Global Experiment for the International Year of Chemistry

# Water: a Chemical Solution

Water is beautiful, useful and precious. The Global Experiment unites students around the globe to participate in activities that highlight the role that chemistry plays in issues of water quality and purification. The recognition that clean, fresh water is a limited resource is leading to increased interest in education about water.

The international nature of the experiment will be celebrated by participants contributing data and information to the Experiment's Global Database and displayed through web-based global maps. Students will be able to access data from the database for their school, local area, region and country as well the global map.

## The Activities

**Acidity - *pH of the Planet***: Students measure the pH of a local water source and explore the acidity of the water sample.

**Salinity - *Salty Waters***: The salinity of a salty water sample is measured by evaporation.

**Water Treatment – *Water: No Dirt, No Germs*** - A dirty water sample is first clarified with a homemade filter and then disinfected.

**Distillation – *Solar Still*** - Students construct and test a solar still, exploring how it works, and then construct a still to their own design.

Schools are invited to register for the Global Experiment so that their classes can submit the results for the four activities to the database:


Teachers can include the activities as they choose. They may build them into their existing teaching topics during 2011, or use some, or all, of the activities to supplement their curriculum and give their students a chance to participate in the Global Experiment.

Materials for the activities can be found through the IYC 2011 website: **http://www.chemistry2011.org/**.

MICROSCALE GLOBAL WATER KIT INSTRUCTIONS

Global Experiment for the International Year of Chemistry

# pH of the Planet

## (Testing the pH of Different Water Sources)

**Teacher Notes**

### Overview of the pH Activity

The title **"pH of the Planet"** refers to the testing of the pH of different water samples. Since the activity is part of the Global Experiment, students from all over the World will be submitting their data to the Global database and so the pH of the waters of our Planet will be in the spotlight. In this activity students will collect a water sample from a local natural source. They will measure the pH of the sample using coloured indicator solutions. An average value from the class results will be reported to the Global Experiment Database together with information about the sample and the school.

### Background to the pH Activity

pH measurement is one of the most common tests performed on water. This is because the pH of a body of water is an indication of the quality of that water, both for aquatic systems living in the water as well as for human consumption. All organisms can only tolerate a certain amount of acidity and therefore function within a particular pH range. If the pH changes only slightly, these organisms may die. Similarly, humans can only drink water that is in a specific pH range otherwise we may suffer serious health problems. The pH of water is greatly affected by the addition of certain chemicals to water. For example: the dumping of chemicals into water by individuals, industries and communities can change the pH and other properties of the water. Pollutants such as sulfur dioxide from car and coal power station emissions escape into the atmosphere and produce acid rain that drastically reduces the pH of streams and rivers. When acidic water comes into contact with metals and other chemicals, the water can become even more poisonous. pH is therefore a critical factor of the health of a particular body of water, and as students perform this activity they need to be aware of the impact that human activities can have on water quality.

### 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 the water was sampled: | |
| Name of local water source: | (e.g. Limpopo River) |
| pH of local water source: | |
| Nature of water: | (fresh, salt, estuarine, sea, etc.) |
| Water temperature: | (temperature while measuring the pH) |
| Number of students involved | |
| School/class Registration number | |

# Teacher's Summary of School Results

## pH of the Planet Observation Table
## (summarizing results from a school)

NAME OF SCHOOL: _____
_____
_____

LOCATION OF SCHOOL: _____
_____

NUMBER OF STUDENTS: _____

| Type of water | Description of water source | Temperature of Water at time of Measuring pH/°C | Average pH value of Water Sample |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

# Additional Information about the Activity

## Safety Precautions

It should be emphasized that the water samples will not 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.

Teachers should take care when preparing the indicator solutions, because the solid indicators may cause irritation particularly if ingested. The indicators have been specially packaged in bottles so that contact with the solids is kept to a minimum. However, they should still be handled with care when preparing the indicator solutions and hands should be washed afterwards.

