
MICROSCALE GLOBAL WATER KIT INSTRUCTIONS

Global Experiment for the International Year of Chemistry

Salty Waters

Overview of the Salty Waters Activity

In the '**Salty Waters**' activity, students will prepare a **salt (saline) solution** or collect a **natural salt water** sample, such as sea water. A sample of known mass and volume will be left in a suitable place to allow for complete evaporation of the water to take place. The mass of the salt residue will be measured after evaporation. Younger students will calculate the mass of salt present in the original solution, whilst older students will also calculate the density of the dissolved salt in the solution. This can be converted to a Salinity (g/kg) value for the sample.

Background to the Salty Waters Activity

Water, $\text{H}_2\text{O}(\text{l})$, is rarely found as a pure substance and because many substances dissolve in it, it is often referred to as the Universal Solvent. Water acts as solvent to many mineral substances, leading to the formation of aqueous solutions of different composition and therefore waters of various qualities. The substances in solution (i.e. the solutes) are mostly salts and make the water salty. This activity will help students realize that clear, colourless water samples are not always pure and may contain dissolved substances that contribute to the saltiness of water and also affect its density.

Submitting Results to the Global Database

The following information should be submitted to the database. If the details of the school and location have already been submitted in association with one of the other activities, these results should be linked to the previous submission.

Date sampled:

Name of local water source:

Mass of Dissolved Salt in **2 ml**
Sample

g (all learners)

Density of salty water sample

$\text{g}\cdot\text{cm}^{-3}$ (older learners only)

Salinity of salty water sample

g/kg (older learners only)

Nature of water:

(fresh or estuarine)

Ambient Temperature:

(air temperature at time of sample collection)

Number of students involved

School/class Registration number

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Instructions for the Activity (Teacher)

Experiment Outline

Freezing and melting of sea ice, as well as evaporation and precipitation over the sea affect the saltiness of ocean water. The melting of sea ice, increased rainfall and rivers flowing into the ocean all make sea water less salty. The more salty water is, the less fit it is for human consumption (i.e. poor potability).

When evaporation of a salt solution occurs, the water vapour enters the atmosphere and leaves behind a solution which is more concentrated with respect to non-volatile (non-evaporating) substances. If evaporation proceeds to dryness, a solid deposit is formed. In the case of seawater, this deposit consists of sea salt crystals composed mostly of sodium chloride, $\text{NaCl}(s)$ (95%).

Salt solutions are electrolyte solutions with the capacity to conduct electricity, because the solutes may dissociate into ions that carry charge. This was the discovery of the Swedish scientist Svante Arrhenius (1859 –1927) for which he was awarded the Nobel Prize for Chemistry in 1903.

Students should work in small groups (4 – 6 students, or pairs if numbers permit) and use a known volume and mass of salt water sample (or prepared salt solution). The sample will be allowed to evaporate to dryness and the solid that remains will be weighed. The mass of salt in the sample after evaporation can then be calculated. Older students can calculate the density and salinity of the sample.

Prior to performing the Salty Waters activity, use the thermometer in the Global Water Kit to measure the temperature of the water sample or the water used to prepare the salt solution.

The Salty Waters activity involves the following steps:

- Preparation of a salt water sample (saline solution) OR collection of a natural salt water sample e.g. sea water.
- Finding the mass of a known volume (2 mL) of the sample.
- Evaporation of the salt water sample.

Thereafter, to find the mass of salt in the sample/solution:

- Weighing of the remaining salt after evaporation i.e. the mass of salt that was dissolved in the salt solution (younger and older students).
- Calculating the density and thereafter salinity of the sample (older students).

Lastly, to complete the activity:

- Analyzing the data and reporting results to the Global Experiment Database.

