

## Pacific H<sub>2</sub>O Lab: Preparation

This document is for technicians or teachers who will be preparing the lab's starting solutions and gathering necessary equipment.

Important notes:

- This lab is designed for students to work in teams of three.
- Each team will start with 100mL of a contaminated solution. There are three possible contaminated solutions: coastal aquifer sample, river water sample, and rainwater catchment sample. Each team will be assigned one sample by their teacher. Preparation instructions can be found in section 1 of this document.
- Each team will conduct assays (tests) on their water to identify the impurities. Students should have access to multiple assays. Assay information can be found in section 2 of this document.
- Each team will perform at least one treatment to their sample. Treatment information can be found in section 3 of this document.
- Each team will need access to a device, such as a laptop or tablet.
- Throughout this document we have prepared stock solutions using large beakers. Typically this preparation would be done using volumetric flasks. You may use volumetric glassware if it is available to you, otherwise a large beaker is sufficient.
- Lab safety information can be found in the [teacher lab procedures document](#).
- NOTE: The river water sample is more complex than the others. Teachers might want to assign this sample to students who would be excited about a challenge.

## Section 1: Prepare Starting Solutions (100 mL/group needed)

Sample	Number of Student Groups	Impurities
Coastal Aquifer	~1/3 of the class	Salt (NaCl) Bacteria** <i>**implied in the app, not added in the lab</i>
River Water	~1/3 of the class	Nitrates ( $Mg(NO_3)_2$ ) Turbidity (oat milk) Soil ( <b>optional</b> to make more turbid) Bacteria** <i>**implied in the app, not added in the lab</i>
Rainwater Catchment	~1/3 of the class	Low pH (vinegar or lemon juice) Copper ( $Cu(NO_3)_2$ ) Bacteria** <i>**implied in the app, not added in the lab</i>

### Coastal Aquifer Sample

#### Preparation for One Group:

1. Weigh 100 mg of table salt (sodium chloride) on a weighing balance. Add the measured salt to a 100 mL beaker.
2. Measure 100 mL of tap water in a measuring cylinder.
3. Slowly add the tap water into the 100 mL beaker, adding 20 mL at a time, stirring after each addition.
4. Continue to stir the solution until the salt is completely dissolved to simulate seawater.

#### Preparation for Ten Groups:

1. Weigh 1 g of table salt (sodium chloride) on a weighing balance. Add the measured salt to a 1000 mL beaker.
2. Measure 1000 mL of tap water in a measuring cylinder.
3. Slowly add the tap water into the 1000 mL beaker, adding 100 mL at a time, stirring after each addition.
4. Continue to stir the solution until the salt is completely dissolved to simulate seawater.

### River Water Sample

#### Preparation for One Group:

1. Prepare a stock solution of 500 mg/L magnesium nitrate  $Mg(NO_3)_2$ .
  - a. Weigh 50 mg of magnesium nitrate  $Mg(NO_3)_2$ . Add to a 100 mL beaker.
  - b. Add 100 mL of water to the beaker.

- c. Stir the stock solution.
2. Using a measuring cylinder, measure 20 mL of the stock solution. Add to a clean 100 mL beaker.
3. Measure 10 mL of oat milk in a measuring cylinder. Add the milk to a 100 mL beaker.
4. Fill the beaker with water until the total volume is 100 mL.
5. Stir the solution.

#### **Preparation for Ten Groups:**

1. Create a stock solution of 500 mg/L magnesium nitrate  $\text{Mg}(\text{NO}_3)_2$ .
  - a. Weigh 250 mg of magnesium nitrate  $\text{Mg}(\text{NO}_3)_2$ . Add to a 500 mL beaker.
  - b. Add 500 mL of water to the same beaker.
  - c. Stir the stock solution.
2. Using a measuring cylinder, measure 200 mL of the stock solution to a clean 1000 mL beaker.
3. Measure 100mL of oat milk in a measuring cylinder. Add the milk to the 1000 mL beaker.
4. Fill the beaker with water until the total volume is 1000 mL.
5. Stir the solution.

#### **Rainwater Catchment Sample**

##### **Preparation for One Group:**

1. Prepare a stock solution of 0.05M  $\text{Cu}(\text{NO}_3)_2$ .
  - a. Weigh 20 mg  $\text{Cu}(\text{NO}_3)_2$ . Add to a 1000 mL beaker.
  - b. Add 1000 mL of water to the same beaker.
  - c. Mix the stock solution.
2. Measure 25 mL of vinegar in a measuring cylinder. Add to a clean 100mL beaker.
3. Measure 75mL of tap water in a measuring cylinder. Add the tap water slowly to the 100mL beaker.
4. Add 4 drops of 0.05M stock solution of  $\text{Cu}(\text{NO}_3)_2$ .
5. Stir the solution.

##### **Preparation for Ten Groups:**

1. Prepare a stock solution of 0.05M  $\text{Cu}(\text{NO}_3)_2$ .
  - a. Weigh 20 mg  $\text{Cu}(\text{NO}_3)_2$ . Add to a 1000 mL beaker.
  - b. Add 1000 mL of water to the same beaker.
  - c. Mix the stock solution.
2. Measure 250mL of vinegar in a measuring cylinder. Add to a clean 1000mL beaker.
3. Measure 750mL of tap water in a measuring cylinder. Add the tap water slowly to the 1000mL beaker.
4. Add 1.7 mL of 0.05M stock solution of  $\text{Cu}(\text{NO}_3)_2$ .
5. Stir the solution.

