



35 minutes total

Lesson Plan 13

Concentration and Unit Conversions

Overview of Activities

1. Introduction
2. Concentration and Unit Conversion Presentation
3. Concentration and Unit Conversion Exercise
4. Review

Learning Outcomes

At the end of this session participants will be able to:

1. Explain concentration and unit conversion
2. Apply unit conversions for different concentrations

Materials & Preparation

- Activity: Introduction demonstration
- Salt
- One measuring cup
- One litre of water
- Activity: Concentration and Unit Conversion Presentation
- Handout: Unit Conversion Chart, see end of lesson (one page; print one copy per participant)
- PowerPoint: Concentration and Unit Conversions
- Activity: Concentration and Unit Conversion Exercise
- Handout: Concentration and Unit Conversion Activity (one page, print one copy per small group)

Recommended Reading

- Technical Brief: Testing for Chemical Aspects in Drinking Water

5 minutes



Introduction

1. Show the group a grain of salt on the end of your finger, walking around the room so everyone can see it. Hold up a cup of salt, ask how many grains of salt are in the cup.
2. Explain: "One cup of salt contains approximately one million grains of salt. If you take a single grain of salt it represents one in a million grains in the cup or 1 part per million (ppm)."
3. Write on the flipchart 1/1,000,000.
4. Ask: "What is concentration?"
 - The amount of a component per volume of a solution
5. Demonstrate concentration by adding a few grains of salt to a litre of water.
6. Explain: "This is a concentration of approximately one milligram (mg) of salt in one litre of water or 1 mg/L."
7. Present the learning outcomes or an overview of the lesson.

15 minutes



Concentration and Unit Conversion Presentation

Use PowerPoint: Concentration and Unit Conversions for this presentation.

1. Use PowerPoint to explain concentration and unit conversions (optional).
2. Ask: "Why are concentrations important in DWQT?"
 - Test results are reported as concentrations
 - Concentration in water quality testing is the amount of a component (microorganism or chemical) per volume of water, stated in units
 - Units are standards of measurement
 - Without units, test values are meaningless. E.g., microbiological test results are reported as CFU/100 ml (the number of bacteria in a volume of sample)
 - Measurements are of no use unless they can be compared to standards
3. Ask: "What are some units you are aware of?"
 - NTUs (Turbidity), CFU (Colony forming bacteria), mg, L, mL, etc.
4. Explain: "Parts per million (ppm) and parts per billion (ppb) are common units used in drinking water testing."
5. Demonstrate ppm and ppb using PowerPoint or explain that one grain of rice in a 20 kg bag of rice represents 1 ppm (there are approximately 1 million grains of rice in a 20 kg bag) and 1 grain of rice in one thousand 20 kg bags of rice represents 1 ppb. *Trainer tip: since one 20 kg bag of rice contains 1 million grains, then 1,000 bags = a billion grains.*

- Discuss how parts per million and milligrams per litre are equal units.

$$1 \text{ ppm} = 1 \text{ mg/L} = 1/1 \text{ million} = 0.000001$$

- Discuss how parts per billion and micrograms per litre are equal units.

$$1 \text{ ppb} = 1 \text{ } \mu\text{g/L} = 1/1 \text{ billion} = 0.000000001$$

- Give one Unit Conversion Chart handout to each participant.
- Discuss the Unit Conversion Chart and how to convert from ppm to ppb and mg/L to $\mu\text{g/L}$ using the chart.

To convert ppb to ppm divide by 1,000

To convert $\mu\text{g/L}$ to mg/L divide by 1,000

To convert ppm to ppb multiply by 1,000

To convert mg/L to $\mu\text{g/L}$ multiply by 1,000

Trainer Tips

It is important for participants to understand that 1 ppb is 1,000 times **smaller** than 1 ppm.

0.000000001 is 1,000 times smaller than 0.000001

10 minutes

Unit Conversion Exercise



Use PowerPoint: Concentration and Unit Conversions for this activity.

- Divide participants into groups of three or four people. *Trainer tip: make sure each group includes one person who has a good grasp of this concept.*
- Use PowerPoint to display the Unit Conversion Chart (optional).
- Hand out the Concentration and Unit Conversion activity.
- Instruct small groups to solve the questions in the handout.
- Allow 10 minutes for groups to complete the exercise.
- Ask for a volunteer to solve the question on a flip chart, if appropriate, to the group. Review the answers as a large group.

- Convert: 0.01 ppm into ppb (Answer = 10 ppb)
- Convert: 20 $\mu\text{g/L}$ into mg/L (Answer = 0.02 mg/L)
- The WHO guidelines for Drinking Water is <0.01 mg/L for arsenic. You are the project manager for a large NGO that has implemented a borehole drilling project in your area. Water quality testing was done on one of the boreholes and you have received a lab report stating that the arsenic concentration is 8 ppb.

Is the borehole water within acceptable limits?

(Answer = Yes, the results are equal to 0.008 ppm or mg/L and are within the guideline value of 0.01 mg/L)

5 minutes



Review

1. Pose review questions to the group asking them to answer by raising their fingers in front of their chest. This allows all participants to answer the questions and allows you to easily and quickly assess how well they have understood the material.
2. Explain: "I will pose a set of true or false questions. Answer by raising your finger in front of your chest."
 - One finger up = TRUE
 - One finger down = FALSE
3. Ask: "One part per million (ppm) is larger than one part per billion (ppb)?"
 - True (0.000001 is bigger than 0.000000001)
4. Ask: "1,000 parts per billion (ppb) is equal to one part per million (ppm)?"
 - True (to convert ppb to ppm you must divide by 1,000)
5. Ask: "1 ppb = 1 mg/L?"
 - False (1 ppb = 1 μ g/L)
6. Ask: "1 μ g/L = 1 ppb?"
 - True

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Unit Conversion Chart

Handout

$$1 \text{ ppm} = 1 \text{ mg/L}$$

$$1 \text{ ppb} = 1 \text{ } \mu\text{g/L}$$

$$1 \text{ mg/L} = 1,000 \text{ } \mu\text{g/L}$$

$$1 \text{ ppm} = 1,000 \text{ ppb}$$

To convert ppb to ppm divide by 1,000

To convert $\mu\text{g/L}$ to mg/L divide by 1,000

To convert ppm to ppb multiply by 1,000

To convert mg/L to $\mu\text{g/L}$ multiply by 1,000

Concentration and Unit Conversions

Handout

Concentration and Unit Conversion Activity

In small groups, solve the questions in the following exercise:

1. Convert: 0.01 ppm into ppb
2. Convert: 20 $\mu\text{g/L}$ into mg/L
3. The WHO guidelines for drinking water is < 0.01 mg/L for arsenic.

You are the project manager for a large NGO that has implemented a borehole drilling project in your area. Water quality testing was done on one of the boreholes and you have received a lab report stating that the arsenic concentration is 8 ppb.

Is the borehole water within acceptable limits?