



Funded by the European Union



Government of Sindh



Teacher Training Module: Science Learning Cycle Seventeen

Chemical Equation

Sindh Technical Assistance –
Development through
Enhanced Education Programme
(STA-DEEP)



THE AGA KHAN UNIVERSITY

School Education & Literacy Department (SE&LD)

Government of Sindh.

Introduction and Rationale of the Training

Dear Teachers!

Welcome to the School Education & Literacy Department (SE&LD) Government of Sindh's Teachers Continuous Professional Development (CPD) Program. This school Cluster-based Teachers' Continuous Professional Development (CPD) program has been developed and is being implemented under the revised School Clustering Policy of 2021 and CPD Model of 2022.

This Content-Based Learning Cycles (CBLCs) series, consisting of cycles 11 to 20, has been developed to further enhance your knowledge and skills in content-based classroom teaching practices. The initial 10 Learning Cycles (LCs) focused on improving pedagogical skills to create interactive, participative, and enjoyable classrooms for students. Building upon these skills, CBLCs 11 to 20 will provide learning opportunities in Mathematics, Science, English, Urdu, and Sindhi for students in grades 1-8 will equip you with modern teaching strategies and subject knowledge to effectively manage classroom situations.

CPD Program vision

The CPD program aims to improve the quality of teaching practices in schools all over Sindh so that students become active and collaborative learners, problem solvers, and critical thinkers who approach tasks creatively and confidently. These CBLCs would help students clearly understand the subject knowledge and connect learned knowledge and acquired skills to the world around them. To make this possible, teachers must be better prepared for the classroom teaching requirements of pedagogy and the subjects' content. Moreover, this program provides specialised training to teachers at the school level through School Cluster-based CPD to make an impact and substantially increase students' learning outcomes.



CPD Program Teaching Philosophy

The CPD training sessions, including this one, adhere to a participatory teaching philosophy. This approach encourages participants to actively engage in collaborative learning while fostering self-reflection and peer reflection, ultimately creating a community of practice. The main goal is to enhance teaching practices and promote an understanding of the subject content theory and the strategies that enable students to confidently and effectively apply the learned knowledge in their daily lives.

Supporting You

The training module is designed to support you in your classroom teaching instruction practices. It will introduce you to the subject content and some approaches for use in the classroom. This will make your teaching more manageable and help you grow as a skilled teacher.

Online CPD portal for teachers

An online CPD portal has been developed for teachers to ask questions to experts, exchange ideas, and share personal learning experiences and difficulties in rolling out the CBLCs. The online CPD portal would help teachers connect with other teachers from all the districts and subject experts to share and learn as a community of teachers. Online portal: <https://stadeep-cpd.com/>

Note: CBLCs have been developed in alignment with the School Education & Literacy Department (SE&LD), Government of Sindh notified curriculum and textbooks of English subject from grades 1-8 under STEADA and PITE supervision. English textbooks of Grade 1-8 have been used in this LC as a reference.

CBLCs: 1-20: Please refer to the last page of this LC to see the complete list of topics for 1-20 LCs.



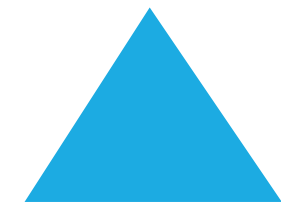
Acknowledgement

This module was developed by IBA Sukkur University and Aga Khan University - Institute for Educational Development under the direction of the Provincial Institute of Teacher Education (PITE). It was supported by UNICEF by under the Sindh Technical Assistance Development through Enhanced Education Program (STA-DEEP), funded by the European Union.

We would like to express sincere gratitude to the following contributors:

