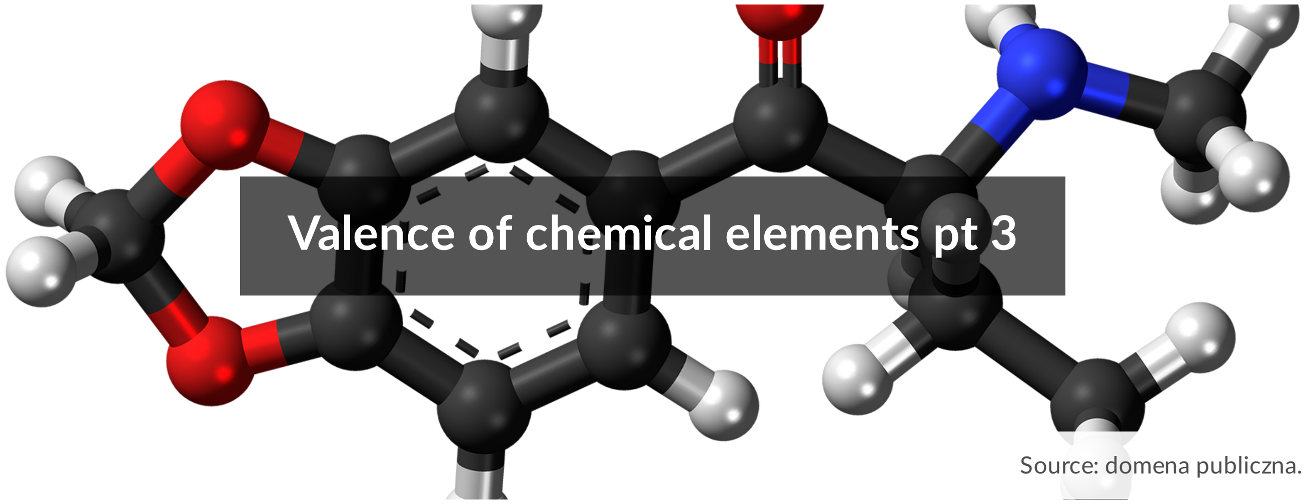
Valence of chemical elements pt 3



Source: domena publiczna.

Link to the lesson

Before you start you should know

- how the atoms of the elements create ionic and covalent bonds.

You will learn

- define the term valency;
- read from the periodic table the maximum valences of chemical elements of groups 1st, 2nd and from 13th to 17th of the periodic table in their compounds with hydrogen or oxygen;
- write molecular formulas of two-element chemical compounds based on information of the valency of elements which create them;
- determine the valency of one chemical element in relation to when the valency of the other is known;
- recognize the oxide based on its molecular formula;
- write the molecular formula of the oxide, knowing its name;
- draw structural formulas of two-element chemical compounds, knowing what is the valency of the elements which create them.

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Nagranie dźwiękowe abstraktu

How do we create oxide names based on their molecular formulas?

Oxygen compounds with other elements are called oxides. The only exception is the oxygen-fluorine compound, called oxygen fluoride. In all oxides, oxygen has a valency of