## Materials and Equipment Listing

### Materials needed for the pH of the Planet Activity

### Collect the following:

- 1 x sample of water from local source such as sea, fresh, estuarine (100 – 250 ml)
- Tap water (for rinsing)
- Permanent marker or ink pen (to label the propettes containing indicator solutions)
- A piece of white paper (to place under the comboplate as this helps to observe the colours better)
- Universal indicator solution (optional – only required if the pH of the water sample does not fall within the range of either the bromothymol blue or *m*-Cresol purple indicators)
- Other water samples (optional – a group can collect and test more than one water sample if desired)

### Components from the Global Water Kit:

- 1 x comboplate
- 1 x 2 ml plastic syringe
- 2 x propettes (you may need a third one if Universal indicator solution is also used)
- 1 x plastic microspatula per water sample

### Components from the School Resource Kit

- a thermometer - THE TEACHER MUST SUPPLY THE THERMOMETER
- bromothymol blue indicator solution –THE TEACHER MUST SUPPLY THIS INDICATOR
- *m*-Cresol purple indicator solution – THE TEACHER MUST SUPPLY THIS INDICATOR
- colour charts for the bromothymol blue and *m*-Cresol purple indicators - THE TEACHER MUST SUPPLY THE COLOUR CHARTS

## Notes on Materials Procurement:

1. The IYC Global Water Kit (GWK) will be made available to selected schools in countries where resources for carrying out the Global Experiment are lacking. However, any school can use the kits for the Global Experiment. The apparatus in these learner kits is small scale and mostly plastic making it robust and safe to use in any environment. A laboratory is not needed and the kits can be safely taken into the field. Students can work in groups of 4 to 6. If the school has received a School Pack, it should contain 10 GWKs which will cater for classes of 40 to 60 learners working in groups. For the pH of the Planet activity, students will need the comboplate, syringe, propettes and microspatulas found in the GWK. As with any kind of apparatus, students must take care of the kit components by ensuring that they always clean, rinse and dry the equipment after each activity. The equipment should always be placed back into the kit for the next group to use.
2. The School Resource Kit (SRK) has been specially designed as a supporting kit for the Global Water Kit. It is to be maintained and managed by the teacher, who must distribute the items as required per activity. For the pH activity, the teacher must make the thermometer, indicator solutions and indicator colour charts available to learners for determining the temperature of the water, as well as for measuring the pH of water samples. The thermometer should be handled with care and put back into the cardboard tube after use to protect it from breakage. Both the bromothymol blue and *m*-Cresol purple indicators are supplied as solids. Teachers are responsible for preparing the solutions in the bottles prior to the pH activity. The method for solution preparation is provided below. There is only one colour indicator chart for each indicator per SRK, which means that teachers need to ensure that the charts are returned to the kit after the pH activity has been completed.
3. The bromothymol blue indicator can be prepared as follows:

    a) Remove the screw cap from the plastic bottle containing the solid bromothymol blue.
    b) Carefully measure and pour 25 ml of ethanol into the bottle. Replace and tighten the cap and carefully swirl the bottle to dissolve the solid in the ethanol.
    c) Once dissolved, remove the cap and add 25 ml of distilled water to the solution in the bottle. The bottle should now be full to the top.
    d) Replace the lid once again and carefully invert the bottle to mix the contents of the bottle. The solution is now ready to use. Store at room temperature.

    If ethanol is not available, surgical spirits or uncoloured methylated spirits can be used to dissolve the solid bromothymol blue. Distilled water is often available from petrol stations and pharmacies, but if it cannot be found then cooled, boiled water can be used as an alternative.

4. The *m*-Cresol purple indicator can be prepared as follows:

    a) Remove the screw cap from the plastic bottle containing the solid *m*-Cresol purple.
    b) Carefully measure and pour 25 ml of ethanol into the bottle. Replace and tighten the cap and carefully swirl the bottle to dissolve the solid in the ethanol.
    c) Once dissolved, remove the cap and add 25 ml of distilled water to the solution in the bottle. The bottle should now be full to the top.
    d) Replace the lid once again and carefully invert the bottle to mix the contents of the bottle. The solution is ready for use. Store at room temperature.

5. Both the bromothymol blue and *m*-Cresol purple solutions prepared in this way are orange in colour. For this reason, students should carefully follow the instruction about clearly labelling the propettes used for the indicator solutions. The labels can be removed after the activity once the propettes have been rinsed. Since only 3 drops of indicator solution are used at a time, the teacher can fill two or three propettes with each indicator solution before the activity begins i.e. 3 propettes of bromothymol blue solution and three propettes of *m*-Cresol purple solution. The teacher must clearly label the propettes so that students do not mix them up. If this system of propettes is used, then teachers can keep the bottles of indicator solutions aside as their stock solutions. Students can collect the propettes as required from a central location. They should then share the propettes containing each indicator with the other groups in the class, because each group will only need a few drops per solution. In this way, contamination of the stock indicator solutions is avoided and wastage of the indicators is also prevented. If students return the propettes at the end of the activity, the teacher can use these again with another class.