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Students' Instructions

Materials needed for the Salty Waters Activity

Collect the following:

- 1 x 250 mL sample of seawater or saline surface water OR a salty solution prepared as described in Part 1 of the Procedure below.
- A plastic cup or similar container (200 – 250 mL capacity)
- Tap water (if you are preparing a salty solution)

Components from the Global Water Kit:

- 1 x small Petri dish with lid
- a plastic teaspoon
- 1 x 2 mL plastic syringe

Chemical from the Global Water Kit:

- Table Salt in plastic bag (sodium chloride)

Components from the School Resource Kit:

- a thermometer - ASK YOUR TEACHER FOR THE THERMOMETER
- Digital Pocket Scale (DPS – 150 g) – ASK YOUR TEACHER FOR THE DPS

Safety Precautions

The water in this activity is not safe to drink and direct contact with water samples should be avoided. Wash your hands with soap and water after doing the activity.

Part 1 - Procedure for Preparing the Salty Water Sample

1. If you have a seawater or surface water sample, then you do not have to prepare a saline solution. Simply use your collected water sample.

HINT: Try to use the water sample very soon after it is collected. Measure and record the temperature of the water at the time it is collected.

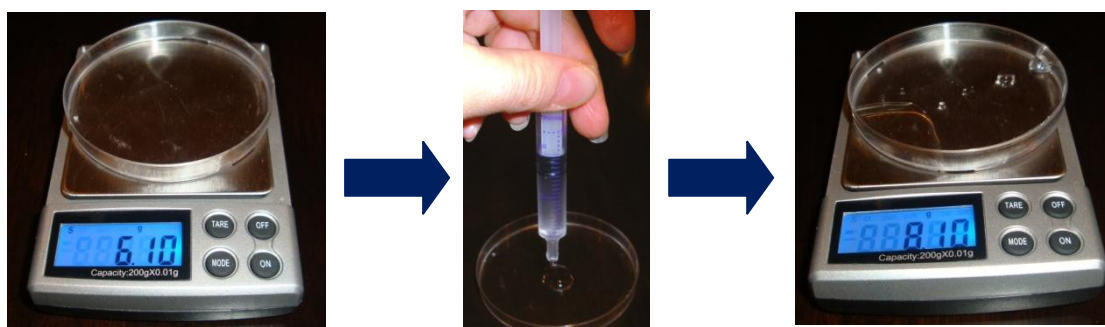
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- If you do not have a natural water sample, you will need to prepare a salt solution. First fill a plastic cup or similar container with about 200 to 250 mL of clean tap water. Measure and record the temperature of the water.
- Add 1 level teaspoon of salt from the Global Water Kit (GWK) and stir until all of the salt has dissolved.



Part 2 - Procedure for Finding the Volume and Mass of the Salty Water Sample

- Switch on the DPS. When the "0.00" appears on the screen, place the base of a clean, empty Petri dish onto the pan of the DPS and weigh it.
- Write down the exact mass of the empty Petri dish. Record this on the Student Observations and Results Sheet provided for Sample A.
- Use the syringe to remove 2 mL of the salt solution from the cup. Add this carefully to the Petri dish without spilling.
- Now carefully weigh the Petri dish as before using the DPS. Record the exact mass of the Petri dish + water on the Student Observations and Results Sheet.



- Repeat steps 1 to 4 using the lid of the same Petri dish. Record the results on the Observations and Results Sheet for Sample B.
- Calculate the mass of water used in Sample A and Sample B, and the average mass of water sample used. Record the results on the Observations and Results Sheet.

Part 3 - Procedure for Evaporating the Salty Water Sample and Finding its Salt Content

- Place both the base and lid of the Petri dish in a warm sunny place (such as on a window sill in the sun) and leave them there until all of the water has evaporated.
- Observe the contents of the Petri dish base and lid and write down what you see on the Student Observations and Results Sheet.
- Now use the DPS as before to find the mass of the Petri dish base and its contents after evaporation. Do the same for the Petri dish lid. Record these values on the Results Sheet.

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4. Calculate the mass of salt remaining in the Petri dish base and lid. Use these two values to calculate the average mass of salt in the water sample. (All learners)
5. Calculate the density ($\text{g}\cdot\text{cm}^{-3}$) of the original solution using the average mass value. (Older learners)
6. Find the salinity of the sample in g/kg. (Older learners).
7. Add your results to the Class Table of Results.
8. Make sure that the DPS is switched off so that the batteries do not run out.

