# Activity: Mystery laundry powders and detergents (Years 7 and 8)

Micro-organisms at work—at the sewage treatment plant

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| Victorian Curriculum F–10[[1]](#footnote-1) links:  **Levels 7 and 8**  **Science**  **Science Understanding**  **Science as a Human Endeavour**  Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations  **Chemical sciences**  Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques |

Students identify the main chemicals contained in laundry powders and detergents; measure salt content using an electrical conductivity (EC) meter; measure phosphates using a phosphate test kit or phosphate testing strips; measure the pH of solutions containing laundry powders and detergents.

**Duration**

One period session and one double-period session (practical)

**Equipment**

Selection of empty packaging for laundry powders and detergents

Four laundry powder/detergent solutions (as below)

Containers or beakers for testing solutions of laundry powders and liquids

Teacher tip

Schools that do not have access to an EC meter could contact their local council to enquire about the availability of Melbourne Water Waterwatch kits provided for local groups/schools to borrow.

Universal indicator and scale or data-logging equipment with pH probe

An EC meter, or data-logging equipment with EC probe

Phosphate testing strips or (a phosphate test kit to be conducted by the teacher).

**Preparation**

Mix samples of four laundry powders or detergents labelled samples 1–4:

* regular laundry powder—5 g (1 teaspoon) to 1 L of water (equates to a standard wash for front loader). Note: Use the rate 15 g per 1 L for top-loading laundry powders.
* regular laundry liquid—5 mL to 1 L of water (equates to a standard wash for front loader). Note: Use the rate 15 mL per 1 L for top-loading laundry detergents.
* low-sodium/low-phosphate laundry powder—5 g (1 teaspoon) to 1 L of water (equates to a standard wash for front loader). Note: Use the rate 15 g per 1 L for top-loading laundry powders.
* eco variety of laundry detergent—5 mL to 1 L of water (equates to a standard wash for front loader). Note: Use the rate 15 mL per 1 L for top-loading laundry detergents.

Ensure that all safety requirements are followed.

**Activity steps**

1. Discuss the range of substances and items that might end up in the sewerage system from households and factories. In particular, focus on laundry powders and detergents. Discuss reasons why laundry powders and detergents are of concern in the treatment of sewage. (Refer to **Teacher background** for further information.)
2. Look at a selection of empty packaging for laundry powders and detergents in class or as a take-home task. Have students identify the key chemical constituents. Alert students to look for compounds that include chlorides, sodium, sulphates and phosphates.
3. Students complete the Table 1 using information supplied on the packaging or research using relevant websites (see References on page 6).

Table 1 Laundry chemicals

|  |  |
| --- | --- |
| **Chemical/substances identified in laundry powders and detergents** | **Why these chemicals are used in the laundry powders and detergents** |
| sodium polyphosphate | softens water and removes soil |
|  |  |

1. Explain that you have made up solutions of four laundry products and that the students’ task will be to carry out some tests to find out about the products and match each solution to its package using their results. Explain that, in each case, tap water will be measured and used as a reference.

**Test 1: Electrical conductivity**

1. Demonstrate how to measure the salinity of prepared solutions of laundry powders and detergents using an electrical conductivity (EC) meter. Use students from the class to assist in testing the water sample and the mystery laundry powders and detergents. Create a table of results (Table 2) to display the salt content measured in μS/cm (micro-Siemens/centimetre). Interpret the results.

Table 2 Electrical conductivity results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Tap water** | **Sample 1** | **Sample 2** | **Sample 3** | **Sample 4** |
| EC (µS/cm) |  |  |  |  |  |

1. Pose and discuss the following questions:
2. Are there differences in EC measurements from the water sample and the solutions? What does this mean?
3. Is there a difference between EC measurements of mystery solutions? What does this mean?

**Test 2: Phosphates**

1. Demonstrate the use of a phosphate testing kit to roughly indicate phosphorus levels of the mystery solutions. Kits typically have a colour chart showing pre-determined concentrations, which can be used to best match the colour of each mystery solution. The corresponding concentration can be recorded.
2. Phosphate test strips can be used to determine the presence or absence of phosphates. Select a range for measuring at least of 0–100 mg/L. (Up to 500 mg/L would be most suitable for testing laundry product solutions.)

Table 3 Phosphate results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Tap water** | **Sample 1** | **Sample 2** | **Sample 3** | **Sample 4** |
| Phosphates (mg/L)  (mg/L) |  |  |  |  |  |

**Test 3: pH**

1. Demonstrate how to measure the pH of water using a universal indicator, pH meter, or data-logging equipment and pH probe. Students measure the pH of the mystery solutions. Use the universal indicator to determine the alkalinity or acidity of the solutions. Record results in a table.