6. Teachers may already have bromothymol blue indicator solutions in their cupboards that they use for the teaching of acidity and pH. These solutions can also be used provided they are very close to 0.05% $\frac{m}{v}$ in concentration. Dilution of more concentrated solutions will be required to make them compatible for use with this activity.

7. 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 appropriate if the container is made of a transparent material. If a 2 ml sample cannot be easily removed from a container (such as a half-filled bottle) using the syringe, then a small volume of the water sample can be poured into a cup or other container for easier access.

   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. Local tap water can also be tested. 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.

   A group of students may test more than one water sample. There are twelve large wells in the comboplate which means that 4 water samples can be tested (if their pH values all fall within the range of bromothymol blue indicator) or 2 samples can be tested (if the pH of each sample needs to be checked with both bromothymol blue and *m*-Cresol purple indicators). A separate results sheet should be completed for each water sample.

8. All equipment must be thoroughly rinsed as soon as the pH tests have been completed, otherwise the indicator solutions may stain the plastic of the comboplate and propettes.

## Interpreting pH values

pH values obtained in the activity need to be interpreted cautiously because there is a natural variability due to differing light levels and temperatures and artefacts of the different measuring techniques. In the case of freshwater sources the natural variability is quite large, commonly between 6.5 and 8.0. Marine (sea) waters usually are buffered and have a smaller range in pH variation, between 8.1 and 8.4.

Temperature changes cause changes in the pH of sample solutions and of pH sensors. Although these changes remain small if the temperature remains close to 20-25$^{o}$C, bigger variation is to be expected with more extreme temperatures. For natural waters, the pH also changes during the day due to the living material in the water.

Respiration of organisms produces carbon dioxide which lowers the pH of the sample. In daylight the pH increases because the photosynthesizing organisms reduce the levels of carbon dioxide.

MICROSCALE GLOBAL WATER KIT INSTRUCTIONS

Global Experiment for the International Year of Chemistry

# Salty Waters

## Teacher Notes

### 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 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 | $g.cm^{-3}$ | (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 | | |

# 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**

# 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 water recorded was 2,08 g (0,00208 kg).

To obtain the density one must find the mass of salt solution in a 1 mℓ sample

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

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

∴ **Density of your saline solution = 1,04 g.cm$^{-3}$**

1 mℓ = 1 cm$^3$

## Calculating Salinity (g/kg) of the Saline Solution

The average mass of dissolved salt in the water sample was 0,13 g

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

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

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

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

# 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.

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.

MICROSCALE GLOBAL WATER KIT INSTRUCTIONS

Global Experiment for the International Year of Chemistry

# No Dirt, No Germs!

## (How Water Treatment helps us)

## Teacher Notes

### Overview of the Water Treatment Activity

The title **"No Dirt, No Germs!"** refers to one or both of the main steps of drinking water treatment, namely **water clarification** and **water disinfection**. Starting with natural surface waters obtained from the surroundings, and using mostly commonly available materials or the Global Water Kit, students will replicate these two steps in water treatment. Younger students will clarify natural surface water and readily observe the effects of clearing water of solid debris. For younger students, disinfection can be done by the teacher. Older students will both clarify and disinfect natural water.

### 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 the water was sampled:

Name of local water source:

Minimum number of drops of disinfectant needed to reach a stable "free available chlorine level":

Nature of water: (fresh or estuarine)

Water temperature: (water temperature when collected)

Number of students involved

School/class Registration number

# Teacher's Summary of School Results

## Free Available Chlorine Observation Table
## (Summarizing results from a school)

NAME OF SCHOOL: _____
_____
_____

LOCATION OF SCHOOL: _____
_____

NUMBER OF STUDENTS: _____

| Type of water | Description of water source | Average minimum number of drops of disinfectant added to 2 ml of filtered water before free chlorine was detected after 10 minutes |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |

# Additional Information about the Experiments Safety Precautions

It should be emphasized that neither the clarified water nor the disinfected water will be safe to taste or drink. The students should be made aware of this at the start of the activity.
Contact with the solid substances (alum and calcium hypochlorite) should be avoided. Students should wash their hands with soap and water after doing the activity.

