Making your own EC meter

Background information

In this activity students build their own **salinity** meter. They calibrate the meter using solutions of known salinity. The students could then measure the salinity of unknown sample(s); for example, local groundwater, local creeks, drains or rivers. The samples of known salinity should be labelled 'A' – 'D' and their salinity levels in mg/L should be shown. Sample(s) X is measured after calibrating the meter. To save time, duplicate sets of solutions in beakers could be made up.

Make up 1 L of each solution as follows:

A For 500 mg/L use 0.5 g salt to 1 L distilled water
B For 750 mg/L use 0.75 g salt to 1 L distilled water
C For 2,000 mg/L use 2 g salt to 1 L distilled water
D For 4,000 mg/L use 4 g salt to 1 L distilled water

Provide each group with 100 mL of each solution.
After developing an **EC** meter it may prove useful to invite a Ribbons of Blue/Waterwatch WA coordinator as a guest speaker to discuss the importance of monitoring our waterways, wetlands and estuaries. Students could also test solutions and compare their results with the equipment used by the Ribbons of Blue coordinator.

Conversion of salinity units		
Salinity	Conversion factor	Salinity
Electrical conductivity (mS/m)	x 5.5	= Total soluble salts (mg/L)
Total soluble salts (mg/L)	x 0.18	= Electrical conductivity (mS/m)
Electrical conductivity (mS/m)	x 10	= Electrical conductivity (uS/cm)
Total soluble salts (mg/L)	x 1	= Total soluble salts (ppm)

mS/m = milliSiemens per metre
mg/L = milligrams per litre
uS/cm = microSiemens per centimetre
ppm = parts per million

Student handout and worksheet

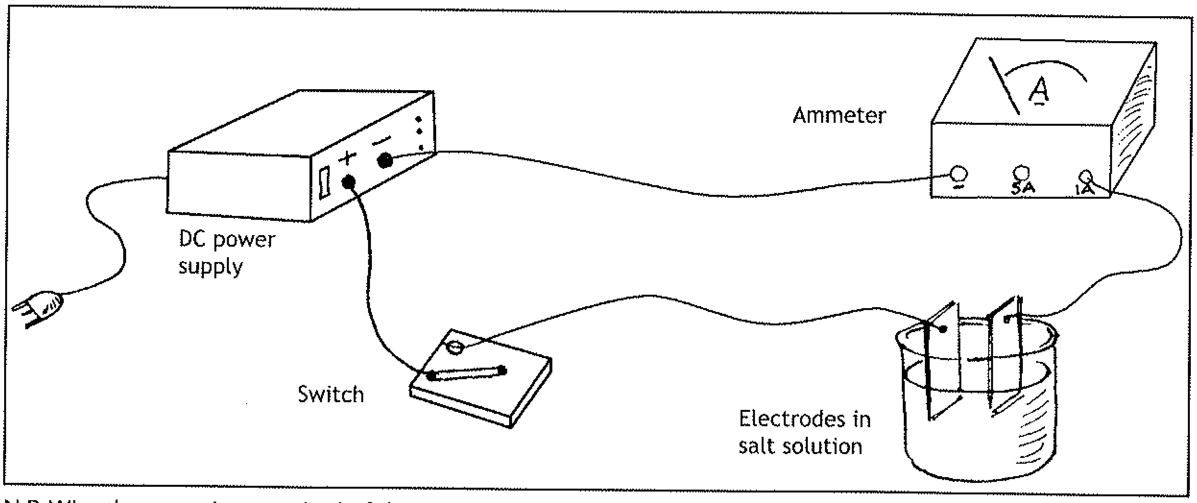
Your goal is to construct a simple circuit that can be used to measure electrical conductivity and to calibrate the meter using solutions of known salinity.

Materials (necessary care should be taken when using these materials)

- DC power supply
- Ammeter (O-5A)
- 2 copper electrodes
- switchwires
- alligator clips
- distilled water
- beakers
- 5 solutions of different salinity (labelled A - D, X)

Procedure

1 Connect the parts of the circuit as per the following diagram:



N.B. Wire the negative terminal of the ammeter to the negative terminal of the power supply.

2 Clean the electrodes and place them in a beaker containing one of the salt solutions (only use 100 mL of solution). Close the switch and record the reading on the ammeter. Be sure to keep the electrodes at a constant and specified distance apart, to enable comparison of results.

