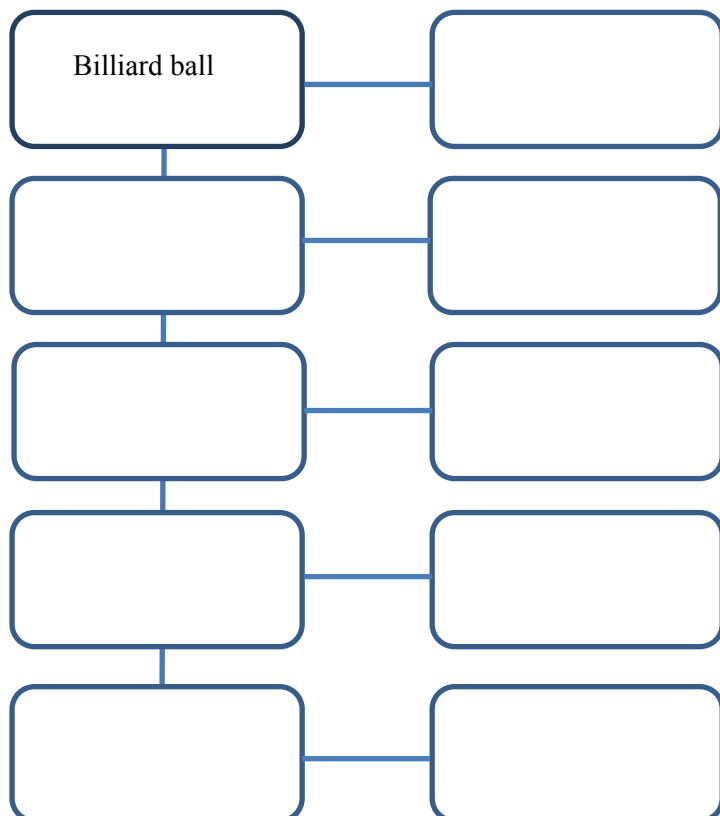
Complete the blanks with the phrases/names from the list. There are three too many

*plum pudding*  
*J. Dalton*

*apple pie*  
*E. Schrodinger*

*planetary*  
*E. Rutherford*

*J.A.R. Newlands*



**Now read the excerpts and match them with the models above.**

1. The hydrogen atom is the simplest atom, which is why \_\_\_\_\_ chose it for study. Its nucleus is a single proton, and \_\_\_\_\_'s theory assumes that its one electron revolves around the nuclear proton in a circular orbit – in much the same way as a satellite orbits the Earth or a planet orbits the Sun.
2. \_\_\_\_\_ studied electrical discharges in tubes of low pressure gas. He discovered that when high voltage was applied to the tube, a “ray” was produced at the negative electrode and sped to the positive electrode. Unlike electromagnetic radiation, the ray was deflected by electric and magnetic fields. \_\_\_\_\_ concluded that the ray consisted of a stream of negatively charged particles, now called electrons. ... \_\_\_\_\_'s model conceived of the atom as a sphere of positive charge in which negatively charged electrons were embedded.
3. This is a very sophisticated, highly mathematical model that treats the electron as a wave and can explain more data and predict more accurately. This model is harder to visualise than the previous models. The location of a specific electron becomes more vague and can be given only in terms of probability. However, the important point is that this model enables us to determine accurately the energy of the electrons in multielectron atoms. For scientists, knowing the electron's energy is much more important than knowing its precise location.
4. \_\_\_\_\_'s major hypothesis was that each chemical element is composed of tiny, indivisible particles called atoms, which are identical for that element but different (particularly in their masses and chemical properties) from atoms of other elements. \_\_\_\_\_ thought of atoms as essentially featureless, indivisible spheres of uniform density.
5. \_\_\_\_\_ discovered that 99.97% of the mass of an atom is concentrated in a very tiny core called the nucleus. \_\_\_\_\_'s model of the atom pictured the electrons as circulating in some way in the otherwise empty space around this very tiny, positively charged core. Yet, even this model has undergone modification.

**After you read: Collocations**

**In the excerpts above, find collocations for these words:**

- Theory

- Model

**Task 4: LISTENING: Bonding****1. COVALENT BONDS**

**a) Read through the text below and try to complete it with suitable verbs. Then listen to the recording and check your answers.**

A covalent bond 1 \_\_\_\_\_ when two atoms share electrons. In the case of two hydrogen atoms, each shares its single electron with the other. This sharing allows each to fill its electron shell with two electrons. The pair of shared electrons 2 \_\_\_\_\_ a covalent single bond.

