Method 1: Boiling Water Canning

Can My Tomatoes

Brought to you by the National Center for Home Food Processing and Preservation, University of Georgia Cooperative Extension and Clemson Cooperative Extension
The PUT IT UP! series of lessons in home food preservation includes six different food preservation methods: boiling water canning, making jam, pickling, freezing, drying, and pressure canning. Each method is divided into a beginning hands-on activity and an advanced hands-on activity. Activities may stand alone or be sequenced for cumulative learning. In addition to step-by-step procedures, reflection questions, and ideas for experimentation, each method also includes additional activities: a science-based fill-in-the blank challenge, a history-based word search, a glossary, a resource list, a knowledge test, and more.

On the following pages, PUT IT UP! Can My Tomatoes contains:

- Beginning Activity: Can My Crushed Tomatoes
- Advanced Activity: Can My Salsa
- Additional Activities: Can My Tomatoes
PUT IT UP!

Can My Crushed Tomatoes

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National Center for Home Food Processing and Preservation,
University of Georgia Cooperative Extension and Clemson Cooperative Extension
Credits and Acknowledgments

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Boiling Water Canning: A Preservation Exploration

Have you ever used crushed tomatoes as a base for spaghetti sauce or chili? You might have made your own pizza sauce with crushed tomatoes? In this food science exploration, you’ll get to learn how to can your own crushed tomatoes at home, using just a few simple ingredients.

Let’s start with some basics of food science and preservation:

Preservation means to prevent decay, or in other words to stop a food from breaking down and spoiling. Rotten tomatoes, moldy bread, and stinky old milk are all examples of spoiled foods. Refrigeration and freezing are very common preservation methods used in modern households to extend the shelf-life of foods. Other home food preservation methods are pickling, drying (or dehydrating), making jam, and canning.

Canning is the process of putting jars of food in a canner and heating those jars in the canner on a stovetop. Boiling Water Canning is when this process is done in a boiling water canner, which is basically a large stockpot with a rack in the bottom and a loose-fitting lid resting on top.

Boiling water canning is simple, but it’s important that you follow the detailed directions in the procedure to do it correctly. As you’ll see, you will fill a large stockpot about half full with water and heat it while you prepare tomatoes and fill jars. Then you will lower the filled jars into almost boiling water, submerging them completely so that hot water surrounds them on all sides. Once the water comes to a full boil, you’ll set a timer.

How does heat move through the food? As heat moves into the jars from the hot water, the food gets heated evenly. If there is enough liquid in a jar for fluid to flow, then a convection pattern will form, circulating heat in loops. If the food in the jar is more solid, then the heating pattern is called conduction, and it moves in a straight direction, inwards. Even the coldest spot in the jar must be heated in order for the canned food to be safe to eat.

Where’s the “Can” in “Canning”?!?

In the past, canning was done in tin kerosene cans with glass liners. By the 1900s, companies were producing stand-alone glass jars for home canning. Still, the term “canning” stuck.
Beginning Boiling Water Canning Activity:
Crushed Tomatoes

Time required:
1 to 1½ hours procedure + 1 to 1½ hours additional processing time
= 2 to 3 hours total (+ 12 hour minimum cooling time)

Ingredients:
For a canner load of 9 pint jars
(canner size may vary, so check capacity ahead of time and adjust accordingly)

- 14 to 16 pounds of tomatoes (1½ to 1¾ pounds per pint)
- 9 tablespoons bottled lemon juice (or 2¼ teaspoons citric acid)
- 4½ teaspoons canning salt (optional)
- Any additional ingredients from ‘Want to Experiment?’ (optional)