| | |
|---------------------------|--|
| Mr. Sayed Rasool Bux Shah | Executive Director, Sindh Teachers Education Development Authority (STEDA), Karachi |
| Ms. Nusrat Fatima Kalhoro | Director-General Provincial Institute of Teacher Education (PITE), Shaheed Benazirabad |
| Mr. Inayat Ullah Shaikh | Additional Director, Directorate of Teacher Training Institutions Sindh, Hyderabad |
| Dr. Altaf Hussain Samo | Director Executive Development Center at Sukkur IBA University, Sukkur |
| Dr. Takbir Ali | Associate Professor and Director Outreach at Aga Khan University, Karachi |
| Mr. Abdul Majeed Bhurt | Director, Directorate of Curriculum, Assessment and Research (DCAR), Jamshoro |
| Mr. Shahabuddin Mallah | Director and English Subject Specialist, Provincial Institute of Teacher Education (PITE), Shaheed Benazirabad |
| Mr. Sayed Rasool Bux Shah | Executive Director, Sindh Teachers Education Development Authority (STEDA), Karachi |
| Mr. Zaheer Abbas Chang | Director Provincial Institute of Teacher Education (PITE), Shaheed Benazirabad |
| Mr. Imtiaz Ali Kumbhar | Module Developer, Associate Professor, TTIs Hyderabad |
| Dr. Tasneem Anwar | Module Developer, Aga Khan University (IED), Karachi |
| Ms. Jamila Khanum | Module Developer, Aga Khan University (IED), Karachi |
| Ms. Pirah Saba | Module Developer, Sukkur IBA University |
| Mr. Hassan Ali | Module Designer, Sukkur IBA University |
| Mr. Syed Kamran Shah | Project Coordinator, Sukkur IBA University, Sukkur |

| | |
|--------------------------|---|
| Ms. Rabia Batool | Project Manager, Sukkur IBA University, Sukkur |
| Ms. Abeer Maqbool | Education Manager, UNICEF |
| Mr. Asif Abrar | Education Specialist, UNICEF |
| Dr. Pervaiz Pirzado | Education Officer, UNICEF |
| Mr. Aftab Ahmed Nizamani | National Teachers Professional Development Consultant, UNICEF |

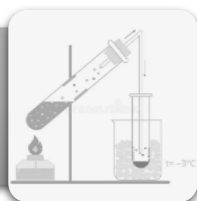


Chemical Equation

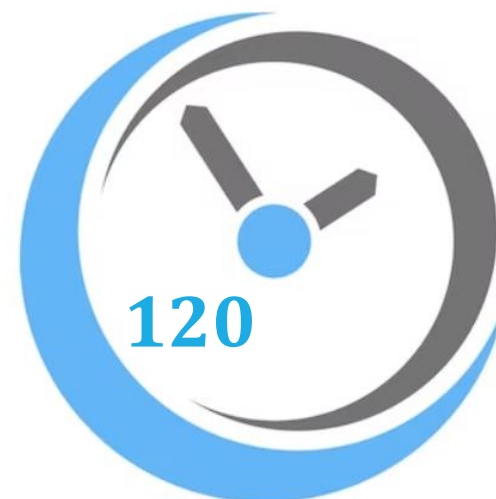
Learning Objectives: By the end of the session, the teachers will be able to:



Define chemical equation and apply the principles for balancing chemical equations






Define law of conservation of mass and its application in balancing a chemical equation



Session Plan

Instructional strategies/activities

| Time | Objective/purpose of the activity | Activities/learning experiences | Materials/resources |
|--|--|--|--|
|  10 mins | Welcome 1. Remind the rules of the workshop. 2. The facilitator will help teachers connect with their experience of the last learning cycle | 1 Quick recall of the rules of the workshop. 2 Ask each teacher to share one key takeaway from classroom implementation of the previous learning cycle. | Sticky notes/paper chits |
|  10 mins | Warm-up  This activity provides an opportunity for participants to share their knowledge and learn from others. | 1. The facilitator will collect the responses of teachers about chemical reaction and starts the discussion on topic <div style="text-align: center; border: 1px solid black; border-radius: 50%; width: 100px; height: 60px; margin: 10px auto; display: flex; align-items: center; justify-content: center;"> <p>Chemical Reaction</p> </div> 2. Subject to access to computers and internet, engage teachers to play balancing equation game at https://phet.colorado.edu/en/simulations/balancing-chemical-equations | Paper, Pencil, charts, white board and Multimedia. |
| | | | |



30 mins

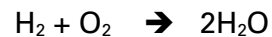
Input



Facilitator's input is planned to create a shared understanding of basic concepts of chemical equation among the participants.

Think – Pair – Share:

- The facilitator will write a chemical reaction of the formation of water on white/black board (See handout 17.1 for reference):



and discuss the concept of chemical equation in detail. Facilitator will ask the participants to observe the chemical reaction and compare the number of atoms/masses of each element from either side of equation (refer to the figure below).

Recognize whether a chemical equation containing coefficients is balanced or not and how that relates to the law of conservation of mass.

Coefficient $4(\text{CO})_2$

Subscript $4(\text{CO})_2$

- Give time to the participants to think and share their observations with their pair. After sharing they will note their response on a notepad and share it with the whole class.