Let's now 3 \_\_\_\_\_ oxygen, an atom with eight electrons. Two electrons fill the innermost shell, and the other six electrons 4 \_\_\_\_\_ in the next shell. This outer shell needs two more electrons to complete it (the octet rule). Two oxygen atoms form a covalent double bond by sharing two electron pairs from their outer shells.

Carbon is perhaps the most versatile element on Earth, in large part because it 5 \_\_\_\_\_ contains only four electrons in a shell that can 6 \_\_\_\_\_ eight. To fill its outer shell, carbon forms four covalent bonds with up to four other atoms.

In a molecule of methane, carbon 7 \_\_\_\_\_ electrons with hydrogen atoms, forming four covalent single bonds. Although this molecule is relatively simple, carbon often 8 \_\_\_\_\_ the backbone of large, complex molecules. With each carbon atom able to 9 \_\_\_\_\_ to four other atoms, carbon-based molecules are incredibly diverse.

Triple bonds are rare, but nitrogen gas molecules (the most abundant molecule in the air we breathe) form triple bonds. The two nitrogen atoms share three pairs of electrons, 10 \_\_\_\_\_ allowing each to have eight electrons in its outermost electron shell.

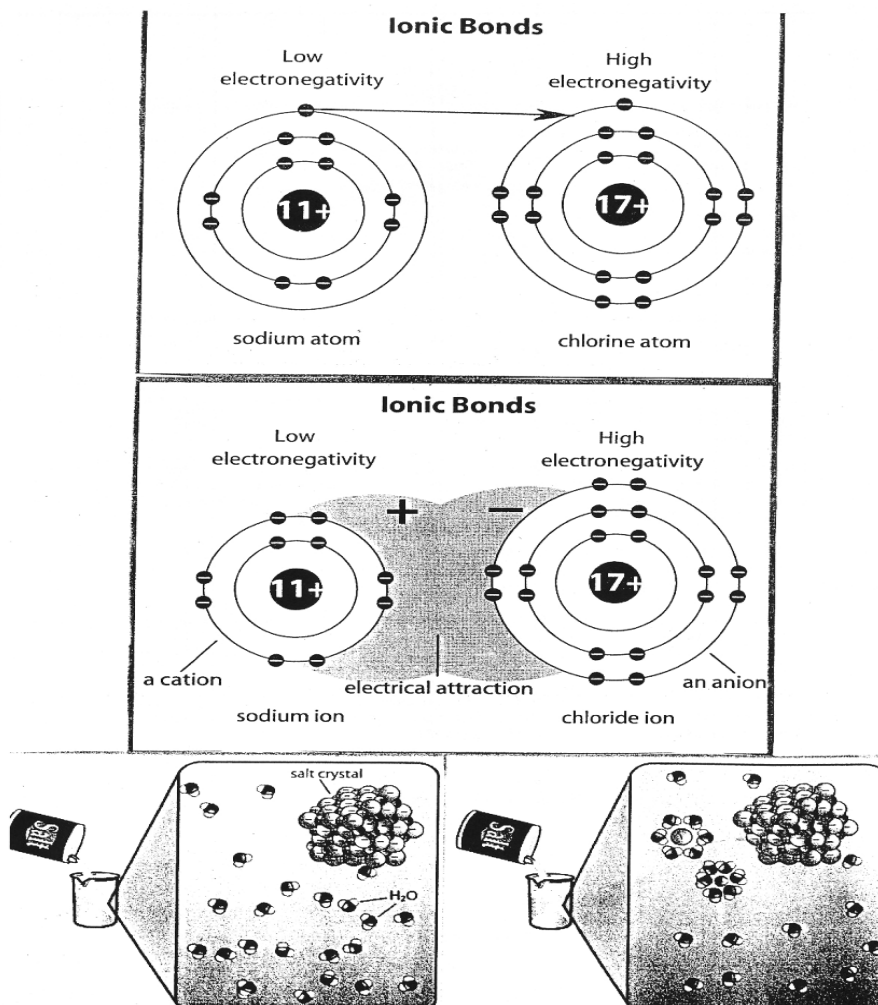
**Now answer these questions:**

- a) What is a covalent bond?
  
- b) Which element forms a single covalent bond?
  
- c) What is the most versatile element?
  
- d) What is the most abundant molecule in the air?
  
- e) What kind of bonds does it form?