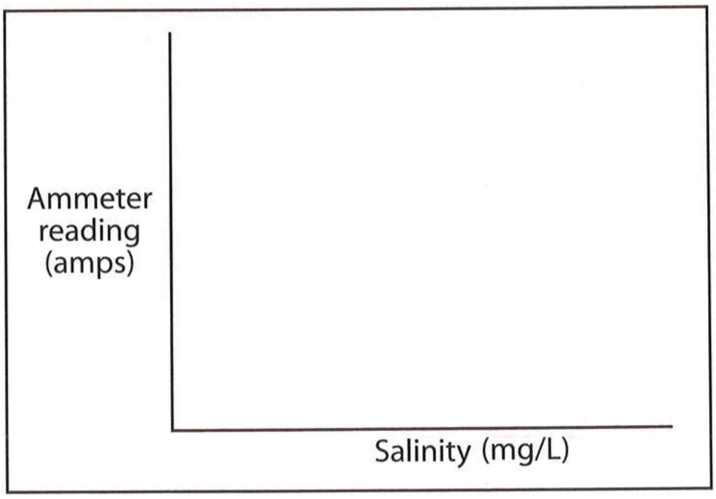
SOLUTION	AMMETER READING	RANK (1 = most salty)	EC READING
A	________	________	________
B	________	________	________
C	________	________	________
D	________	________	________

3 Repeat the exercise for the other salt solutions (clean the electrodes in distilled water each time).

4 Arrange the solutions A to D in order of increasing salinity.

5 Verify your results with an EC meter.

6 Graph the results.



7 Using the 'home made' salinity meter, and your graph, predict the salinity of solution X.

8 Verify your prediction with an EC meter.

Predicted value of solution X using ammeter (mg/L): ....

EC value of solution X using EC meter (mg/L):..

Testing for soil salinity

Students could make an **EC** meter (see Activity 20) to determine the approximate salt content of the **soil** samples.

Materials

- EC meter
- dry soil samples (e.g. oven-dried)
- 100 mL beaker
- distilled water
- stirring rod
- standard salt solution

NB: Three or four samples should be collected from the site area and thoroughly mixed together, to provide a representative sample. The soil can then be dried in an oven (approximately one hour at 150°C).

Procedure

1. Weigh out 10 grams of dry soil.
2. Grind the soil sample with a mortar and pestle or a rolling pin until all of the lumps are gone. Remove any gravel.
3. Put the 10 g of soil into a 100 mL beaker and add 50 mL of distilled water. (Soil **salinity** is conventionally determined by a 1:5 ratio.)
4. Stir thoroughly then let stand for at least 5 minutes.
5. Calibrate the EC meter using a standard solution.
6. Stir the soil/water mixture again.
7. Test the salinity of the soil/water mixture and record the result.

Effect of salination on crop germination

Activity 22
MC • EA

Students investigate the effect of **salinity** on crop germination.

Background information

This experiment is best run over a period of one to two weeks, in order to give the seeds adequate time to germinate. Bean and sunflower seeds are suggested, however, seeds of barley, alfalfa (lucerne), wheat, oats, mung beans and millet are equally worth investigation. Students may compare results for different seeds.

Materials

- seeds of sunflowers and beans (or whatever is chosen)
- 10 petri dishes
- filter papers
- distilled water
- 5 salt solutions at the following concentrations in plastic squash ('squirt') bottles:
  1) distilled water 2) 2.5 grams salt per litre distilled water 3) 5 g/L 4) 10 g/L 5) 15 g/L
- plastic film ('glad wrap')

Note: by conventional standards salinity is measured in mg/L or milli Siemens. (G/L have been used in this instance for ease of measurement per litre.)

Procedure

1. Place filter paper in the bottom of each petri dish.
2. Label two dishes 'A', two dishes 'B' etc. until all are labelled ('A' to 'E').
3. Spread bean seeds (not too thickly) across the filter paper on one dish 'A'. Do the same with sunflower seeds in the other dish 'A'. (Other seeds, as listed above in 'Background', can be used.)
4. Repeat step 3 for each of the remaining dishes 'B' - 'E'. There should be five bean dishes and five sunflower dishes, making ten in all.
5. Add distilled water to each dish 'A'. Add sufficient only to moisten the seeds - excess water is not necessary.
6. Repeat for each of the remaining dishes, using the salt solutions, solution 'B' on dishes 'B', solution 'C' on dishes 'C', etc.
7. Cover each dish with plastic film to prevent it drying out. Place the dishes on a bench in a safe place (need not be in direct sunlight).
8. Check every two days and add solution as necessary to keep the seeds moist. At each check, count the number of germinated seeds.
9. Continue checking and recording over a period of one to two weeks.