Equipment needed:
- Gas or electric stovetop range with four burners
- Boiling water canner (or large stockpot) with rack
- Pint canning jars, regular or wide mouth
- Ring bands, regular or wide mouth
- Two-piece metal canning lids, regular or wide mouth
- Permanent marker, or labels and pens
- Medium saucepan for boiling water to be added to canner
- Large colander or bowl for washing tomatoes
- Paring knife(s)
- Cutting board
- Large stockpot, 8-10 cup
- Slotted spoon
- Large wooden spoon or mallet
- Large mixing bowl for cold water or ice water
- Jar lifter
- Liquid measuring cups
- Measuring spoons
- Large ladle
- Jar funnel
- Headspace tool or ruler
- Bubble freer or narrow plastic spatula
- Spoon
- Paper towels
- Thermometer
- Kitchen timer (may be on oven)
- Dry towel or cake-cooling rack
- Ice (optional; for cooling tomatoes)

Select disease-free, preferably vine-ripened, firm tomatoes. Do not make salsa with tomatoes from dead or frost-killed vines.

If range is a smooth-top, boiling water canner must have a flat-bottom.
The Procedure:
Just Follow These Steps...

Part One: Preparing the Canner and Jars

1. Wash hands thoroughly with soap under running water for at least 20 seconds, rinse well, and dry.

2. Assemble equipment and ingredients.

3. * Fill boiling water canner half full with clean, hot water. Turn heat on medium-high to heat water in canner to just under boiling (simmering, 180˚F).

4. Examine ring bands and discard any with rust or bends. Examine jars carefully. Discard any with cracks or chips in the rim.

5. Wash jars thoroughly in warm soapy water, rinse well, and then place them in the boiling water canner (or in a dishwasher) to stay warm until ready to use. Use a thermometer to check that water in canner is at 180˚F.

6. Wash ring bands if necessary; otherwise, keep them dry until use.

7. Use a permanent marker to label lids with your name, the name of the product and the date. If using labels and pens, then wait until after processing, when jars have cooled.

8. Prepare lids according to manufacturer's recommendations.

Part Two: Preparing the Tomatoes

10. * Fill a stockpot with enough water to cover several tomatoes at a time. Bring water to a boil while preparing tomatoes.

Leader Demonstration: Basic knife skills. Grip the knife handle with your dominant hand, wrapping fingertips behind knuckles for tight grip. When slicing, use a rocking motion, not just downwards. Always pay attention and keep your hands away from the blade.

11. * Wash tomatoes. Carefully cut an “x” in the bottom of each tomato with the tip of a paring knife.

12. Fill a large bowl with cold water and ice if you have it.

13. * Place 2 to 3 tomatoes at a time in boiling water for 30 to 60 seconds, until skins split, then immediately remove them with a slotted spoon and place in the cold water. Slip off and discard tomato skins.

14. * Place tomatoes on a clean cutting board and core them: carefully use a paring knife to remove the inner, more firm core. Trim off any bruised portions.

15. * Cut about 4 medium tomatoes into quarters and heat them to boiling in a large stockpot. Use a large mallet or spoon to crush the tomatoes and stir constantly to prevent burning.

16. * Continue to cut tomatoes into quarters and keep the tomatoes in the stockpot boiling while slowly adding quartered tomatoes. Stir, but do not crush anymore. After you add all the pieces, simmer (gently boil) for 5 minutes.

Fun Facts!

Tomatoes are native American fruits; they are originally from South America (and they used to have ruffles and ridges).

1/2 cup of tomatoes has 15% DV vitamin A and 20% DV of vitamin C (DV= daily recommended amount).
Part Three: Packing the Tomatoes

17. * Slowly remove jars from hot water (or dishwasher) with jar lifter. Carefully empty any water back into the canner. Place jars upright on a towel-covered countertop or rack.

18. Measure and add 1 tbsp. bottled lemon juice or ¼ tsp. citric acid to each jar.

19. If desired, measure and add ½ tsp. salt to each pint jar.

20. * Rest funnel in jar opening and ladle tomatoes into hot pint jar leaving ½-inch from the top of the tomatoes to the top of the jar rim. This gap is called headspace. Measure headspace with headspace tool or ruler to ensure headspace is ½-inch.

21. Remove air bubbles by moving bubble freer or plastic spatula gently in and out around the inside edge of the jar. Check the headspace of each jar again, using a spoon to remove or add small amounts if needed to make it ½-inch.

