

# pH in Soil & Food, Teacher Resource

Topics	Coverage
<p><b>Goals</b></p>	<ul style="list-style-type: none"> <li>• Students will understand what pH is and how it is measured in soil and food.</li> <li>• Students will identify factors that affect soil pH, including soil acidification, leaching, root crops, fertilizers, acid rain, and oxidative weathering.</li> <li>• Students will investigate the pH levels required for optimal growth of various food plants.</li> <li>• Students will learn how to test soil pH levels using a pH soil meter.</li> <li>• Students will develop skills in recording observations, characteristics, and fixing issues that arise with a plant.</li> </ul>
<p><b>What is pH</b></p>	<p>pH measures the acidity or alkalinity in soil.</p>
<p><b>Why do we need to measure pH in soil?</b></p>	<p>The pH in the soil controls the nutrient chemical form as well as controls their reactions.</p> <p>ultra acidic (&lt;3.5), extremely acidic (3.5–4.4), very strongly acid (4.5–5.0), strongly acidic (5.1–5.5), moderately acidic (5.6–6.0), slightly acidic (6.1–6.5), neutral (6.6–7.3), slightly alkaline (7.4–7.8), moderately alkaline (7.9–8.4), strongly alkaline (8.5–9.0) and very strongly alkaline (&gt;9.0)</p>
<p><b>What controls pH in soil?</b></p>	<p><b>Soil acidification:</b> the acidity of the soil decreases over time</p> <p>The rate at which the acidity decreases depends on:</p> <p><b>Rainfall:</b> the more rain, the more acidic the soil becomes due to an atmospheric reaction with CO<sub>2</sub> that creates carbonic acid. The pH of normal rain is around 5.6. With rain comes leaching.</p> <p><b>Leaching:</b> when water-soluble substances are deposited into lower soil by precipitation With heavy rain comes water pollution. The water-soluble substances are carried elsewhere instead of leaching</p> <p><b>Root crops:</b> a root crop is a root vegetable like potatoes, beets, or carrots. When these crops grow roots, they output hydrogen ions to create a more acidic soil</p> <p><b>Fertilizer:</b> similar to root crops, the use of ammonium</p>



	<p>fertilizers also outputs hydrogen ions to create a more acidic soil. The fertilizer undergoes a nitrification process to form nitrate which leads to the discharge of hydrogen into the soil.</p> <p><b>Nitrification Process:</b> ammonium is converted into nitrite through oxidation and nitrite is oxidized into nitrate</p> <p><b>Acid Rain:</b> this occurs when sulfur and nitrogen are oxidized from burning fossil fuels or volcanoes Does not always have to be raining. This could be in snow, fog, hail, or dust with acid in it. The pH of acid rain is around 4.6. While a lesser number than rain, normal rain is considered neutral and acid rain is not. When acid rain gets into waterways, it contaminates and creates a more acidic environment.</p> <p><b>Oxidative weathering:</b> when oxygen combines with other substances to create an oxide</p>
<p><b>What pH do foods need?</b></p>	<ul style="list-style-type: none"> <li>● 6.0-7.5 <ul style="list-style-type: none"> <li>○ Plum: 6.0-8.0</li> <li>○ Asparagus: 6.0-8.0</li> <li>○ Lemon: 6.0-7.5</li> <li>○ Orange: 6.0-7.5</li> <li>○ Pear: 6.0-7.5</li> <li>○ Beet: 6.0-7.5</li> <li>○ Brussels sprout: 6.0-7.5</li> <li>○ <u>Kale: 6.0-7.5</u></li> <li>○ Pea, sweet: 6.0-7.5</li> <li>○ Spinach: 6.0-7.5</li> <li>○ Squash, crookneck: 6.0-7.5</li> </ul> </li> <li>● 6.0-7.0 <ul style="list-style-type: none"> <li>○ Cherry, sour: 6.0-7.0</li> <li>○ Peach: 6.0-7.0</li> <li>○ Broccoli: 6.0-7.0</li> <li>○ Cabbage: 6.0-7.0</li> <li>○ Chive: 6.0-7.0</li> <li>○ <u>Lettuce: 6.0-7.0</u></li> <li>○ Radish: 6.0-7.0</li> </ul> </li> <li>● 5.0-7.5 <ul style="list-style-type: none"> <li>○ Celery: 5.8-7.0</li> <li>○ Garlic: 5.5-8.0</li> <li>○ Cauliflower: 5.5-7.5</li> </ul> </li> </ul>