Support information 2.4, 2.4.2, 2.6, 2.6.3, 2.7.2

Worksheet

1 Record the results in a table (one table for each seed type):

Seed type:				
Salt concentration	**No. of germinated seeds**			
	1st count	**2nd etc.**	**final**	**class total**
A				
B				
C				
D				
E				

2 Draw bar graphs of the results, showing the bars for beans in one colour and sunflowers in another.

3 What effect does salt appear to have on seed germination? Explain.

4 How did the two kinds of seed respond to the salt solutions? Point out any differences between them. Discuss.

5 What are the implications for farmers in salt-affected areas?

The effect of salt on seed germination

Background information

Salt in the **topsoil** causes many problems on farmland. In this activity students investigate the effect of various salt concentrations on the germination of seeds.

Plants have two ways of coping with salt **ions**: they either take them in or they exclude them. The salt-excluding are less salt-tolerant than plants that take in salt ions.

Saltbush seeds could be compared with cereals and are available from Kimseed, 42 Sarich Court, Osborne Park, Western Australia, (telephone (08) 9446 4377). www.kimseed.com.au or kimseed@kimseed.com.au.

Prior to carrrying out this activity ask students to infer reasons why a particular organism is adapted to a particular environment and to cite examples of structural, behavioural and physiological adaptations.

Some discussion on some of Western Australia's environmental problems would also be useful.

Materials (per group)

- access to seeds (select from: wheat, barley, oats, saltbush, alfalfa (lucerne), mung beans and sunflowers)
- 5 petri dishes
- sticky labels
- filter paper
- distilled water
- salt solutions: 2.5 g/L (grams of salt per litre) 5.0 g/L, 10 g/L, 15 g/L (note: 2.5g/L = approx. ½ level tspn per litre.)

Note: by conventional standards salinity is measured in mg/L or milliSiemens. Grams have been used in this instance for ease of measurement.

Conversion of salinity units		
Salinity	Conversion factor	Salinity
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Total soluble salts (mg/L)	x 0.18	= Electrical conductivity (mS/m)
Electrical conductivity (mS/m)	x 10	= Electrical conductivity (uS/cm)
Total soluble salts (mg/L)	x 1	= Total soluble salts (ppm)

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ppm = parts per million

Worksheet A

Salinity is one of Australia's most serious environmental problems. Many thousands of hectares of farmland are lost each year to salinity. What is the effect of salinity on the germination of plants grown by farmers?

Materials (per group)

- access to seeds (same variety as Activity 22)
- 5 petri dishes
- sticky labels
- filter paper
- distilled water
- salt solutions: 2.5 g/L (grams of salt per litre) 5.0 g/L, 10 g/L, 15 g/L

Procedure

1. Label the lid of the first petri dishes 'A', the next one 'B', and so on to 'E'. To each label add the date and your group name or number.
2. Place filter paper in each of the petri dishes.
3. Count out 50 seeds in five lots of 10.
4. Moisten Dish 'A' with distilled water and spread 10 seeds on the filter paper. Place the lid on the dish.
5. Moisten Dish 'B' with 2.5 g/L salt solution and spread 10 seeds on the filter paper. Place the lid on the dish.
6. Complete the remaining dishes using 5 g/L on Dish C', 10 g/L on Dish 'D' and 15 g/L on dish 'E'.
7. For two weeks, check the seeds for signs of germination every time you return to class. Record your observations in a table like the one below. (Keep seeds moist over the germination period.)

Number of germinated seeds					
Date	Dish A (0 g/L)	Dish B (2.5 g/L)	Dish C (5 g/L)	Dish D (10 g/L)	Dish E (15 g/L)

Worksheet B

Alternative activity

1 What effect does salt have on seed germination?

The following materials will assist you in carrying out an investigation to enable you to answer this question.

Materials (per group)

- access to 5 different seeds
- 5 petri dishes
- sticky labels
- filter paper
- distilled water
- salt solutions (2.5 g/L (grams of salt per litre) 5.0 g/L, 10 g/L, 15 g/L)

2 Write a procedure for carrying out this investigation.

3 Show your procedure to your teacher.

4 Carry out your investigation and complete the questions on Worksheet C.

Worksheet C

Make a prediction about the outcome of this experiment. Which dish will have the worst germination? Which dish will have the best? Explain why.

....

....

....

....

Looking at your results

1 Display your results in a graph. (Your choice e.g. bar, column or pie.)

2 What effect does salt have on seed germination?

....

....

....

3 What effects do you think salt has on the crops farmers grow?

....

....

....

Try this

1 Compare the effect of saline water on the germination of cereal crops such as wheat, oats and barley. These are the main cereal crops grown in Western Australia. Are there differences?

2 Saltbush is often grown on saline soils. You could investigate how well it germinates using different salt concentrations.

3 Other seeds worth investigating are those of alfalfa (lucerne), mung beans and sunflowers.

4 Do all salts have the same effect on germination?