**Rinse and dry all of the equipment you used and place it safely back in the kit.
Wash your hands with soap and water.**

If possible, keep your salty solution for the Solar Still activity.

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Students' Observations and Results Sheet for the Salty Waters Activity

Nature of water: (tick the option that applies)	Salt Solution Prepared with Global Water Kit	Natural Body of Salt Water			
		Estuarine	Marine	Inland Sea	Other
Location of Water Source (if natural):					
Date sampled:					
Temperature of Water:					
Weather conditions	Ambient air temperature.....°C. WetDryWind.....				

Observations

What do you notice about the contents of the base and lid of the Petri dish after all of the water has evaporated?

Calculating Mass of Dissolved Salt

	Sample A	Sample B
Mass of empty Petri Dish (g)		
Mass of Petri Dish + Water Sample (g)		
Mass of Water Sample Used (g)		
Average Mass of Water Sample Used (g)		
Mass of Petri Dish after Evaporation (g)		
Mass of Dissolved Salt in Sample (g)		
Average Mass of Dissolved Salt in Sample (g)		

Calculating Density and Salinity of the Saline Solution (older learners)

Density of Saline Solution, g.cm ⁻³	
Salinity of Sample (g/kg)	

*See next page for formulae needed to calculate density and salinity.

MICROSCALE GLOBAL WATER KIT INSTRUCTIONS**Example calculation****Calculating Density (g/cm⁻³) of Salt Solution**

An initial volume of 2 ml of the sample was used in both the base and lid of the Petri dish. The average mass of dissolved salt recorded in the table above is therefore for a 2 ml sample. **Let's assume that the average mass of the salt water sample was 2,08 g and the mass of the dissolved salt is 0,13g.**

To obtain the density one must find the mass of solution in a 1 ml sample i.e. divide by 2

$$\text{Density} = \frac{\text{Average Mass of Salt Solution (g)}}{2 \text{ ml water sample}}$$

$$= \frac{2,08 \text{ g}}{2 \text{ ml water sample}}$$

$1 \text{ ml} = 1 \text{ cm}^3$

∴ Density of your saline solution = 1,04 g.cm⁻³

Calculating Salinity (g/kg) of the Saline Solution

$$\text{Salinity} = \frac{\text{Mass of Dissolved Salt (g)}}{\text{Mass of water sample (kg)}}$$

You have recorded the average mass in grams of water sample used. Convert this to a mass in kg and calculate salinity of the sample

$$\text{Salinity} = \frac{0,13 \text{ g}}{0,00208 \text{ kg}}$$

∴ Salinity of your solution = 62,5 g/kg

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Teacher's Notes

Using the Activity with your Students

This activity has been written so that it can be included as part of an existing water-related unit of work. However teachers may wish to use it just to give their students an experience of contributing to an international scientific experiment.

Some elaborations for the activity and ancillary activities are provided so that teachers can choose options to suit the time their class has available and the depth of understanding about the topic of saline solutions and salinity appropriate for their class.

Learning outcomes range from using simple equipment and making and recording observations for younger students, to an introduction to evaporation, as well as aqueous solutions and their compositions for older students. The activity lends itself to discussions of the value of solar energy, and its role in physical and chemical transformations.

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Teacher's Summary of School Results

Salty Waters Observation Table
(summarizing results from a school)

NAME OF SCHOOL: _____

LOCATION OF SCHOOL: _____

NUMBER OF STUDENTS: _____

Type of water	Description of water source	Mass of Dissolved Salt (g)	*Density of Solution/Sample (g.cm ⁻³)	*Salinity of Solution/Sample (g/kg)	Appearance of Base and Lid of Petri Dish after Complete Evaporation
1.					
2.					
3.					
4.					