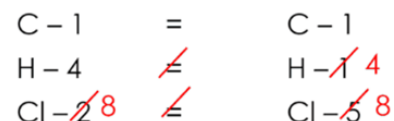
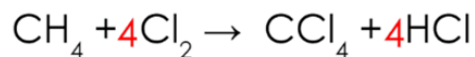
Discussion:

- Facilitator will show the chart (showing all steps of balancing a chemical equation) and discuss how a chemical equation can be balanced.

Multimedia, Board, Marker, Chalks, Flip Charts, Handout# 17.1, G.Science STBB P#56

Balancing Chemical Equations Practice

Step 1 – Take Inventory of the elements and atoms on the product and reactant side.







Step 2 – Is it balanced?



Step 3 – If unbalanced, change coefficients until it's balanced.

Balanced!

Rules for Balancing Chemical Equations:

- The same number and type of atom must be present on each side of the equation.
- NEVER change the subscripts in the equation. Balancing is done by adding coefficients.
- Don't give up! Balancing is done by trial and error.
- Check your work!
- Adjust the equation if necessary.

| | | | |
|---|---|---|---|
|  50 mins | <p style="text-align: center;">Practice</p>  <p>This activity will promote the skills of participants in balancing a chemical equation</p> | <p>Individual Practice</p> <ol style="list-style-type: none"> Facilitator will provide handout 17.1 to all teachers for their reference to rules of balancing chemical equation and then assign all teachers to solve practice exercise (handout 17.3) of balancing different chemical equations (any one equation from the given handout 17.3). | <p>White papers, General Science Class VIII, STBB P#58,</p> <p>Handout# 17.2 and 17.3</p> |
|  10 mins | <p style="text-align: center;">Conclusion</p>  <p>The facilitator will provide guiding prompts to teachers to summarize their learning.</p> | <ol style="list-style-type: none"> The facilitator will write a balanced equation on the board and ask quick questions to help teachers to summarize their learning: $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ <ol style="list-style-type: none"> What does this chemical equation represent? What are the products here? What are the reactants in this equation? Is this equation balanced? If yes, then how do you know this equation is balanced? If no, then why? | <p>Sticky notes/paper chits</p> |

| | | | |
|--|--|---|-----------------------|
|  <p>10 mins</p> | <p>Assessment</p>  <p>This will assess teachers' understanding from this LC. (Individual task)</p> | <p>The facilitator will assess the teachers' learning by asking them to respond to Handout# 17.4.</p> | <p>Handout # 17.4</p> |
|--|--|---|-----------------------|

Handout# 17.1

Facilitator's Reference Material

Chemical Equation

A chemical equation is the symbol in Chemistry that represents chemical reaction with the help of chemical formulas. It contains the chemical substances that are involved in the reaction. It contains reactants and products. The reactants are the elements that react with one and another in a chemical reaction, while the products are the elements that we get after the reaction.

The chemical equation has the products on the right side, while the reactants are written on the left side. Both of them are separated by an arrow. For instance, $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ denotes that there are four atoms of hydrogen and 2 atoms of oxygen on both sides of the equation. The amount of reactants must be equal to the amount of products. Chemical equations need to be balanced even because chemicals will not react until you have added the correct mole ratios. Balanced equation is necessary in determining how much reactant you would need to have, for making the specific product. This simply means that the correct products will not be formed unless you add the right amount of reactants.

Chemical Reaction

Chemical reaction is a process that involves the rearrangement of the atoms in reactant molecule(s) to form new molecules, which are referred to as the product(s). As you can see in the reaction, the reactants are rearranged to form the products.

Subscripts

Subscripts are used to show the number of each type of atoms in a chemical substance. They are written as a small number after the element symbol. The equation above shows that there is one magnesium atom and two chlorine atoms present in magnesium chloride (MgCl_2).

In some cases, the subscript is outside of a group of atoms that are surrounded by *parenthesis*. The reaction above includes magnesium nitrate ($\text{Mg}(\text{NO}_3)_2$) as a product. The parenthesis indicate that the nitrate is a group of atoms bonded together one nitrogen and three oxygen. The subscript after the parenthesis tells us that there are two nitrates involved in the reaction.

Coefficient

A coefficient is a number written before a chemical formula to show how many molecules (or moles) are present.