22. Wipe jar rims with clean, damp paper towel, then apply lids according to manufacturer’s directions. Turn bands onto jars until fingertip tight. Fingertip tight is when you meet firm resistance as you turn the band with your thumb and two fingers onto the jar.

23. * Use a thermometer to check temperature of water in canner is 180°F. Adjust burner higher or lower, if necessary.
Part Four: Boiling Water Canner Processing

24. * Use jar lifter to carefully place jars of tomatoes one at a time on the rack in the canner. Keep jars upright at all times. Make sure water is 1-2 inches above tops of jars. Add hot water from the saucepan if needed, pouring between jars rather than directly on top of jars.

25. * Place lid on canner and turn heat to high. Bring water in canner to a strong boil before timing.

26. Set timer using the times recommended on the table to the right. Maintain a steady, strong boil throughout the entire timing process.

27. * When the timer goes off, turn off heat then remove canner lid with lid pointed away from you. Wait 5 minutes for contents to settle in jars.

28. * After 5 minutes of cooling, keep jars straight up as you remove jars one at a time with jar lifter. Be careful not to tilt them. Place jars at least 1 inch apart on dry towels or cake-cooling rack. Place away from drafts of moving air.

29. Let jars cool, undisturbed 12 to 24 hours. Check jars for vacuum seals. If jars are taken home before cooling completely, keep in a refrigerator.

30. Remove ring bands from sealed jars and wipe jars. Store in a cool, dark, dry place. Enjoy with family and friends within one year for best quality. Store unsealed or opened jars in the refrigerator and eat within one week.

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Altitude Adjustments and Processing Times for Hot Packs of Crushed Tomatoes in Pint Jars:

<table>
<thead>
<tr>
<th>Altitude</th>
<th>Process Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1,000 feet</td>
<td>35 minutes</td>
</tr>
<tr>
<td>1,001-3,000 feet</td>
<td>40 minutes</td>
</tr>
<tr>
<td>3,001-6,000 feet</td>
<td>45 minutes</td>
</tr>
<tr>
<td>above 6,000 feet</td>
<td>50 minutes</td>
</tr>
</tbody>
</table>

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Time to Reflect...

Write your responses to these questions. Then, share your reflections with one or two others.

What was your favorite part of canning crushed tomatoes?

________________________________________________________________________

For you, what was the most challenging part of canning crushed tomatoes?

________________________________________________________________________

What surprised you most in this activity?

________________________________________________________________________

Now think about how you will apply what you have learned today. Again, share your ideas.

If you could do this activity again, what is one thing you would change? Why?

________________________________________________________________________

Do you think that canning tomatoes is a useful skill? Why or why not?

________________________________________________________________________

How will you use what you have learned about canning tomatoes?

________________________________________________________________________
Want to Experiment?

Scoop a spoonful of crushed tomatoes onto crispy toasted pieces of bread, then top with basil and maybe even parmesan cheese. Yum!

Make spaghetti sauce with your canned crushed tomatoes by adding Italian seasonings like oregano, basil, rosemary, and thyme after opening. These flavors are strong, so stir in a few shakes and then taste before adding more. You may also like to mix in roasted vegetables or cooked ground beef.

Mix chilled tomatoes with tomato juice, chopped peppers, cucumbers, onions, and cilantro (if you like) for a popular cold soup called gazpacho!

Ask for help to follow directions for canning a fruit product such as peaches or peach salsa. Recipes are in So Easy to Preserve and on the National Center for Home Food Preservation website (homefoodpreservation.com). How is canning fruit similar to canning tomatoes? How is it different?

Compare home-canned tomatoes with store-bought tomatoes. How do tastes, textures, and appearances differ? Do you prefer one more than the other? Why?

Plant tomato seeds! Make sure the plants have enough space, sun, and water.

Did you really like canning? Brainstorm, research, or just ask your leader about careers in which you get to play with food, like food science, cooking, or catering.
PUT IT UP!