# Materials and Equipment Listing

### Materials needed for Water Clarification

### Collect the following:

- 200 – 500 mℓ of "dirty" natural water. The water can be collected from a stream, pond, river or swamp (or you can add 2 – 3 teaspoons of dirt or mud to a cup of water and stir it well). Don't try to collect "clean" water – the water should be murky.
- 1-2 teaspoons washed and dried fine sand (± 1mm in grain size).
- 1-2 teaspoons washed and dried coarse sand (maximum 5mm in grain size).
- A clock with a second hand or a stopwatch, if possible.

### Components from the Global Water Kit:

- 2 large sample vials with lids.
- 2 x 2,5 mℓ disposable plastic syringes.
- Comboplate
- Microstand with cross-arm
- A small piece of cotton wool
- 1 microspatula
- 2 propettes
- 1 plastic teaspoon

### Chemical from the Global Water Kit:

- Crystals of alum in plastic bag (potassium aluminium sulfate).

### Notes on Materials Procurement:

1. Water Samples: The water samples can be collected in plastic drink bottles or in any other suitable container. For comparison with the treated water, it will be more suitable if the container is made of a transparent material.
   The local natural water source sample to be reported to the Global Experiment Database might come from a river, lake, large pond or an estuary. The activity is not suitable for sea water. Do not try and collect the "best" water from the water source; it should be murky.

The water to be tested can be collected from just beneath the surface of the water source. Try to find a source that is a recognizable 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.

2. The Global Water Kit will contain sufficient alum for many clarification experiments.
3. Although the procedure for water clarification specifies using 200 – 500 mℓ cold drink bottles, smaller containers will also be suitable. A transparent container is best.
4. Although white play sand or swimming pool sand will be ideal fine sand, it can easily be replaced with clean fine building sand used for plastering of walls.
5. The coarse sand should have a larger grain size and can be the building sand used in concrete mixtures.
6. Sand samples can be washed and dried before using them in the sand filter. This will provide a cleaner filtrate.

## Materials needed for Water Disinfection (using the Global Water Kit)

### The filtrate from the Water Clarification

Students should be able to collect at least 10 mℓ of filtrate from the sand filter.

### Components from the Global Water Kit:

- Chlorine test strips
- One propette
- 1x 2,5 mℓ disposable plastic syringe
- A clock with a second hand or a stopwatch

### Chemical:

- A solution of calcium hypochlorite (to be made up by the teacher)
  The solid hypochlorite is found only in the School Resource Kit.

## Teachers' Instructions for making up the disinfectant (calcium hypochlorite) solution (a fresh solution should be made up every day):

1. Use the 100 mℓ plastic bottle supplied in the School Resource Kit.
2. Use the Digital Pocket Scale and weigh 0.03 g of calcium hypochlorite into the 100 mℓ bottle.
3. Use distilled or boiled water to fill the bottle, but don't fill the neck of the bottle. Shake well.

### Notes on Materials Procurement:

Chlorine Test Strips: The strips are supplied with a colour-code linked to parts-per-million "free available chlorine". Students dip the test strip into the water to be monitored and then wait 15 seconds before matching the colour of the appropriate square on the test strip to the free chlorine color guide. Approximately 10 test strips will be needed for each disinfection experiment. These will be included in the Global Water Kit. Additional strips will be supplied in the School Resource Kit.

MICROSCALE GLOBAL WATER KIT INSTRUCTIONS

Global Experiment for the International Year of Chemistry

# SuperPower Sun → Clean Water

## (Designing and building a Solar Still)

**Teacher Notes**

### Overview of the Water Treatment Activity

The title **"SuperPower Sun → Clean Water"** refers to the use of solar energy to purify water. Essentially this is a process of controlled evaporation and condensation, where water is allowed to evaporate in a closed container and the condensate is collected. Starting with natural surface waters obtained from the surroundings, or a salt solution, and using mostly commonly available materials or the Global Water Kit, students will design and build a Solar Still.

### Background to the Solar Still Activity

Water covers about 70% of the Earth's surface, of which more than 97% is seawater – a concentrated saline (salt) solution that is unsuitable for most uses. Despite being an abundant resource, seawater requires desalination which is a process that promotes the separation of the water from the dissolved salts. The desalination produces purified water, the quality of which is adequate for various uses, namely for agricultural purposes and even for human consumption.

