

# Engineering Activity 3: Measure Up: Investigating Water Quality

## Educator Preview

### Activity Snapshot

Learners measure the water quality of the samples they have made.



### Timing | 45 minutes

Get Ready & Team Up 10 min.  
 Water Quality 25 min.  
 Reflect 10 min.  
**Total 45 min.**  
**Level Up Activities** 5–20 min. each



### Prep Snapshot\*

#### Prep Time 15 min.

- Space Need: Sink
- Set up Materials Table.
- Print handouts.

*\*See Materials & Preparation for full info.*



### 21st Century Skills

#### Connection

- Critical Thinking

#### Habits of Mind

- Investigate features and uses of tools.



### Guiding Question

*How can we tell if water is safe to reuse?*

### Learners Will Do

Test for at least one level of water quality.

### Learners Will Know

Engineers gather data to understand problems.



### Connecting Across Activities

Activity 2: Water Where We Are From	Activity 3: Investigating Water Quality	Activity 4: Investigating Filters
<b>Last time</b> , learners considered who uses water in their community and how, and they made water samples.	<b>Today</b> , learners measure the water quality of the samples they have made.	<b>Next time</b> , learners will investigate the ability of various filter materials to remove contaminants from a water sample.

## Activity Resources

Access videos and digital resources using the link or QR code below. More information for teaching this curriculum is available in the [Educator Guide Introduction, pgs. iii–xxvi](#). Access more PLANETS units, research, and pathways at <https://planets-stem.org/>.



weblink: <https://hov.to/f72a8d8f>

## Materials and Preparation

### Materials

#### For the whole group

- *Our Ideas* poster (on paper or a shared digital document) in Prep & Setup Guide (PDF) [Examples](#) & [Template](#)
- water
- towels or disposable tablecloths (optional)

#### For each learner

- [Engineering Notebook \(PDF\)](#)

#### For each group of 4

- water sample from Activity 2
- 1 coffee filter
- 1 flashlight
- 1 packet of pH strips
- 1 piece of construction paper (the same color for all groups)
- 1 plastic cup
- [Engineering Activity 3 How to Test Water Quality Handout, pgs. 47–51](#)
- [Engineering Activity 3 How Clean Does It Need to Be? Handout, pgs. 52–53](#)



### Teaching Tip

Instead of pH strips, you can use alternative methods to measure pH, such as goldenrod paper or red cabbage juice.



### Support Learner Differences

It may be helpful for your learners to use light meter and color meter apps for measurement. These apps are useful for two reasons: First, they allow learners who are blind or low-vision to make water quality measurements. Second, they quantify features of water quality, making the measurements more exact.

Various **light meter apps** are available for free download. These apps measure camera images in lux, a unit describing how much an area is illuminated. For example, a light meter app may give a reading of 20 lux for a water sample, which means that very little light is passing through the water because it is so cloudy. By giving numbers, the app allows for accurate comparisons of water clarity. Make sure learners orient devices so the cameras are down as close to the tabletop as possible.

Because measurements of light meter apps can vary depending on lighting and background, it's important to make the measurement of a cup of clear water first. Comparing the measurement of the clear water to the measurement of the water sample can help learners decide how clear the sample is. For consistency, it's also important to continue using the same app throughout the activity.

Various **color meter apps** are available for free download. These apps measure the color of part of an image, allowing for non-visual color assessments and measurements of pH strip results. For example, a color meter app may identify the color of a pH strip as R:62, G:171, B:159, which allows easy comparison to the reference colors on a pH scale.

If necessary for your learners, make sure the devices you are using for these apps have a read-aloud function enabled for using the apps (e.g., TalkBack for Android, VoiceOver for iOS).

If you have some devices available, but not enough for every group to have one, you can set up stations where groups can use devices as needed to measure their samples.



## Activity 3 Materials Preparation (15 min.)

### Ahead of Time

1. Watch the video [Engineering How to Part 1](#) (0:53–2:55) to learn about what happens in this activity.
2. Review the “In-Use Example” in the *Our Ideas* [Prep & Setup Guide \(PDF\)](#) to help you think about what to add to the *Our Ideas* poster during the discussions in this activity.
3. Review instructions on [Engineering Activity 3 How to Test Water Quality Handout, pgs. 47–51](#). Make one copy for each group.
4. Make one copy of [Engineering Activity 3 How Clean Does It Need to Be? Handout, pgs. 52–53](#), for each group.

### In Your Space

5. Place the *Our Ideas* poster in a visible place in your learning setting or prepare to share it digitally.
6. Fill up one cup of clean water for each group.



### Teaching Tip

Lead this activity in a room with a sink for easy setup. Organize group materials in bags for easy distribution.