Can My Salsa

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Adv.3

Boiling Water Canning: A Preservation Exploration

Have you ever crunched into chips and salsa for a snack or appetizer? You might have added salsa to a burrito, taco, or quesadilla? In this food science exploration, you’ll get to learn how to can your own salsa at home, using just a few simple ingredients.

Let’s start with some basics of food science and preservation:

**Preservation** means to prevent decay, or in other words to stop a food from breaking down and spoiling. Rotten tomatoes, moldy bread, and stinky old milk are all examples of spoiled foods. Refrigeration and freezing are very common preservation methods used in modern households to extend the shelf-life of foods. Other home food preservation methods are pickling, drying (or dehydrating), making jam, and canning.

**Canning** is the process of putting jars of food in a canner and heating those jars in the canner on a stovetop. **Boiling Water Canning** is when this process is done in a boiling water canner, which is basically a large stockpot with a rack in the bottom and a loose-fitting lid resting on top.

Boiling water canning is simple, but it’s important that you follow the detailed directions in the procedure to do it correctly. As you’ll see, you will fill a large stockpot about half full with water and heat it while you prepare tomatoes and fill jars. Then you will lower the filled jars into almost boiling water, submerging them completely so that hot water surrounds them on all sides. Once the water comes to a full boil, you’ll set a timer.

How does heat move through the food? As heat moves into the jars from the hot water, the food gets heated. If there is enough liquid in a jar for fluid to flow, then a convection pattern will form, circulating heat in loops. If the food in the jar is more solid, then the heating pattern is called conduction, and it moves in a straight direction, inwards. Even the coldest spot in the jar must be heated in order for the canned food to be safe to eat.
Advanced Boiling Water Canning Activity: Choice Salsa

Time required:
1½ to 2 hours procedure + ½ to 1 hour additional processing time
= 2 to 3 hours total (+ 12 hour minimum cooling time)

Ingredients:
For a canner load of 6 pint jars or 12 half-pints
(canner size may vary, so check capacity ahead of time and adjust accordingly)

- 6 cups (about 5 pounds) tomatoes
- 9 cups (about 3 pounds) onions and/or peppers of any variety
- 1½ cups commercially bottled lemon or lime juice
- 3 teaspoons canning or pickling salt
- Any additional ingredients from ‘Want to Experiment?’ (optional)

Equipment needed:
- Gas or electric stovetop range with four burners
- Boiling water canner (or large stock pot) with rack
- Pint or half-pint canning jars, regular or wide mouth
- Ring bands, regular or wide mouth
- Two-piece metal canning lids, regular or wide mouth
- Jar lifter
- Jar funnel
- Headspace tool or ruler
- Bubble freer or narrow plastic spatula
- Medium saucepan for boiling water to be added to canner
- Large stockpot for scalding tomatoes and heating salsa
- Large colander or bowl for washing tomatoes
- Large mixing bowl for cold water or ice water
- Small paring knives
- Cutting boards
- Large ladle
- Chef’s knives
- Slotted spoon
- Dry and liquid measuring cups
- Measuring spoons
- Large spoon for stirring
- Permanent marker, or labels and pens
- Food-handling gloves (if using hot peppers)
- Paper towels
- Thermometer
- Dry towel or cake-cooling rack
- Timer (may be on oven)
- Ice (optional; for cooling tomatoes)

Paste tomatoes like Romas make thicker salsa. Slicing tomatoes make watery salsa.

Peppers may be any color, sweet or hot.

If range is a smooth-top, boiling water canner must have a flat-bottom.
Part One: Preparing the Canner and Jars

1. Wash hands thoroughly with soap under running water for at least 20 seconds, rinse well, and dry.

2. Assemble equipment and ingredients.

3. * Fill boiling water canner half full with clean, hot water. Turn heat on medium-high to heat water in canner to just under boiling (simmering, 180°F).

4. Examine jars carefully. Discard any with cracks or chips in the rim. Examine ring bands and discard any with rust or bends.