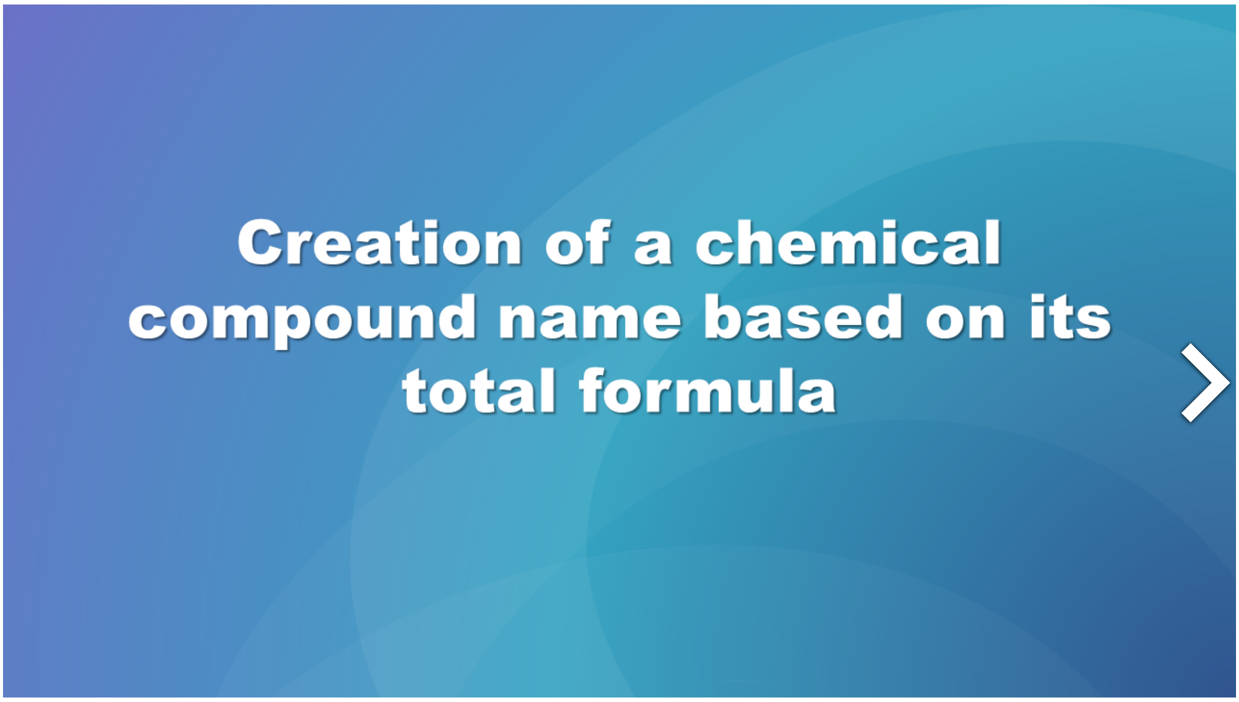
two. On this basis, knowing the oxide formula, we can determine the valency of elements in oxides.

Molecular formula of oxide	Valency of oxygen in the oxide	Valency of the element in the oxide
CO_2	oxygen(II)	carbon(IV)
CO	oxygen(II)	carbon(II)
SO_2	oxygen(II)	sulfur(IV)
SO_3	oxygen(II)	sulfur(VI)
CuO	oxygen(II)	copper(II)
Ag_2O	oxygen(II)	silver(I)
MnO_2	oxygen(II)	manganese(IV)
Cl_2O_7	oxygen(II)	chlorine(VII)

The names of oxides are double-segmented. The first term is the name of the element in the genitive and the second – the word ***oxide*** e.g. ***sodium oxide***. Many elements create several oxides in which their valency is different. An example is the compounds of lead with oxygen with the following molecular formulas: PbO_2 and PbO.
In the first oxide, lead has a valency of four, in the second - two. Therefore, to uniquely determine the type of compound, e.g. oxide, its name often gives the valency of the element connected with oxygen. The compounds of the formulas discussed above PbO_2 and PbO are respectively: lead(IV) oxide and lead(II) oxide. Oxygen valency is not determined in the names of oxides, since it is always two (II).

Exercise 1

Watch the presentation ‘Creating the name of a chemical compound based on its total formula’. Note your conclusions.