***NOTE: Density and Salinity of the sample/saline solution need be reported by older learners only**

MICROSCALE GLOBAL WATER KIT INSTRUCTIONS

Teacher's Summary of School Results - Sample

Salty Waters Observation Table
(summarizing results from a school)

NAME OF SCHOOL: *St. Benedict's College*

LOCATION OF SCHOOL: *Bedfordview,
Johannesburg,
South Africa*

NUMBER OF STUDENTS: *160*

Type of water	Description of water source	Mass of Dissolved Salt (g)	*Density of Solution/Sample (g.cm ⁻³)	*Salinity of Solution/Sample (g/kg)	Appearance of Base and Lid of Petri Dish after Complete Evaporation
1. <i>Prepared salt solution</i>	<i>Tap water in school classroom</i>	<i>0,13</i>	<i>1.04</i>	<i>62,5</i>	<i>There is a film of fine, white salt crystals on the bottom of the base and lid</i>
2. <i>Sea water</i>	<i>Durban, KwaZulu Natal, South Africa</i>	<i>0,09</i>	<i>1.05</i>	<i>42,9</i>	<i>White sea salt crystals with some black particles can be seen on the bottom of the base and lid</i>

***NOTE: Density and Salinity of the sample/saline solution need be reported by older learners only**

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Sample of Students' Observations and Results Sheet for the Salty Waters Activity

Nature of water: (tick the option that applies)	Salt Solution Prepared with Global Water Kit	Natural Body of Salt Water			
	✓	River mouth	Sea	Inland Sea	Other
Location of Water Source (if natural):	-				
Date sampled/prepared:	22 August 2010				
Temperature of Water:	18°C				
Weather conditions	Ambient air temperature 23°C WetDry ✓ Wind ✓				

Observations

All the water has evaporated. Where the water was, white crystals can be seen. The crystals are all joined together, so the shapes can't be reported.

Calculating Mass of Dissolved Salt

	Sample A Petri Dish	Sample B Petri dish lid
Mass of empty Petri Dish (g)	5.95	5.83
Mass of Petri Dish + Water Sample (g)	8.01	7.92
Mass of Water Sample Used (g)	2.06	2.09
Average Mass of Water Sample Used (g)	2.08	
Mass of Petri Dish + salt after Evaporation (g)	6.09	5.94
Mass of Dissolved Salt in Sample (g)	0.14	0.11
Average Mass of Dissolved Salt in Sample (g)	0.13	

Calculating Density and Salinity of the Saline Solution (older learners)

Density of Saline Solution, g.cm ⁻³	1,04 g.cm ⁻³
Salinity of Sample (g/kg)	62,5 g/kg

*See next page for formulae needed to calculate density and salinity.

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Additional Information about the Activity

Safety Precautions

It should be emphasized that neither the water sample nor the prepared salty solution will be safe to taste or drink. The students should be made aware of this at the start of the activity.

The materials used in this activity are not hazardous in the form of the dilute solutions suggested in the procedures, but students should still wash their hands with soap and water after doing the activity.

Materials and Equipment Listing

Materials needed for the Salty Water Activity

- 250 mL sample of seawater or salt surface water OR a salty solution prepared as described in the Procedure
- A plastic cup or similar container (200 – 250 mL capacity, for preparing the salt solution if a salt water sample has not been collected)
- Tap water (to dissolve the table salt)

Components from the Global Water Kit

- 1 x small Petri dish with lid
- a plastic teaspoon
- 1 x 2 ml plastic syringe

Chemical from the Global Water Kit

- Table Salt in plastic bag (sodium chloride)

Components from the School Resource Kit

- Thermometer - THE TEACHER MUST SUPPLY THE THERMOMETER
- Digital Pocket Scale (DPS – 150 g) – THE TEACHER MUST SUPPLY THE DPS

Notes on Materials Procurement:

1. If a salt water sample is not collected, the students will use the table salt (NaCl(s)) in the GWK to prepare a salt solution. There is only a small quantity of salt in each GWK, therefore two groups should be able to share one salt solution if a 250 mL sample has been prepared. If the salt in the kits is depleted, ordinary table salt should be available in local shops to replace it.
2. Water samples: The water samples can be collected in clean, plastic drink bottles (500 mL will be plenty), or in any other suitable container. It will be more suitable if the container is made of a transparent material.