5. Wash jars thoroughly in warm soapy water, rinse well, then place them in the boiling water canner (or in a dishwasher) to stay warm until ready to use. Use a thermometer to check that water in canner is at 180°F.

6. Wash ring bands if necessary; otherwise, keep them dry until use.

7. Use a permanent marker to label lids with your name, the name of the product and the date. If using labels and pens, then wait until after processing, when jars have cooled.

8. Prepare lids according to manufacturer’s recommendations.

9. * Heat 3-4 cups hot water in a medium saucepan for adding to canner, if needed.
Part Two: Preparing the Salsa

10. * Fill a stockpot with enough water to cover several tomatoes at a time. Bring water to a boil while preparing tomatoes.

11. Fill a large bowl with cold water, adding ice if you have it.

12. Wash tomatoes.

13. * Cut an “x” in the peel on the bottom of tomatoes with the tip of a small knife.

14. * Place 2 to 3 tomatoes at a time in boiling water for 30 to 60 seconds or until skins split. Remove tomatoes with a slotted spoon and place in cold/ice water. Slip off tomato skins and discard them. Place tomatoes on a clean cutting board.

15. * Core tomatoes by carefully using a knife to remove the firm inner core. Coarsely chop tomatoes (blueberry-sized).

16. * Peel, wash, core, and dice onions into small (1/4-inch) pieces (that fit on a chip).

17. * Wash and core bell peppers, removing seeds and membranes before dicing.

18. * If using hot chile peppers, place food-handling gloves on both hands. Wash and dry hot chile peppers. Remove stems of the peppers, and keep or remove the seeds and membranes, depending on how much heat you want. Chop chile peppers. Remove and discard gloves, then wash hands well.

19. Measure and combine 9 c. of peppers and onions with 6 c. of tomatoes in a large stockpot. Measure and add 1 1/2 c. lemon or lime juice and 3 tsp. salt. Stir to mix ingredients evenly.

20. * Heat to boiling over high heat, then reduce heat to a simmer for 3 minutes, stirring as needed to prevent scorching.
Part Three: Packing the Salsa

21. * Slowly remove jars from hot water with jar lifter. Carefully empty any water back into the canner. Place jars upright on towel-covered countertop or rack.

22. * Rest a funnel in a jar. Ladle hot salsa into the hot pint jar leaving ½-inch from the top of the salsa to the top of the jar rim. This gap is called headspace. Measure headspace with headspace tool or ruler to ensure headspace is ½-inch.

23. Remove air bubbles by slowly moving bubble freer or spatula gently in and out around the inside edge of the jar. Check headspace and gently add or remove salsa with a small spoon, if needed.

24. Wipe jar rims with a clean, damp paper towel.

25. Apply lids according to manufacturer’s directions. Turn bands onto jars until fingertip tight. Fingertip tight is when you meet firm resistance as you turn the band onto the jar using your thumb and two fingers.

26. * Use a thermometer to check that the temperature of the water in the canner is 180°F. Adjust burner higher or lower, if necessary.

Think About It: Freeing Bubbles
What could happen to your final product if air bubbles remain trapped during processing in the canner?

Think Again! Fingertip Tight
Why do you think it is important that lids are tightened just right? Hint: If a band is too tight, could air escape? If a band is too loose, could liquid get out?

Fun Fact!
Capsaicin (cap-say-ah-sin) is what makes hot peppers hot. Its intensity is not affected by heat or freezing, and it does not have any scent or flavor of its own.
**Part Four: Boiling Water Canner Processing**

27. * Use jar lifter to carefully place jars of hot salsa one at a time on the rack in the canner. Keep jars upright at all times. Make sure water is 1-2 inches above tops of jars. Add hot water from the saucepan if needed, pouring between jars rather than directly on top of jars.

28. * Place lid on canner and turn heat to high. Bring water in canner to a strong boil, then start timer using the times recommended on the table to the left. Maintain a steady boil throughout the entire timing process.

29. * Once the timer goes off, turn off heat. Remove canner lid, lifting the underside of the lid away from you to direct the steam away from your face. Wait 5 minutes for the salsa to settle in the jars.