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Nagranie dźwiękowe abstraktu

Compound molecular formula	Valency of oxygen in the oxide	Valency of the element in the oxide	Name of oxide
CO_2	oxide(II)	carbon(IV)	carbon dioxide
CO	oxide(II)	carbon(II)	carbon monoxide
SO_2	oxide(II)	sulfur(IV)	sulfur dioxide
SO_3	oxide(II)	sulfur(VI)	sulfur trioxide
PbO	oxide(II)	lead(II)	lead(II) oxide
PbO_2	oxide(II)	lead(IV)	lead(IV) oxide

Compound molecular formula	Valency of oxygen in the oxide	Valency of the element in the oxide	Name of oxide
Ag_2O	oxide(II)	silver(I)	silver(I) oxide
CuO	oxide(II)	copper(II)	copper(II) oxide
MnO_2	oxide(II)	manganese(IV)	manganese(IV) oxide
Cl_2O_7	oxide(II)	chlorine(VII)	dichlorine heptoxide

By creating the names of metal oxides belonging to groups 1st and 2nd, their valency is not given, because these elements always have only one characteristic valency in chemical compounds: metals from 1st group - one, from 2nd group – two. A similar principle applies to aluminum: due to the fact that this element has a valency of three, it has been assumed not to give its valency in the name of the compounds.

The group to which belongs the element creating an oxide	Molecular formula	Systematic name
1.	Na_2O	sodium oxide
	K_2O	potassium oxide
	Li_2O	lithium oxide
2.	CaO	calcium oxide
	MgO	magnesium oxide
	BaO	barium oxide
13.	Al_2O_3	aluminium oxide
14.	CO	carbon monoxide
	CO_2	carbon dioxide
	SnO	tin(II) oxide
	SnO_2	tin(IV) oxide
	PbO	lead(II) oxide
	PbO_2	lead(IV) oxide
15.	NO	nitrogen monoxide
	N_2O_3	dinitrogen trioxide
	N_2O_5	dinitrogen pentoxide

The group to which belongs the element creating an oxide	Molecular formula	Systematic name
	P_4O_{10}	tetraphosphorus decaoxide
16.	SO_2	sulfur dioxide
	SO_3	sulfur trioxide
17.	Cl_2O	dichlorine monoxide
	ClO_2	chlorine dioxide
	Cl_2O_7	dichlorine heptoxide

How do we determine molecular formulas based on the name?

Based on the full name of the oxide, you can easily write its molecular formula. Remember that oxygen valency in these compounds is two. The valency of the second element must be known or it is given in the name. If the element belongs to the 1st group of the periodic table, its valency will be equal to one, if it is the element located in the 2nd group, it will have the valency equal to two.

Writting molecular formula of barium oxide

We determine the valency of particular elements that make up the oxide:

Element	Principle	Valency
oxygen	oxygen in oxides has a valency of two	II
barium	Barium is in the second group of the periodic table; the elements of this group have a valency of two	II

We write the molecular formula of barium oxide: BaO

Writting molecular formula of dinitrogen pentoxide

We determine the valency of particular elements that make up the oxide:

Element	Principle	Valency
oxygen	oxygen in oxides has a valency of two	II
nitrogen	the valency of non-metal was given in the name	V

We are writting molecular formula of dinitrogen pentoxide: N_2O_5

How do we create structural formulas of covalent compounds based on the knowledge of the valency of elements?

Determining the structural formula of a compound molecule based on its molecular formula is not always possible. For example, without knowing about the existing connections between individual atoms, we will not draw a formula of a compound molecule consisting of three elements with a molecular formula H_2SO_4. In the case of two-element compounds, it is possible if you know the valency of both elements. The easiest way to draw a formula of a molecule made of two atoms. An example is a molecule created by combining nitrogen and oxygen, the valency of which is two. It has the following structural formula:

$$N = O$$

Both atoms of elements have a valency equal to two and form two bonds each.

> **Exercise 2**
>
> Indicate the answer showing the correct systematic name of the chemical compound of the structural formula N_2O_3
>
> - nitrogen monoxide
> - dinitrogen pentoxide
> - dinitrogen trioxide
> - dinitrogen monoxide

> **Exercise 3**
>
> Indicate the answer showing the correct molecular formula of the chemical compound based on the systematic name - sulfur trioxide:
>
> - S_2O_6
> - SO_2
> - SO_3
> - SO_6

Summary

- Oxygen in oxides has valency equal to two. Based on this information and compound molecular formula, valency of the second element in the connections with oxygen can be determined.
- The names of oxides give the valency of the element which in chemical compounds may have different valency.