Table 4 pH results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Tap water** | **Sample 1** | **Sample 2** | **Sample 3** | **Sample 4** |
| pH |  |  |  |  |  |

1. Pose and discuss the questions:

* What does the pH indicate?
* Why is a higher pH preferable for laundry products?

**Results**

1. As a class, have students refer to their tables of results and match the sample to the laundry product. Ask students to provide the reasoning for their suggested matches. Discuss the different claims on the packaging for example ‘Low sodium/low phosphates’.

**Conclusion**

1. Students develop a series of messages about the use of laundry powders and detergents with consideration for the effects on the environment. (These could be refined after their Western Treatment Plant visit). For example:

* Choose washing detergent with a low salt content.
* Concentrated detergents often contain much less salt than powdered varieties.
* Too much salt in the sewerage system means we may not be able to use the recycled water.

1. These messages could be displayed in a place of prominence and linked to raising community awareness about sewage through promoting relevant messages.
2. Students create a list of questions related to sewage treatment and laundry powders and detergents which could be discussed during their Western Treatment Plant visit. For example:

* What happens to salts in the sewage treatment?
* Do phosphates and salts affect the bacteria that help in the treatment process?
* Does a high or low pH affect the treatment process?
* Do the salts in sewage have to be reduced before being released to the environment?
* Does the pH of sewage have to be altered before being released to the environment?

**Teacher background**

Almost half the salt in sewage that flows to the Western Treatment Plant comes from industry located to the west of Melbourne and about one-quarter comes from households.

Laundry powders and detergents may include phosphorus, sodium, boron, chloride and borax. Typically these laundry products contain inorganic compounds (salts) such as sodium tripolyphospate, sodium carbonate, sodium silicate and sodium sulphate. Concentrates generally contain less sodium (salts) than regular laundry products because sodium is used as a filler in powdered laundry detergents. The amount of sodium in laundry detergents needs to be limited when the sewage is to be discharged to vegetation or soil absorption areas, for example if the effluent is used as recycled water.

Phosphates that enter waterways lead to increased nutrient levels which encourage the growth of algae and bacteria.

The concentration of phosphate in the mystery laundry powder or detergent solution can be estimated by matching the colour produced to a colour wheel or colour chart for pre-determined concentrations which can be found in a kit such as Visicolor Phosphate Testing kit or phosphate test strips. If using phosphate testing strips, select those that have a range up to at least 100 mg/L. Up to 300–400 mg/L is preferable otherwise it will be difficult to distinguish between the mystery solutions.

Acidic solutions have a pH of less than 7, while alkaline solutions have a pH of more than 7. Laundry powders are generally very alkaline with a pH above 8.5. A high pH is required to remove organic matter from clothes such as food stains and sweat. Greywater with a high pH, as a result of laundry products, may be harmful to both plants and the micro-organisms in the soil.

**Safety note: Under no circumstances should students conduct tests on laundry grey water. Grey water can contain pathogens that may transmit disease. All laundry powder and detergent solution samples for testing must be prepared with clean water.**

### Resources

Quality recycled water for the Werribee Plains: Salt-reduction strategy, Melbourne Water <<http://ausvegvic.com.au/pdf/env_Quality_Recycled_Water_for_the_Werribee_Plains.pdf>>

Laundry Products Research, Lanfax Labs

<[www.lanfaxlabs.com.au/laundry.htm](http://www.lanfaxlabs.com.au/laundry.htm)>

Sources of critical contaminants in domestic wastewater, CSIRO

<<https://www.researchgate.net/profile/Magnus_Moglia/publication/242137154_Sources_of_critical_contaminants_in_domestic_wastewater_contaminant_loads_from_household_appliances/links/0046352e1b69294c9c000000.pdf>>

Choosing laundry detergents, City West Water

<[www.citywestwater.com.au/residents/choosing\_laundry\_detergents.aspx](http://www.citywestwater.com.au/residents/choosing_laundry_detergents.aspx)>

Electrical conductivity, Healthy Waterways Waterwatch Program

<<http://www.waterwatchmelbourne.org.au/content/volunteer_monitoring/what_we_monitor/what_we_monitor.asp#2>>

Phosphate test strips: Macherey Nagel phosphate test strips Range 0–100 mg/L phosphate. Gradation 0–3–10–25–50–100, Apps Laboratories website,

<<http://appslabs.com.au/index.php?main_page=index&cPath=410_40_28>>

1. Creative Commons Licence Victorian Curriculum and Assessment Authority (VCAA) <<http://victoriancurriculum.vcaa.vic.edu.au/>> Accessed 14 August 2016. [↑](#footnote-ref-1)