Law of Conservation of Mass

The law states that there should be an equal quantity of both before and after the experiment, ensuring the quantity and quality remains the same. This law was established by Antoine Laurent in 1789. He explored that the matter either cannot be destroyed or created.

Reference:

General Science Class VIII- Sindh Textbook Board Jamshoro

<https://study.com/academy/lesson/balancing-chemical-equations-games-activities.html>



Handout# 17.2

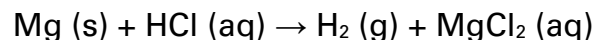
Rules for balancing chemical equations:

1. Mentally, draw a box or circle around chemical formulas – you cannot change any symbol or subscript in the formula to balance equation.
 - a. Example 1: You cannot change a subscript - H_2O is different than H_2O_2 !!
 - b. Example 2: You cannot insert coefficients in the middle of a formula - $\text{H}_2\text{2O}$ is not correct.
2. Count up the number of each type of atom on both sides of the equation. You might want to make a simple table to keep track as you learn how to balance equations.
3. Add coefficients to the front of the chemical formulas to balance the equation and update your element count. **Coefficients must be whole numbers.**
4. These tips will help you balance equations:
 - a. Remember to write the seven diatomic elements (H_2 , N_2 , O_2 , F_2 , Cl_2 , Br_2 , I_2) with the subscript "2". Once they react, they will exist as individual atoms in a molecule.
 - b. If the same polyatomic ion appears both side of the reaction, put a mental box around it and treat it as a single unit
 - c. In some types of ionic reactions it will help to write water as H-OH instead of H_2O .

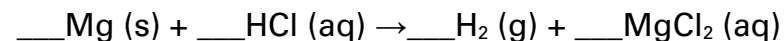
- d. Balance the elements in compounds first. Start with metals and then balance non metals.
 - e. Leave the reactants and products that are elements until the end.
5. When the number of atoms of each element is the same before and after the reaction, equation is balanced.

Sample Problem

Balance the following equation



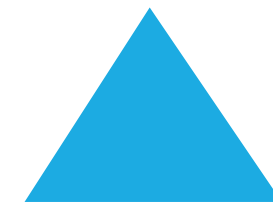
Step 1: Determine the number of each type of atom that are on the reactant and the product side of the equation:



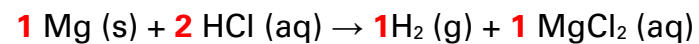
| Reactant | Atom | Product | Mg is balanced but H and Cl are not. There are twice as many products as reactants for H and Cl. Add a coefficient of 2 in front of HCl. |
|-----------|------|-----------|---|
| 1 | Mg | 1 | |
| 1* | H | 2* | |
| 1* | Cl | 2* | |

(*) indicates that the atoms are not balanced in the equation.

Coefficients must be used.



Step 2: Add coefficients to balance the equation. In this case, a coefficient of 2 in front of HCl will balance the equation. The rest of the coefficients are 1.

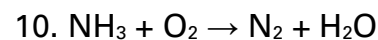
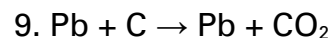
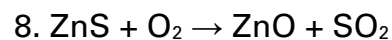
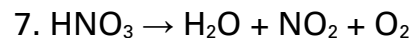
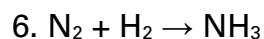
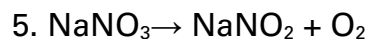
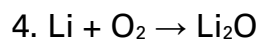
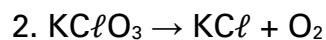
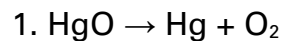
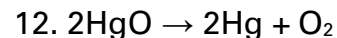
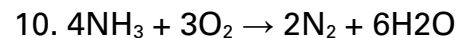
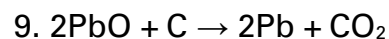
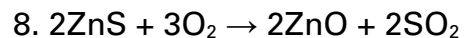
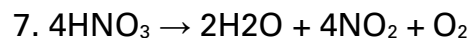
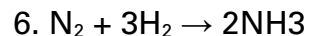
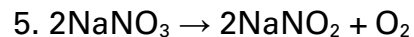
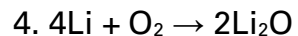
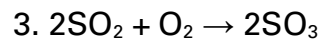
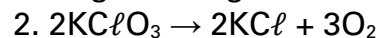
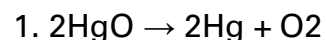


| Reactant | Atom | Product | All atoms are balanced. The equation is balanced. |
|----------|------|---------|--|
| 1 | Mg | 1 | |
| 2 | H | 2 | |
| 2 | Cl | 2 | |

Handout# 17.3

EXERCISE

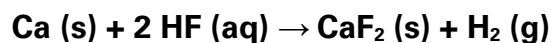
Balance the following equations.