Key words

structural formula, valency

Glossary

structural formula

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Nagranie dźwiękowe słówka

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wzór, który odzwierciedla sposób połączenia atomów w cząsteczce; na jego podstawie można określić liczbę, rodzaj atomów oraz ich wartościowość

valence

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Nagranie dźwiękowe słówka

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liczba wiązań, które tworzy atom danego pierwiastka chemicznego, łącząc się z innymi atomami

Lesson plan (Polish)

Temat: Wartościowość pierwiastków chemicznych (cz. 3)

Adresat

Uczeń szkoły podstawowej (klasy 7. i 8.)

Podstawa programowa:

Szkoła podstawowa. Chemia.

II. Wewnętrzna budowa materii. Uczeń:

14) rysuje wzór strukturalny cząsteczki związku dwupierwiastkowego (o wiązaniach kowalencyjnych) o znanych wartościowościach pierwiastków;

15) ustala dla związków dwupierwiastkowych (np. tlenków): nazwę na podstawie wzoru sumarycznego, wzór sumaryczny na podstawie nazwy, wzór sumaryczny na podstawie wartościowości, wartościowość na podstawie wzoru sumarycznego.

Ogólny cel kształcenia

Uczeń tworzy nazwy tlenków i wykorzystuje wartościowość pierwiastka do ustalania wzorów strukturalnych związków dwupierwiastkowych

Kompetencje kluczowe

- porozumiewanie się w języku ojczystym;
- porozumiewanie się w językach obcych;
- kompetencje matematyczne i podstawowe kompetencje naukowo-techniczne;
- kompetencje informatyczne;
- umiejętność uczenia się.

Kryteria sukcesu
Uczeń nauczy się:

- definiować pojęcie wartościowości;
- odczytywać z układu okresowego maksymalne wartościowości pierwiastków chemicznych grup 1., 2. oraz od 13. do 17. układu okresowego w ich związkach z wodorem lub tlenem;
- zapisywać wzory sumaryczne dwupierwiastkowych związków chemicznych na podstawie informacji o wartościowości tworzących ich pierwiastków;
- określać wartościowość jednego pierwiastka chemicznego w związku, gdy znana będzie wartościowość drugiego;

- rozpoznawać tlenek na podstawie jego wzoru sumarycznego;
- zapisywać wzór sumaryczny tlenku, znając jego nazwę;
- rysować wzory strukturalne dwupierwiastkowych związków chemicznych, wiedząc, jaka jest wartościowość pierwiastków, które je tworzą.

Metody/techniki kształcenia

- **podające**
    - pogadanka.
- **aktywizujące**
    - dyskusja.
- **eksponujące**
    - film.
- **programowane**
    - z użyciem komputera;
    - z użyciem e-podręcznika.
- **praktyczne**
    - ćwiczeń przedmiotowych.

Formy pracy

- praca indywidualna;
- praca w parach;
- praca w grupach;
- praca całego zespołu klasowego.

Środki dydaktyczne

- e-podręcznik;
- zeszyt i kredki lub pisaki;
- tablica interaktywna, tablety/komputery;
- metodnik lub kartki zielone, żółte i czerwone;
- układ okresowy pierwiastków;
- modele kulkowo-pręcikowe.

Przebieg lekcji

Faza wstępna

1. Nauczyciel rozdaje uczniom metodniki lub kartki w trzech kolorach: zielonym, żółtym i czerwonym do zastosowania w pracy techniką świateł drogowych. Przedstawia cele lekcji sformułowane w języku ucznia na prezentacji multimedialnej oraz omawia kryteria sukcesu (może przesłać uczniom cele lekcji i kryteria sukcesu pocztą elektroniczną lub zamieścić je np. na Facebooku, dzięki czemu uczniowie będą mogli prowadzić ich portfolio).