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3. The local natural water source sample to be reported to the Global Experiment Database might come from the sea, river, lake, large pond or an estuary. However, when using the GWK to conduct the Salty Waters activity, the possible non-availability of natural salt water is taken into consideration. Table salt in the kit is dissolved in ordinary tap water to allow learners to prepare a saline solution. If the local tap water is not suitable for solution preparation, distilled water can be used. This is usually available from garage stations and pharmacies. Alternatively cooled, boiled tap water can be used.
4. If a natural body of salt water (such as the ocean or an inland sea) can be found nearby, students can collect these water samples. The water source should be a familiar landmark that will be identifiable by students from other schools for comparative purposes. Collect the water sample as close to the time the class will be carrying out the activity as possible.
5. Since the Salty Waters Activity uses a small volume of water, the salt water samples (or prepared salt solutions) can also be used for the Solar Still activity. This will help to control consumption of the salt in the kits and avoid wastage should the salt solutions need to be discarded.
6. If the students are not going to do the Solar Still activity soon after the Salty Solutions activity, then one way of conserving the salt supply in the kits is to allow only one or two groups to prepare the salt solutions as per the procedure. These can be marked as samples A and B (or something similar). Instead of only one group using one solution, let several groups have access to sample A and other groups can use sample B. In this way, younger learners can find an average mass of dissolved salt for each sample and older learners can find an average density and salinity value for each sample. This also exposes learners more widely to the use of average values, which are required in the other activities contributing to the international scientific experiment.

Student Learning Outcomes

Science Process Skills

- Taking samples that are representative of a system.
- Using a digital mass balance to quantitatively determine mass.
- Determining mass by difference.
- Measuring volume using graduated apparatus.
- Preparation of a chemical solution.
- Using the environment (wind, sun) as a means of evaporation.
- Interpreting data in terms of environment and nature of the water involved.
- Recording of the scientific data and observations in an appropriate manner.
- Asking scientific questions about salt content of water/aqueous solutions.
- Carrying out scientific investigations by selecting and controlling variables.
- Performing scientific calculations.

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Chemistry background

- Solutions/Homogeneous mixtures
- Dissociation of a salt (like sodium chloride) into its ions when in solution.
- Solutes; qualitative and quantitative composition of aqueous solutions.
- Physical and chemical properties of saline solutions.
- Hydrated ions.
- Evaporation.
- Evaporation as a method of separation.
- Chemical reactions that selectively involve chemical species in solution.
- The role of energy in physical and chemical transformations.
- Density of a solution; reporting density as $\text{g}\cdot\text{cm}^{-3}$ i.e. $\frac{\text{mass}}{\text{volume}}$
- Salinity; reporting sample salinity as g/kg

Learning outcomes for Primary Classes

In primary schools the Salty Waters activity affords students the opportunity to use simple, small scale equipment to conduct a scientific investigation and helps to develop the useful skill of recording observations. There is some quantitative processing of data required, namely that the mass of the dissolved salt in the water sample must be calculated. This calculation only requires subtraction and averaging.

The Salty Waters activity shows that evaporation can be used as a means of separation, and that the environment (wind and sun) can be used successfully for evaporation – for example: to dry certain fruits and our clothes.

The Water Cycle can be discussed.

Learning outcomes for Junior High School

In addition to the learning outcomes mentioned for primary schools, calculation of the density of the sample/solution is included.

This is an opportunity to discuss and select adequate measuring facilities for volume and mass.

The topic of units, namely SI units, for expressing volume, mass and density can appropriately be discussed here. The effect of the mass of dissolved salt on the density of water can also be discussed.

The concepts of soluble and insoluble substances, solutions and solubility may be introduced.