## Activity Guide

### Get Ready & Team Up (10 min.)

1. Ask: **If you did the last activity, what did you do and why?** (*We thought about how groups in communities we belong to use water and how water gets contaminated. We made water samples for different sources. This helped us get ready to think about cleaning the water.*) Draw learners' attention to their work on the *Our Ideas* poster about community water users, water uses, and sources of contamination.
2. Say: **Our challenge is to find ways to help people reuse water in a place where water is hard to get.** Show the *Engineering Activity 2 Extreme Environments* slides to remind learners of possible locations (desert Southwest, Mars, research boat, or the International Space Station).
3. Say: **Today, we're going to start by investigating our questions about measurement of how clean water is.** Share the Guiding Question or a similar question from the *Our Ideas* poster with learners aloud and in writing (using multiple languages as needed): **How can we tell if water is safe to reuse?**
4. Organize learners into groups of four and distribute Engineering Notebooks.

### Water Quality (25 min.)

5. Have learners discuss in their groups: **What are some ways we can measure how clean or contaminated water is?** (*We can measure how clear it is, if there are things in it, if it smells bad, if it has chemicals in it, what color it is.*) Record ideas on the *Our Ideas* poster.
6. Give each group its water sample from the previous activity, 1 cup of clean water, 1 coffee filter, 1 flashlight, 1 packet of pH strips, and 1 piece of construction paper.
7. Give each group a copy of *Engineering Activity 3 How to Test Water Quality Handout*, pgs. 47-51. Say: **This sheet has tests to measure water quality. As a group, you will have about 15 minutes to try three to five of these tests on your water samples, then record your results on *Our First Water Sample*, pg. 8 in your Notebook.**



#### Support Learner Differences

If new learners are joining you, lead an [inclusion activity \(pgs. xx-xxi\)](#) and use other [engagement strategies as necessary \(pgs. viii-xviii\)](#).



#### Support Learner Differences

As needed, provide groups with a tub or other container to hold their materials. Give learners time to examine the materials before they begin testing.



#### Support Thinking

To help learners understand what they will be doing during this activity, play the translatable videos from the [How to Prepare and Teach playlist](#).

8. Say: **To get used to testing, we will start by doing one test all together.** Read the instructions for the “How Clear Is It?” test aloud one step at a time, and have learners follow them using their cups of clean water. This will give them a measurement for how much light passes through clean water.



### Level Up!

Cut out the circles on [Engineering Activity 3 Secchi Disks Handout \(PDF\)](#) and give one to each group. Explain that these disks are tools used by environmental professionals to measure water quality. Learners can hold the disks in place of the construction paper as they determine water clarity.

9. Have learners repeat the test with their water samples and compare their results to the results for the clean water. Have each group record its results. Make sure learners do not contaminate the clean water by using tools that were previously in contaminated water.



### Support Thinking

Remind learners that *clear* and *colorless* do not mean the same thing. Give an example, like apple juice, that is clear but has a yellow color.

10. Give groups 15 minutes to perform additional tests on their water samples. As needed, offer clarifications and explain testing instructions.



### Teaching Tips

The pH strips may stain the tabletop, so have learners place their used strips on a paper towel. Placing samples on white paper makes them easier to see.

11. After about 15 minutes, have learners stop testing. If groups did not have a chance to perform all the tests, have each group pair up with another that performed different tests and share their results.



### Support Learner Differences

Allow blind and low vision learners time to touch and orient themselves with materials before starting the testing time.




### Level Up!

- ✦ Pass out the [Engineering Activity 3 Acidity Chart Handout \(PDF\)](#) so learners can compare the acidity of their water samples to the common contaminants on the chart. A Braille version of the chart is available online. (5 min.)
- ✦ Have the entire group decide on one additional observable feature to determine water quality. Have learners add it to the testing directions on [Engineering Activity 3 How to Test Water Quality Handout, pgs. 47–51](#). (20 min.)

12. Connect learners' experience to vocabulary by saying: **Good job testing your water samples! To make it easy to talk about these sorts of tests, scientists and engineers use certain words.**
13. Say: **What words would you use to describe what you measured in the "How Clear Is It?" test?** (*Clearness, transparency, translucency, opacity, clarity.*) Write the terms learners suggest on the *Our Ideas* poster. Say: **How clear the water is can be called *clarity*.** Write *clarity* on the *Our Ideas* poster.
14. Say: **What words would you use to describe what you measured in the "How Acidic Is It?" test?** (*Acid, acidic, base, basic, neutral, pH.*) Write the terms learners suggest on the *Our Ideas* poster. Say: ***pH* is how acidic or basic a sample is. *pH strips* are tools that measure pH.** Write *pH* on the *Our Ideas* poster.
15. Say: **How clean or contaminated a water sample is, is called *water quality*. Clarity, color, pH, smell, and texture are ways to figure out water quality. How water can be reused depends on its quality.** Write *water quality* on the *Our Ideas* poster. You can have learners add translations of terms, drawings, or related images to the poster as well.