2. Prowadzący wspólnie z uczniami ustala – na podstawie wcześniej zaprezentowanych celów lekcji – co będzie jej tematem, po czym zapisuje go na tablicy interaktywnej/tablicy kredowej. Uczniowie przepisują temat do zeszytu.
3. BHP – przed przystąpieniem do eksperymentów uczniowie zapoznają się z kartami charakterystyk substancji, które będą używane na lekcji. Nauczyciel wskazuje na konieczność zachowania ostrożności w pracy z nimi.

Faza realizacyjna

1. Nauczyciel inicjuje lekcję od przypomnienia uczniom zasad zapisywania wzorów sumarycznych na podstawie nazw. Podaje kilka przykładowych nazw tlenków – chętni zapisują ich wzory sumaryczne na tablicy.
2. Nauczyciel wyświetla tabelę „Przykładowe nazwy tlenków” z abstraktu – trwa analiza i dyskusja.
3. Prowadzący zajęcia omawia zasady tworzenia nazw tlenków na podstawie ich wzorów sumarycznych. Wyświetla prezentację „Tworzenie nazwy związku chemicznego na podstawie jego wzoru sumarycznego”. Następnie prezentuje tabelę „Wartościowość wybranych pierwiastków w tlenkach” – trwa analiza i dyskusja.
4. Uczniowie wraz z nauczycielem analizują tabelę „Nazwy przykładowych tlenków pierwiastków wybranych grup układu okresowego” – trwa dyskusja.
5. Nauczyciel tłumaczy zasady ustalania wzorów sumarycznych na podstawie nazw. Wyświetla kolejno instrukcje: „Zapisywanie wzoru sumarycznego tlenku baru”, „Zapisywanie wzoru sumarycznego tlenku azotu(V)” z abstraktu i omawia je.
6. Uczniowie poznają zasady tworzenia wzorów strukturalnych związków kowalencyjnych na podstawie znajomości wartościowości pierwiastków. Nauczyciel zapisuje na tablicy kilka przykładów, np. tlenku azotu(II), tlenku siarki(IV) i wyjaśnia je.
7. Nauczyciel dzieli uczniów na grupy, rozdaje modele z plasteliny. Prosi o zbudowanie modeli cząsteczek dla pierwiastków z ich wartościowościami zapisanymi wcześniej na tablicy, np. Al(III) i O(II), Li(I) i O(II), Cr(VI) i O(II), Fe(II) i O(II), N(IV) i O(II), Mn(VII) i O(II). Monitoruje przebieg pracy uczniów.
8. Pod koniec lekcji nauczyciel prosi uczniów o wykonanie ćwiczeń interaktywnych – praca indywidualna.

Faza podsumowująca

1. Nauczyciel prosi uczniów o rozwinięcie zdań:
    - Dziś nauczyłem się…
    - Zrozumiałem, że…
    - Zaskoczyło mnie…
    - Dowiedziałem się…

   W celu przeprowadzenia podsumowania może posłużyć się tablicą interaktywną w abstrakcie lub polecić uczniom pracę z nią

Praca domowa

1. Odsłuchaj w domu nagrania abstraktu. Zwróć uwagę na wymowę, akcent i intonację. Naucz się prawidłowo wymawiać poznane na lekcji słówka.
2. Wykonaj w domu notatkę z lekcji metodą sketchnotingu.

W tej lekcji zostaną użyte m.in. następujące pojęcia oraz nagrania

Pojęcia

> **structural formula**
>
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>
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> ---
>
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> **valence**
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>
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>
> liczba wiązań, które tworzy atom danego pierwiastka chemicznego, łącząc się z innymi atomami

Teksty i nagrania

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Nagranie dźwiękowe abstraktu

Valence of chemical elements pt 3

Oxygen compounds with other elements are called oxides. The only exception is the oxygen-fluorine compound, called oxygen fluoride. In all oxides, oxygen has a valency of

two. On this basis, knowing the oxide formula, we can determine the valency of elements in oxides.