### 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: | |
| Percentage yield obtained in Solar Still: | |
| Nature of water: | (fresh, sea, estuarine or salt solution) |
| Ambient Temperature: | (average air temperature while Solar Still is in operation) |
| Number of students involved | |
| School/class Registration number | |

# Teacher's Summary of School Results

## Solar Still Observation Table
## (summarizing results from a school)

NAME OF SCHOOL: _____
_____
_____

LOCATION OF SCHOOL: _____
_____

NUMBER OF STUDENTS: _____

| Type of water | Description of water source | Time allowed for Desalination | Appearance of Water Sample before and after Desalination in the Solar Still |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |

# Teacher's Summary of School Results (2)

## Quantitative Solar Still Results Table
## (summarizing results from a school)

NOTE: This is an optional activity for older students

NAME OF SCHOOL: _____
_____
_____

LOCATION OF SCHOOL: _____
_____

NUMBER OF STUDENTS: _____

| Type of water | Description of water source | Time allowed for Desalination | Yield (%) | Appearance of Water Sample before and after Desalination in the Solar Still |
|---|---|---|---|---|
| 1. | | | | |
| 2. | | | | |
| 3. | | | | |
| 4. | | | | |

# Additional Information about the Activity

## Safety Precautions

It should be emphasized that neither the water samples used before desalination nor the condensate collected after desalination will be safe to taste or drink. The students should be made aware of this at the start of the activity.
Contact with solid substances (such as copper sulfate crystals) should be avoided. Students should wash their hands with soap and water after doing the activity.

## Materials and Equipment Listing

### Materials needed for the Construction of a Solar Still and Desalination of a Saline Sample using the Solar Still

- 250 ml sample of seawater or saline/"dirty" 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 saline solution if a salt water sample has not been collected)
- Tap water (to dissolve the table salt)
- A ruler (to measure ½ cm of water poured into the lunch box of the Global Water Kit)
- A coin or stone (to ensure that the plastic cover of the solar still slants downwards and inwards over the Petri dish for collection of condensate)
- Adhesive tape (optional – only required if the coin or stone moves and students want to tape it in a fixed position)

Each group needs the following which will be included in the Global Water Kit:

- 1 x Petri dish
- 1 x microspatula
- a teaspoon
- a small piece of Prestik
- the lunch box of the Global Water Kit
- a piece of clean cling wrap
- 2 x elastic bands
- a thermometer
- table salt (i.e. sodium chloride)

Collect from your teacher:

- powdered food colouring (any colour) or copper sulfate crystals

## Notes on the Global Water Kit:

1. The IYC Global Water Kit (GWK) will be made available to selected schools in countries where resources for carrying out the Global Experiment are lacking. However, any school can use the kits for the Global Experiment. The apparatus in these learner kits is small scale and mostly plastic making it robust and safe to use in any environment. A laboratory is not needed and the kits can be safely taken into the field.
2. Students can work in groups of 4 to 6. If the school has received a School Pack, it should contain 10 GWKs which will cater for classes of 40 to 60 learners working in groups.
3. For the Solar Still activity, students will find most of the equipment in the GWK. The lunch box container of the kit will form the main body of the solar still. Some other items such as stones and rulers, should be easily found in the immediate environment. As with any kind of apparatus, students must take care of the kit components by ensuring that they always clean, rinse and dry the equipment after each activity. The equipment should always be placed back into the kit for the next group to use.
4. The School Resource Kit (SRK) has been specially designed as a supporting kit for the Global Water Kit. It is to be maintained and managed by the teacher, who must distribute the items as required per activity. For the Solar Still activity, the teacher must make the powdered food colouring or copper sulfate crystals available to students from the SRK.

## 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 saline solution. There is only a small quantity of salt in each GWK, therefore two groups should be able to share one saline 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. Teachers may need to replace some items after a few times of use e.g. the cling wrap for the solar still may become stretched or contain holes after several times of use. Cling wrap can be purchased in rolls from shops, but other types of thin, transparent plastic may be used (even recycled, uncoloured plastic bags that are transparent).

3. Water samples: The water samples can be collected in clean, plastic drink bottles (500 mℓ will be plenty), or in any other suitable container. For comparison with the desalinated water, it will be more suitable if the container is made of a transparent material.

4. 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 Solar Still 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.

5. If a natural body of salt water (such as the ocean or an inland sea) can be found nearby, students can collect 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.

6. Since the Solar Still Activity uses a small volume of water, the salt water samples (or prepared salt solutions) can also be used for the Salty Waters activity. This will help to control consumption of the salt in the kits and avoid wastage should the saline solutions need to be discarded.

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