### Support Learner Differences

If you have learners who speak multiple languages, have them discuss words for "clarity," "color," "pH," "smell," "texture," and "quality" in their preferred languages and notice similarities between languages. If you can, provide an example from a language you know. Take time to learn learners' words and use them throughout the activities. 



### Support Thinking

Have learners discuss different reasons why contaminated water is bad to reuse. *It can make you sick; it is gross to drink water with chunks in it; really acidic water can hurt you.*



### Teaching Tip

Learners may note, or you may want to point out, that water quality involves other features beyond the five measured in these tests. For example, water containing pathogens may seem clean but be unsafe to drink. As a result, learners should never drink water samples they create, even if they seem clean.



### Level Up!

- ✦ In addition to water quality, you can have learners think about water accessibility. Have them consider places where water may not be easy to get, such as communities without running water, and how this lack of accessibility affects people in those areas. (10 min.)
- ✦ NASA uses satellite missions to look for water on Earth. Learn more about how they are working on solving water problems on Earth at <https://earthobservatory.nasa.gov/images/151134/water-tracking-satellite-reveals-first-views>. (5 min.)



16. Give each group a copy of *Engineering Activity 3 How Clean Does It Need to Be? Handout*, pgs. 52–53. Say: **This page gives instructions on how to figure out water quality using the measurements you took. Figure out the quality of your sample as a group and record it on *Our First Water Sample*.** Give groups a few minutes to determine the quality of their water samples.

### Reflect (10 min.)

17. Have learners revisit the Guiding Question in their small groups: **How can we tell if water is safe enough to reuse?** (*We can measure clarity, color, pH, smell, and texture. Water with bad quality is probably not safe to reuse.*) As needed, refer to terms on the *Our Ideas* poster.
18. Say: **Next time, you will use what you learned about water quality to design ways to remove contaminants from water.**

### After the Activity

- Clean up:
  - Keep the *Our Ideas* poster for use in Activity 4.
  - Dispose of used pH strips and coffee filters.
  - Save the water samples and measurement supplies for use in Activity 4. Decide if you need to make more.
  - Collect the handouts.
- Plan for Engineering Activity 4. See the [Activity 4 Preparation on pg. 57](#).
- Take time to reflect on the following educator prompt. **How did you connect learners' observations to new vocabulary?**

### Water in Extreme Environments Additional Resources

Resources include All Downloads, All Videos, Family Connections, and more.



weblink: <https://hov.to/7cb5c428>



### Level Up!

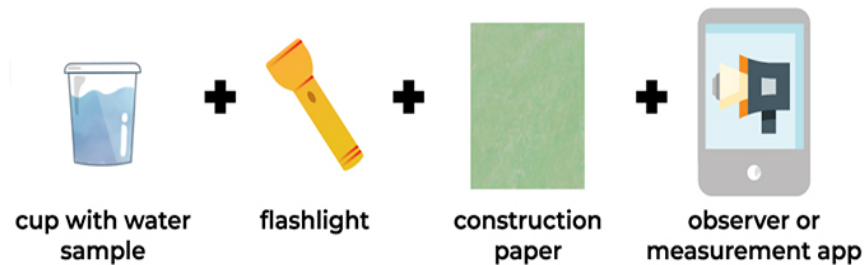
- Refer to the *Engineering Design Process* poster. Ask: **What phases of the Engineering Design Process did you use today?** (*We investigated how water quality is measured.*) (5 min.)
- Ask this story prompt question: **Can you tell a story about a time when you've had to observe water closely, either out in a natural setting or somewhere else?** (*Possible responses include while boating, fishing, or cooking.*) Have learners share with a partner (note that the sharing can take forms other than speaking aloud). Consider returning to learners' ideas at the start of the next activity. (20 min.)
- Tell learners, if anyone asks them what they did today, they can tell them "We explored water quality and how to measure it." (5 min.)
- You can introduce learners to the industry terms *potable water*, *greywater*, and *wastewater*. Potable water is clean water that people can drink safely. Greywater is somewhat contaminated water, which has been used once and can be used again for some purposes. Wastewater is very contaminated water, which cannot be reused for most tasks before its quality is improved. (5 min.)



## How to Test Water Quality

Use 3 to 5 of these tests on your sample.