The names of oxides are double-segmented. The first term is the name of the element in the genitive and the second – the word ***oxide*** e.g. ***sodium oxide***. Many elements create several oxides in which their valency is different. An example is the compounds of lead with oxygen with the following molecular formulas: PbO_2 and PbO.
In the first oxide, lead has a valency of four, in the second - two. Therefore, to uniquely determine the type of compound, e.g. oxide, its name often gives the valency of the element connected with oxygen. The compounds of the formulas discussed above PbO_2 and PbO are respectively: lead(IV) oxide and lead(II) oxide. Oxygen valency is not determined in the names of oxides, since it is always two (II).

By creating the names of metal oxides belonging to groups 1st and 2nd, their valency is not given, because these elements always have only one characteristic valency in chemical compounds: metals from 1st group - one, from 2nd group – two. A similar principle applies to aluminum: due to the fact that this element has a valency of three, it has been assumed not to give its valency in the name of the compounds.

Based on the full name of the oxide, you can easily write its molecular formula. Remember that oxygen valency in these compounds is two. The valency of the second element must be known or it is given in the name. If the element belongs to the 1st group of the periodic table, its valency will be equal to one, if it is the element located in the 2nd group, it will have the valency equal to two.

We determine the valency of particular elements that make up the oxide:

We write the molecular formula of barium oxide: BaO

We determine the valency of particular elements that make up the oxide:

We are writting molecular formula of dinitrogen pentoxide: N_2O_5

Determining the structural formula of a compound molecule based on its molecular formula is not always possible. For example, without knowing about the existing connections between individual atoms, we will not draw a formula of a compound molecule consisting of three elements with a molecular formula H_2SO_4. In the case of two-element compounds, it is possible if you know the valency of both elements. The easiest way to draw a formula of a molecule made of two atoms. An example is a molecule created by combining nitrogen and oxygen, the valency of which is two. It has the following structural formula:

$N = O$

Both atoms of elements have a valency equal to two and form two bonds each.

- Oxygen in oxides has valency equal to two. Based on this information and compound molecular formula, valency of the second element in the connections with oxygen can be determined.
- The names of oxides give the valency of the element which in chemical compounds may have different valency.

structural formula, valency

Lesson plan (English)

Topic: Valence of chemical elements pt 3

Target group

Elementary school student (grades 7. and 8.)

Core curriculum:

Elemntary school. Chemistry.

II. Internal structure of matter. Pupil:

14) draws a structural formula of a molecule of a two-element compound (with covalent bonds) with known valences of elements;

15) determines for two-element compounds (eg oxides): name based on the sum formula, a summary formula based on the name, a sum-based formula based on valence, valence on the basis of the sum formula.

General aim of education

The student creates names of oxides and uses the element's valence to determine the structural formulas of the two-element compounds

Key competences

- communication in the mother tongue;
- communication in foreign languages;
- mathematical competence and basic competences in science and technology;
- digital competence;
- learning to learn.

Criteria for success
The student will learn:

- define the concept of valence;
- read from the periodic table the maximum valences of chemical elements of groups 1, 2 and from 13 to 17 of the periodic table in their relationship with hydrogen or oxygen;
- write summary formulas of two-element chemical compounds on the basis of information on the valences that make up their elements;
- determine the valence of one chemical element in a relationship, when the valence of the other is known;
- recognize an oxide based on its total formula;

- write the total formula of the oxide, knowing its name;
- draw structural formulas of two-element chemical compounds, knowing what is the valence of the elements that make them.

Methods/techniques

- **expository**
    - talk.
- **activating**
    - discussion.
- **exposing**
    - film.
- **programmed**
    - with computer;
    - with e-textbook.
- **practical**
    - exercices concerned.