**Answer of Handout 1- Exercise (Balanced Equations)**

Reference: <https://teachchemistry.org/classroom-resources/simulation-activity-balancing-chemical-equations>

Handout# 17.4

1. Use this equation to answer the following questions:



| | |
|---|--|
| Write a word equation for this reaction. | |
| Is the reaction balanced? | |
| Identify the coefficient(s). | |
| Identify the subscript(s). | |
| What is the state of each of the reactants? | |
| What will serve as evidence that a reaction has occurred? | |

Reference: <https://keslerscience.com/balancing-chemical-equations-lesson-plan-a-complete-science-lesson-using-the-5e-method-of-instruction>



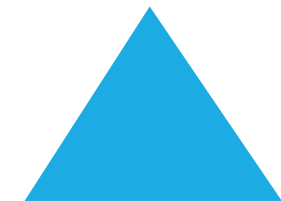
Additional Resources

- <https://phet.colorado.edu/en/simulations/balancing-chemical-equations>
- <https://keslerscience.com/balancing-chemical-equations-lesson-plan-a-complete-science-lesson-using-the-5e-method-of-instruction>

For reference:

List of 1-20 LCs topics

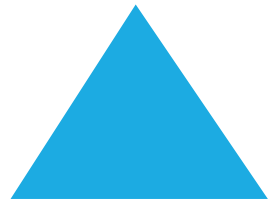
| Learning Cycles (LCs) | Topics |
|------------------------------|-----------------------------|
| LC-1 | Orientation to Science |
| LC-2 | Food and Health |
| LC-3 | Ecology |
| LC-4 | Matter and its States |
| LC-5 | Mixture and Compound |
| LC-6 | Force and Machines |
| LC-7 | Forms of Energy |
| LC-8 | Heat and Temperature |
| LC-9 | Earth and Space |
| LC-10 | STEM |
| LC-11 | Sound |
| LC-12 | Electricity |
| LC-13 | Atomic Structure |
| LC-14 | Microorganisms |
| LC-15 | Pollution |
| LC-16 | Light |
| LC-17 | Chemical Equation |
| LC-18 | Cellular Organisation |
| LC-19 | Human Organ Systems |
| LC-20 | Technology in Everyday Life |



| | | | | | | | | | | | |
|---|---------------------|---|--|--|--|--|---|--|--|---|---|
| Speaker | 1 | ✓ | | | | | | | | | |
| Plastic ruler | 2 | ✓ | | | | | | | | | |
| Metallic ruler | 4 | ✓ | | | | | | | | | ✓ |
| Rubber band | 1 packet | ✓ | | | | | | | | | |
| Wooden ruler | 2 | ✓ | | | | | | | | | |
| Human ear structure | 1 | ✓ | | | | | | | | | |
| Aluminum foil sheet | 7 meter | ✓ | | | | | ✓ | | | | |
| Card stock or construction paper | 12 | ✓ | | | | | | | | | |
| Straw | 24 | ✓ | | | | | | | | ✓ | |



| | | | | | | | | | | | |
|-----------------------------------|---------------|---|---|---|---|---|---|--|--|--|--|
| Ping pong ball | 5 | ✓ | | | | | | | | | |
| Bell | 2 | ✓ | | ✓ | | | | | | | |
| Bucket or Tub | 2 | ✓ | | | | | | | | | |
| Chart | 24 | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | |
| Lemon | 6 | | ✓ | | | | | | | | |
| Paper clip | 2 | | ✓ | | | | | | | | |
| Copper wire | 1 fold | | ✓ | | | | | | | | |
| Comb | 1 | | ✓ | | | | | | | | |
| Battery | 5 | | ✓ | | | | | | | | |
| Small bulb / Led light | 3 | | ✓ | | | | | | | | |



| | | | | | | | | | | | |
|------------|---|--|--|--|--|--|--|--|--|--|---|
| Meter tape | 3 | | | | | | | | | | ✓ |
|------------|---|--|--|--|--|--|--|--|--|--|---|



Contact email address:

kamranshah@iba-suk.edu.pk

School Education & Literacy Department (SE&LD)
Government of Sindh