30. * After 5 minutes of cooling, keep jars straight up as you remove jars one at a time with jar lifter. Be careful not to tilt them. Place jars at least 1 inch apart on a dry towel or cake-cooling rack. Place away from drafts of moving air.

31. Let jars cool, undisturbed, for 12 to 24 hours. Check jars for vacuum seals. If jars are taken home before cooling completely, keep in a refrigerator.

32. Remove ring bands from sealed jars and wipe jars. Store in a cool, dark, dry place. Enjoy with family and friends within one year for best quality. Store unsealed OR opened jars in the refrigerator and eat within one week.

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**Fun Facts from:**


Time to Reflect...

Write your responses to these questions. Then, share your reflections with one or two others.

What was your favorite part of canning salsa?
________________________________________________________________________
________________________________________________________________________

For you, what was the most challenging part of canning salsa?
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

What surprised you most in this activity?
________________________________________________________________________
________________________________________________________________________

Now think about how you will apply what you have learned today. Again, share your ideas.

If you could do this activity again, what is one thing you would change? Why?
________________________________________________________________________
________________________________________________________________________

Do you think that canning tomato products is a useful skill? Why or why not?
________________________________________________________________________
________________________________________________________________________

How will you use what you have learned about canning tomato products?
________________________________________________________________________
________________________________________________________________________
Want to Experiment?

Try different varieties and colors of tomatoes. You may use green, yellow, or orange tomatoes.

Try different ratios and types of peppers and onions. More bell peppers make a milder salsa, while chile peppers make a spicier salsa. Red, yellow, or white onions may be used, and will slightly alter the overall flavor. Remember that it is important to the safety of the salsa that you DO NOT alter the overall quantity of onions and peppers (9 cups total per batch).

Check grocery store shelves for salsa mixes in the home canning products. Follow package directions to try one of them!

Compare home-canned salsa with store-bought salsa. How do tastes, textures, and appearances differ? Do you prefer one more than the other? Why?

Ask for help to follow directions for canning another salsa product such as peach salsa. Recipes are in So Easy to Preserve and on the National Center for Home Food Preservation website (homefoodpreservation.com). How is canning fruit salsa similar to canning tomato salsa? How is it different?

Plant tomato seeds! Make sure the plants have enough space, sun, and water.

Did you really like canning? Brainstorm, research, or just ask your leader about careers in which you get to play with food, like food science, cooking, or catering.
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A.A.2
All About Boiling Water Canning

FUNdamentals of Boiling Water Canning......................................................... A.A.4
Boiling Water Canner and Mason-Style Jar Anatomy........................................ A.A.5
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What’s the Story of Boiling Water Canning?..................................................... A.A.7
Who Are You Calling Spoiled?!...................................................................... A.A.8
Glossary, Sources, and Resources.................................................................. A.A.9
What Do You Know About Boiling Water Canning?........................................ (A.A.10)
Boiling water canning is a science, so there are important facts and concepts at play. These FUNdamentals will help you understand the steps of the canning procedure.

**FUNdamentals of Boiling Water Canning**

Use the word bank at the bottom of the page to correctly fill in the blanks. (Hint: The answers can be found in the pages of this activity book.)

__________ is a method of food preservation that raises the temperature so high that spoilage microorganisms like molds and yeasts are destroyed by the heat.

__________ is measured by pH value. Acid foods have a pH value of 4.6 or lower, low-acid foods have a pH higher than 4.6. Borderline foods sit on the border between acid and low-acid, with a pH range close to 4.6 in either direction.

Adding a proper amount of _____ _____, vinegar, or citric acid to tomatoes adds enough acid that the resulting product can be safely canned in a boiling water canner.

__________ ________ are acidic enough to prevent dangerous bacteria from producing poison. They can be safely canned in a boiling water canner.

A ____________ is created when air is pushed out and unable to re-enter a closed system (like a sealed jar).