	<ul style="list-style-type: none"> <li>○ Pumpkin: 5.5-7.5</li> <li>○ <u>Tomato: 5.5-7.5</u></li> <li>● 5.0-7.0 <ul style="list-style-type: none"> <li>○ Raspberry, red: 5.5-7.0</li> <li>○ <u>Carrot: 5.5-7.0</u></li> <li>○ Cucumber: 5.5-7.0</li> <li>○ Pepper, sweet: 5.5-7.0</li> <li>○ Squash, Hubbard: 5.5-7.0</li> <li>○ Apple: 5.0-6.5</li> <li>○ Blackberry: 5.0-6.0</li> </ul> </li> <li>● Below 5.0 <ul style="list-style-type: none"> <li>○ <u>Miracle Fruit: 4.5-5.8</u></li> <li>○ Potato: 4.8-6.5</li> <li>○ Blueberry: 4.0-6.0</li> </ul> </li> </ul>
<b>How to test pH in soil:</b>	<p>The soil of the Miracle Fruit Plant should always be between 4.5 and 5.8. Failure to do so may result in a wilted, brown, sad plant.</p> <p>Water with filtered water or rain water only</p>
<b>When to check pH level:</b>	<ul style="list-style-type: none"> <li>● When you see brown and/or crispy leaves</li> <li>● We recommend purchasing a soil pH tester from your local hardware store to get accurate reading</li> </ul>
<b>How to raise or lower pH:</b>	<ul style="list-style-type: none"> <li>■ How to raise pH level: <ul style="list-style-type: none"> <li>● Do not use anything with lime or a lime base</li> <li>● Spread your post morning coffee grounds for the tree! Sprinkle grounds on the top of the soil and as they breakdown, it will make your soil more acidic</li> </ul> </li> <li>■ How to lower pH level: <ul style="list-style-type: none"> <li>● Add sphagnum peat moss to the top of the soil, around an inch, and work into the top layers of the soil</li> <li>● Be careful not to disturb the roots</li> </ul> </li> </ul>

**Materials:**

1. Plant pot, 6 inches wide
2. Soil, if not purchased with the plant
3. Miracle Fruit Plant
4. pH Soil Meter
5. Coffee Grounds
6. Sphagnum Moss



**Assignment:** Students will partner up and take turns recording observations, characteristics, and fixing any issues that arise with the miracle berry tree. Each student should have a record of this table and should be gone over every week as a recap for those who were not in charge that week.

It is up to you, the teacher, if you are going to water the plant or the students.

Week	Observations	Quantitative Characteristics	Did I/We Do Anything?
Week 1	Plant looks healthy, 3 leaves	pH reading of 5.5	N/A
Week 2	Plant seems to be yellowing, could be from overwatering	pH reading of 4.0	Sprinkled coffee grounds on the top to help increase pH
Week 3	Plant has sprouted a new leaf making 4 total	pH reading of 5.0	N/A
Week 4	The leaves are turning red	pH reading of 5.3	Moved the plant to a place where there was filtered light. Will continue to watch
Weeks 5-6	No new red leaves	pH of 5.0	Added a little of coffee grounds again to raise pH
Weeks 7-8	The leaves now look pale, not as vibrant as before	pH of 6.0	Added sphagnum moss to the soil in hopes it comes down

**\*\*While these are examples, there are some common issues listed in the observation section. If your plant is having any issues besides pH, you can find how to treat them via our website**