Forms of work

- individual activity;
- activity in pairs;
- activity in groups;
- collective activity.

Teaching aids

- e-textbook;
- notebook and crayons/felt-tip pens;
- interactive whiteboard, tablets/computers;
- methodician or green, yellow and red cards;
- periodic table of elements;
- ball-and-ball models.

Lesson plan overview

Introduction

1. The teacher hands out Methodology Guide or green, yellow and red sheets of paper to the students to be used during the work based on a traffic light technique. He presents the aims of the lesson in the student's language on a multimedia presentation and discusses the criteria of success (aims of the lesson and success criteria can be send to students via e-mail or posted on Facebook, so that students will be able to manage their portfolio).

2. The teacher together with the students determines the topic – based on the previously presented lesson aims – and then writes it on the interactive whiteboard/blackboard. Students write the topic in the notebook.
3. Health and safety – before starting the experiments, students familiarise themselves with the safety data sheets of the substances that will be used during the lesson. The teacher points out the need to be careful when working with them.

Realization

1. The teacher initiates the lesson by reminding the students of the rules for writing summary formulas based on names. He gives some sample names of oxides - willing write their summary formulas on the board.
2. The teacher displays the table „Sample names of oxides” from the abstract - analysis and discussion are under way.
3. The lecturer discusses the principles of creating names of oxides on the basis of their summary models. Displays the presentation „Creating the name of a chemical compound based on its summary formula”. Then presents the table „Valence of selected elements in oxides” - analysis and discussion are under way.
4. The students and the teacher analyze the table „Names of exemplary oxides of elements of selected groups of the periodic table” - discussion continues.
5. The teacher explains the principles of determining summary models based on names. It displays the following instructions: „Writing the barium oxide total formula”, „Saving the sum formula of nitric pentoxide” from the abstract and discusses them.
6. Students learn the principles of creating structural formulas of covalent compounds based on the knowledge of the valence of elements. The teacher writes down a few examples on the board, eg nitric(II) oxide , sulfur dioxide and explains them.
7. The teacher divides the students into groups, distributes plasticine models. He asks for building particle models for elements with their valences previously written on the table, eg Al(III) and O(II), Li(I) and O(II), Cr(VI) and O(II), Fe(II) and O(II), N(IV) and O(II), Mn(VII) and O(II). Monitors the work of students.
8. At the end of the lesson, the teacher asks students to do interactive exercises - individual work.

Summary

1. The teacher asks the students to finish the following sentences:
    - Today I learned ...
    - I understood that ...
    - It surprised me ...
    - I found out ...

   The teacher can use the interactive whiteboard in the abstract or instruct students to work with it

Homework

1. Listen to the abstract recording at home. Pay attention to pronunciation, accent and intonation. Learn to pronounce the words learned during the lesson.
2. Make at home a note from the lesson using the sketchnoting method.

The following terms and recordings will be used during this lesson

Terms

> **structural formula**
>
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> ---
>
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Texts and recordings

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We determine the valency of particular elements that make up the oxide:

We are writting molecular formula of dinitrogen pentoxide: N_2O_5

Determining the structural formula of a compound molecule based on its molecular formula is not always possible. For example, without knowing about the existing connections between individual atoms, we will not draw a formula of a compound molecule consisting of three elements with a molecular formula H_2SO_4. In the case of two-element compounds, it is possible if you know the valency of both elements. The easiest way to draw a formula of a molecule made of two atoms. An example is a molecule created by combining nitrogen and oxygen, the valency of which is two. It has the following structural formula:

$$N = O$$

Both atoms of elements have a valency equal to two and form two bonds each.

- Oxygen in oxides has valency equal to two. Based on this information and compound molecular formula, valency of the second element in the connections with oxygen can be determined.
- The names of oxides give the valency of the element which in chemical compounds may have different valency.

structural formula, valency