## Section 2: Order & Prepare Assays

Assay	Number of Assays Needed	Link to Purchase	Cost
Visual rapid panel	Minimum needed: 2 tests for all groups.	<a href="#">Amazon</a>	\$17 for 125 strips
JBL digital rapid panel (optional)	Note: this test requires a downloaded app to interpret results, but will probably be more fun for students.	<a href="http://animates.co.nz">animates.co.nz</a>	\$64 for 24 strips
Salinity test strip	Minimum needed: 2 tests for coastal aquifer groups, but more groups may want to test for salinity initially.	<a href="#">Amazon</a> <a href="http://directpoolsupplys.co.nz">directpoolsupplys.co.nz</a>	\$16 for 50 strips \$22 for 10 strips
Salinity meter (optional)	Note: this meter could replace the salinity test strips.	<a href="#">Amazon</a> <a href="http://dicksmith.co.nz">dicksmith.co.nz</a>	\$29 for 1 digital meter \$27 for 1 refractometer
Nitrates assay	Minimum needed: 2 tests for river water groups.  Note: the visual and digital rapid panels linked above both include a nitrate test, so this one might not be necessary.	<a href="#">Amazon</a>	\$23 for 50 test tablets
Short-range pH paper	Minimum needed: 2 tests for rainwater catchment groups.  Note: the visual rapid panel linked above includes a pH test, but having pH paper is helpful when students are treating specifically for pH.	<a href="#">Amazon</a>	\$10.19 for 120 tests

## Section 3: Order / Gather Treatment Materials

Treatment	Material(s)	Number of Treatments	Link(s) to	Actual Cost
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	Needed	Needed	Purchase	
Filtration	<ul style="list-style-type: none"> <li>• Coffee filters</li> <li>• Fine filters</li> <li>• Funnel</li> <li>• Beakers</li> <li>• Ring stand (optional)</li> </ul>	<p>Minimum needed: 1 treatment for all groups.</p> <p>Note: not all groups will need to filter, but it is likely they will choose this path.</p>	These items are commonly found in lab equipment inventories.	
pH	<ul style="list-style-type: none"> <li>• pH increaser</li> <li>• pipette</li> </ul>	Minimum needed: 1 treatment for rainwater groups.	<a href="#">Animates</a>	\$17.49 for ~18 treatments
	<ul style="list-style-type: none"> <li>• pH decreaser</li> <li>• pipette</li> </ul>	Minimum needed: 1 treatment for rainwater groups.	<a href="#">Animates</a>	\$17.99 for ~18 treatments
Flocculation	<ul style="list-style-type: none"> <li>• Vinegar, lemon juice, or rice wine vinegar (10ml)</li> <li>• Graduated cylinder</li> </ul>	Minimum needed: 1 treatment for river water groups.	This item is commonly found in grocery stores.	
Boiling	<ul style="list-style-type: none"> <li>• Hot plate</li> <li>• Beaker</li> </ul>	Minimum needed: 1 hot plate for the entire class.	These items are commonly found in lab equipment inventories.	
Chlorination	<ul style="list-style-type: none"> <li>• Chlorination tablets (grounded with mortar and pestle)</li> <li>• Weighing balance</li> </ul>	<p>Minimum needed: <math>\frac{1}{8}</math> tablet needed for all groups.</p> <p>Note: it is recommended that the technician or teacher use a mortar and pestle to grind a few tablets ahead of the lab so students can weigh what they need.</p>	<a href="#">Amazon</a>	\$12 for 100 tablets, $\frac{1}{8}$ tablet per treatment.
			<a href="#">pharmacy direct.co.nz</a>	\$9.85 for 50 tablets, $\frac{1}{10}$ tablet per treatment.
Ion-Exchange	<ul style="list-style-type: none"> <li>• Ion-exchange resin</li> <li>• Glass column or funnel</li> <li>• Beakers</li> <li>• Ring stand/clamps</li> </ul>	Minimum needed: All groups could decide to conduct ion-exchange, but there are other treatment options as well. Having 2-4 ion-exchange set ups	<a href="#">Water Filters Online</a>	\$15 for 1L

	if using column	might be a good start for your class.		
Distillation	<ul style="list-style-type: none"> <li>• Hot plate</li> <li>• Distillation apparatus (two options)</li> </ul>	Minimum needed: All groups could decide to conduct distillation, but there are other treatment options as well. Having 2-4 distillation set ups might be a good start for your class.	<p>Option 1: see image below</p> <p><a href="#">Option 2: Crescendo</a></p>	<p>You might already have supplies for option 1.</p> <p>\$133 for option 2.</p>



Materials needed for Option 1:

- Hot plate
- Conical flask
- Rubber bung with hole
- Plastic tubing
- Collection vessel (beaker or conical flask)
- Clamps
- Ice bath (helps to speed up the process)
- Heat-resistant gloves (optional)