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Learning outcomes for Senior High School

After ensuring that the learning outcomes described before have been covered, the definitions of solute concentration, solubility and salinity may be explored further. The explanations can include the nature of the chemical species in solution, the effect of the solvent (water) on the dissociation or ionization of the dissolved substances (solutes) and the ability of the solution to conduct electrical current.

The quantitative approach provides an opportunity to educate the students on the significance of the digits they use to express values of measured and calculated quantities.

The activity can be expanded to the chemical identification of some of the species in solution, namely sodium chloride, by implementing simple chemical reactions.

It is appropriate to introduce the concepts of amount of substance, concentration and stoichiometric coefficients and to practice writing chemical formulae and chemical equations.

The use of some introductory instrumental techniques to observe some physical manifestations of the salty waters (electrical conductivity) is encouraged as an opportunity to critically assess the possibilities of acquiring informative data.

A more detailed discussion of changes of state can be given, involving the concepts of heat, temperature and vapour pressure.

Salty Waters - Extension Activities

The following activities can be carried out to help students gain a deeper understanding of solutions and salinity. In some cases, the Global Water Kit can be used but for other activities additional equipment may be required.

- Homogeneous mixtures –younger learners can investigate the difference between solutions/homogeneous mixtures and non-homogeneous mixtures by attempting to dissolve soluble (e.g. sugar) and non-soluble (e.g. sand) substances in water using the wells of the comboplate.
- Dissolving vs. melting: younger learners can use the comboplate and warm water to find out the difference between melting and dissolving of different substances. Older learners can be asked to explain the difference in the two processes by referring to chemical and physical changes.
- Factors affecting concentration: older learners can perform the Salty Waters experiment again, but this time varying certain factors. For example: adding more teaspoons of salt to the water to yield a greater mass reading for the salt (and hence greater salinity value) after evaporation, which shows that varying the amount of reagent can affect the concentration of solution (and that salt content affects the density of sea water which can have an impact on the environment).

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- Using conductivity to determine salt content of a sample: using the equipment in the GWK together with an appropriate conductivity meter, older students can prepare sodium chloride solutions of known concentration, measure their conductivity and construct a simple calibration curve for sodium chloride. Various saline samples can be collected and measured to determine their conductivity, and the sodium chloride concentration of each can be found using the curve. (see background information below on Conductivity Measurements).



A Microconductivity Unit is available to measure conductivity of solutions in the comboplate of the GWK

- Detecting the presence of the chloride ion in aqueous solution: using the equipment in the GWK together with 0.1 M silver nitrate solution ($\text{AgNO}_3(\text{aq})$) and 2 M nitric acid ($\text{HNO}_3(\text{aq})$), older students can carry out the test for chloride ions.

Exemplar Procedure:

- Before evaporation, use a clean propette to add 5 drops of the saline solution/sample to a small well of the comboplate.
- Add 2 drops of 2 M nitric acid and 3 drops of 0.1 M silver nitrate solution using another two clean propettes. Observe what happens.

Students should observe that a white silver chloride precipitate forms with the original saline solution. This is the test for chloride ions.

(see background information below on the Knudson-Mohr method of assessing salinity)

Other important concepts embedded in the Salty Waters activity include evaporation and its role in the water cycle. Some other activities that can be done to explore these concepts are:

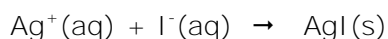
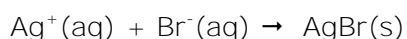
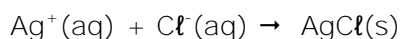
- Factors affecting evaporation/rate of evaporation – learners can perform the activity again using the same saline solution, but this time placing their Petri dishes in different locations e.g. a sunny spot versus a shaded area or in a windy place versus an enclosed space protected from wind. In this way, students can observe the effect that the environment has on evaporation. This is a very important aspect of global salinity because an increase in temperature or wind in a particular area can cause bodies of water - such as inland seas - to evaporate more than usual, resulting in an increase in the salinity of the water. This can have dramatic effects on the ecosystems living in that particular body of water, because certain plants and animals can tolerate saline environments while others cannot.