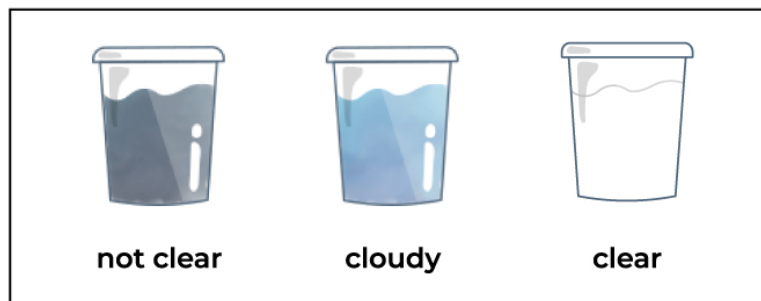
### How Clear Is It?



1. Have one person hold the construction paper behind the water sample.
2. Have another person shine a flashlight down onto the sample from above.



3. Have a third person look at the sample. Figure out how clear the water is.
  - **not clear** (no light goes through)
  - **cloudy** (some light goes through)
  - **clear** (all light goes through)



Do the whole test twice: once with clean water, so you know how much light goes through it, and once with your water sample.

## What Is the Color?



cup with water  
sample



observer or  
meter app

1. Look at the water sample.



2. Score the color.

- **has color**
- **colorless**

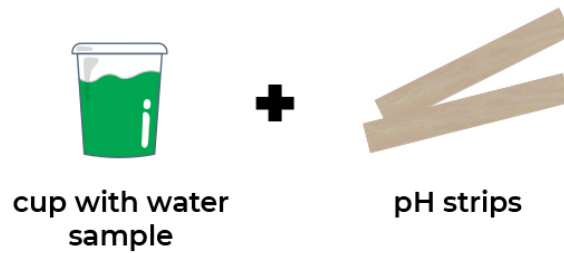


**has color**



**colorless**

## How Acidic Is It?



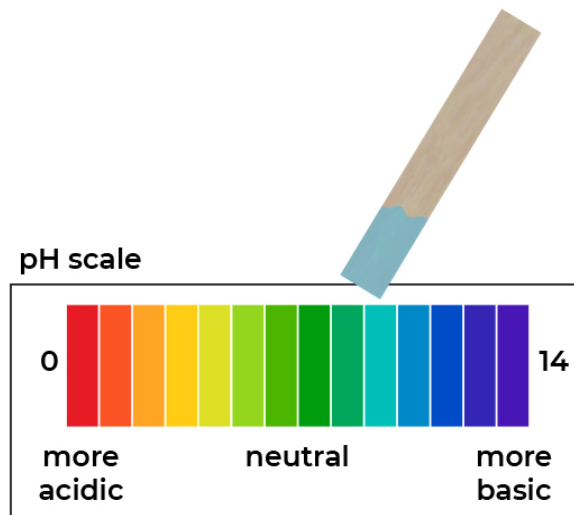
### Use a testing strip:

1. Dip the end of the strip into the water sample.
2. The strip will turn a color. Compare it with the color scale on the packet that came with the strip.



3. Score the acidity.

- **acidic:** 0–5
- **neutral:** 6–8
- **basic:** 9–14



## What Does It Smell Like?



**cup with water  
sample**

1. Smell the sample.



2. Rate the smell.

- **strong smell**
- **weak smell**
- **no smell**

## What Is the Texture?



1. Set up the clear plastic cup.
2. Have one person hold the coffee filter over the top of the cup.
3. Have another person pour about 1 tablespoon of water from the container through the coffee filter into the cup.



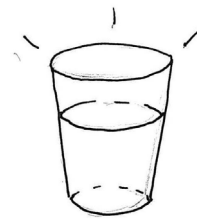
4. Feel the coffee filter. Score the texture.
  - **gritty texture** (you can feel objects)
  - **smooth texture** (you just feel the filter)

## How Clean Does It Need to Be?

We will categorize our water in three ways: clean water, somewhat contaminated water, and very contaminated water. Use the key below to see how clean water needs to be for each category.

### Clean Water

- Clear
- Colorless
- Neutral pH (6–8)
- No smell
- Smooth texture



Can be used at *any* location



## Somewhat Contaminated Water

- Clear or cloudy
- Colorless
- pH 5–9
- No smell or weak smell
- Smooth texture



### Can be used for

- Toilet 
- Watering Edible Plants 
- Watering Landscape Plants



## Very Contaminated Water

- Not clear
- Has color
- pH 0–4 or 10–14
- Strong smell
- Gritty texture



### Can be used for

Watering Landscape Plants