2. IONIC BONDS

a) Watch the animation and note down key words and make notes of the main points.

b) Work with your neighbour. With the help of the pictures, describe ionic bonds.



## Task 5: Reading: Fastest View of Molecular Motion

1. Read the first part of the text (until the headline “Ultra-fast process”) and try to answer the following questions:

- What was the timescale that the researchers watched molecules on?
- Where could the study be used in the future?
- Where was the study published?
- What substances were researched?
- What instrument was used in the experiment?
- What accuracy was the team able to observe the process with?
- What does control of this kind underpin?

### Fastest view of molecular motion

<p><b>Scientists have made the fastest ever observations of motion in a molecule.</b></p>	1	<p>The electron is then drawn back to the molecule, and when it collides a very short burst of x-rays is released.</p>	8
<p>They "watched" parts of a molecule moving on an attosecond timescale - where one attosecond equals one billion-billionth of a second.</p>	2	<p>"That has encoded information within it about the state of the molecule at the point of re-collision, and can give us information about the motion of the protons in this molecule," Dr Tisch told the BBC News website.</p>	9
<p>The researchers say the study gives a new in-depth understanding of chemical processes and could be used in future technologies such as quantum computing.</p>	3	<p>The process is ultra-fast, and the team was able to observe the effect the laser had on motion in the molecules with an accuracy of 100 attoseconds - the fastest ever recorded.</p>	10
<p>The study, which relies on short pulses of light from a specially built laser, was published in the journal Science.</p>	4	<p>The team said being able to see detailed molecular motion would help scientists understand how molecules behaved in chemical processes, thus providing possibilities for controlling molecules.</p>	11
<p>"Understanding how something changes in time means really understanding its essence, and we are now looking at changes on a very, very fast timescale," said team member Dr John Tisch, of Imperial College London, UK.</p>	5	<p>"Control of this kind underpins future technologies, such as control of chemical reactions, quantum computing and high brightness x-ray light sources for material processing," said Professor Jon Marangos, another Imperial College author on the Science paper.</p>	12
<p><b>Ultra-fast process</b></p>	6	<p>"We now have a much clearer insight into what is happening within molecules and this allows us to carry out more stringent testing of theories of molecular structure and motion."</p>	12
<p>The researchers devised a new technique to "see" the motion of protons, one of the building blocks of an atom, in molecules of hydrogen and methane.</p>	6	<p><b>Article Available at</b>          ©<a href="http://news.bbc.co.uk/2/hi/science/nature/4766842.stm">http://news.bbc.co.uk/2/hi/science/nature/4766842.stm</a></p> <p><b>From The BBC News</b></p>	12
<p>The technique involves firing a very short but intense laser pulse at a molecule, which rips an electron away, leaving the molecule in an excited ionised state.</p>	6	<p>The team said being able to see detailed molecular motion would help scientists understand how molecules behaved in chemical processes, thus providing possibilities for controlling molecules.</p>	10

2. Find in the text English equivalents to the following Czech expressions:

1. podrobné/důkladné porozumění/pochopení
2. ta studie se opírá o...
3. ta technika zahrnuje/ spočívá v..
4. kódované informace
5. s přesností...
6. poskytuje možnosti...
7. podporuje/ je základem budoucích technologií
8. jasnější/ přehlednější vhléd do...
9. provádět přísnější testování

**Complete the word-formation table. The first has been provided as an example.**

<b>Noun</b>	<b>Verb</b>	<b>Past form</b>
<i>observation</i>	<i>to observe</i>	
researcher		
motion		
effect		
study		
	to control	
	to collide	
	to behave	
testing		
reaction		

**In your pairs, read out past forms of the verbs, and decide upon the right pronunciation of the verb ending. Write next to each verb in the last column [t], [d] or [id]. Can you work out the rule?**

**Now choose 1 word from each column and use it in a sentence.**

**Example:**

*I've read an interesting study on how animals adapt to their environment.*

Sources:

<https://www.youtube.com/>

<http://bcs.whfreeman.com/thelifewire/content/chp02/02020.html>

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(adapted from) Shipman, J.T.; Wilson, J.D.; Todd, A.W. (2006) *An Introduction to Physical Science* Houghton Mifflin

Tasks 2, 3 prepared by Jana Kubrická

For more information go to: [http://profmokeur.ca/chemistry/history\\_of\\_the\\_atom.htm](http://profmokeur.ca/chemistry/history_of_the_atom.htm)