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Background Information on Some Extension Activities

The ocean is naturally saline at approximately 3.5% (35‰) salt. Salinity is a measure of dissolved salts in sea water, i.e. the amount of salts (in grams) dissolved in 1000 grams (1 kilogram) of sea water. We call this absolute salinity, **S ‰**. Observations of the chemical composition of sea water have made it apparent that its salinity can change. It can become either more saline or less saline due to input of fresh waters or by evaporation, but the proportion of its various solutes remains fairly constant (NaCl being the major component).

The first method recommended for assessing salinity is a chemical one known as the **Knudsen-Mohr** method. It is based on the volumetric analysis of the halide ions i.e. chloride, Cl⁻(aq), bromide, Br⁻(aq) and iodide, I⁻(aq). By addition of a standard solution of silver nitrate, AgNO₃(aq), these ions react with the silver ions, Ag⁺(aq), and form a white precipitate of silver chloride, AgCl(s), silver bromide, AgBr(s), and silver iodide, AgI(s).



Due to the large majority of the chloride ions, the mass of the precipitate is considered to be approximately all made of silver chloride, thus allowing the definition of chlorinity, **Cl ‰**, as the mass (in grams) of the element chlorine (Cl) present in each kilogram of sea water.

In 1969, UNESCO proposed a relation that helps one use chlorinity to calculate salinity, namely: **S = 1,80655 (Cl)**. A salinity of 35 ‰ corresponds to a chlorinity of 19,374 ‰.

The **electrical conductivity** of a water sample can be used as a measure of its ionic composition and hence of its salinity. The instrumental method is based on the comparison of the conductivity of the water under concern and conductivity standards, assuming proportionality between conductivity and salinity. Potassium chloride solutions, KCl(aq), are conductivity standards.

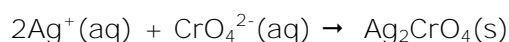
In 1978, oceanographers redefined salinity in Practical Salinity Units (psu): the conductivity ratio of a sea water sample to a standard KCl solution. Ratios have no units, therefore 35 is equivalent to 35 ‰. **Standard saline waters of known conductivity have been developed** to work as standards in the calibration of salinometers, which are specially designed conductivity meters used to assess the salinity of seawater.

Assessment of high quality salinity values has become of particular relevance and is of worldwide concern, due to the main role that salinity plays in the context of current environmental problems associated mainly with Global Change.

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Knudsen-Mohr Method

Take 10 ml seawater; dilute with distilled water up to 100ml. Measure a 25 ml aliquot and add two or three drops of potassium chromate, $K_2CrO_4(aq)$, indicator solution. Titrate with $0.1 \text{ mol dm}^{-3} AgNO_3(aq)$. A white precipitate will be formed. Measure the volume of added titrant until the end point is detected by the formation of a yellow precipitate of silver chromate, $Ag_2CrO_4(s)$ (the product of the reaction of Ag^+ with the chromate ion, CrO_4^{2-}).



Conductivity Measurement

Electrical conductivity is a very sensitive property of aqueous solutions. Many chemical laboratories have commercial conductivity meters. When available they can be used according to instructions.

Good conducting media have low electrical resistance; higher resistance, R/ohm corresponds to lower conductance, $G/\text{siemens}$, and vice-versa. Conductance, S , and resistance, R , are inverse concepts, $G=1/R$. Measuring conductivity, $\sigma (S.m^{-1})$, is basically measuring resistivity, $\rho(\Omega.m)$; $\sigma= 1/\rho$.

Simple measuring setups have been developed with materials often available from electrical kits. Measurement results may be of limited quality for quantitative assessment, but an interesting exercise and an experiment worth doing is the comparison of seawater, river water, drinking water and laboratory water (Seawater: 5 S.m^{-1} ; drinking water: $0.05 - 0,0005 \text{ S.m}^{-1}$; distilled water: $< 0,0001 \text{ S.m}^{-1}$).

High ionic strength gives rise to high electrical conductivity, but high electrical conductivity may also be the result of acidic or basic media in the water associated with industrial pollution sources.