Microorganisms (bacteria, molds, and yeasts) sometimes cause food to ___________. Low temperatures slow the growth of microorganisms; high temperatures kill them.

__________ is a form of energy that can travel through solids, liquids, and gases.

__________, Cooperative Extension, and the National Center for Home Food Preservation have science-based recipes for canning, like the recommendations in the books *So Easy to Preserve* and *Complete Guide to Home Canning*.

**Word bank:** ACIDITY, SPOIL, USDA, BOILING WATER CANNING, ACID FOODS, HEAT, VACUUM, LEMON JUICE
Boiling Water Canner Anatomy

Fill in each blank with the term to the right that describes that part of the canner.

AIRSPACE allows room for a brisk boil.

WATER must cover 1” to 2” above jars so that the jars will be completely surrounded by boiling water, even if a small amount evaporates.

COVER of the canner prevents heat from escaping and reduces water loss from evaporation.

CANNER or STOCKPOT contains water so that it can heat to boiling.

RACK prevents jars from cracking due to high heat from the burner and allows water to circulate underneath the jars so that they are heated evenly on all sides.


Mason-Style Jar Anatomy

Use the labels in the illustration below to correctly fill in the blanks of the descriptions to the left.

A _______ can be used again and again until cracked or chipped.

_________ on top of jar allow ring band to twist on tightly.

A _______ _______ secures lid to jar, and can be reused if not bent or rusty.

A _______ _______ has a springy center that dips down when pulled by a vacuum. After jars cool, gently rub the center of the lids with your fingertip; you have evidence that a vacuum has formed if you feel an indent.

_________ _______ is a soft plastic in the bottom-edge groove of lids that softens when heated and forms an airtight seal around the lid when cooled.


A.A.5
Boiling Water Canning

**pH Power**

What is pH?
pH is a measure of acidity, on a scale from 0 to 14.

Acid must be added to borderline foods to make sure they are acidic enough to be safely canned in a boiling water canner.

Foods are classified as Acid or Low-Acid according to their pH value. Acid foods have a pH of 4.6 or less; Low-Acid foods have a pH above 4.6. Foods that range close to pH 4.6 are called borderline foods.

Acid foods can be safely canned in a boiling water canner, but low-acid foods must be pressure canned. So how do you safely can borderline foods like tomatoes? Add bottled lemon juice, vinegar or citric acid to tomatoes to make them more acidic. Use amounts from recipes recommended by USDA.

The table below shows pH values of several common foods. Under the “Acid, Low-Acid, or Borderline” column, write how that food is classified based on its pH.

<table>
<thead>
<tr>
<th>Food</th>
<th>pH Value</th>
<th>Acid, Low-Acid, or Borderline?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinegar</td>
<td>2.0-3.4</td>
<td>Acid</td>
</tr>
<tr>
<td>Lemon Juice</td>
<td>2.3</td>
<td>Acid</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>4.2-4.9</td>
<td>Low-Acid</td>
</tr>
<tr>
<td>Peppers</td>
<td>5.1</td>
<td>Borderline</td>
</tr>
<tr>
<td>Onions</td>
<td>5.3-5.8</td>
<td>Borderline</td>
</tr>
</tbody>
</table>
Boiling Water Canning

Search the puzzle for the 14 UPPERCASE, UNDERLINED words from the history notes below and circle them!

- Boiling water canning PROCESSES for preserving foods were developed at the end of the 1700s.

- In boiling water canning, ACID foods or ACIDIFIED foods such as fruits, tomatoes, salsas, pickles, jams, jellies or preserves are put in jars, lowered into a canner full of hot water, and then that water is brought to a boil (212°F at sea level).

- This METHOD of preserving food is also called “water bath process” and “boiling water bath canning”, but we’ll use the term “boiling water canning”.

- Have you ever discovered something new without understanding how it works? In the 1790’s, Nicolas Appert discovered that heating foods in SEALED glass jars prevents SPOILAGE, though he did not understand why.

- Louis Pasteur investigated Appert’s question “why?”. In 1864 Pasteur discovered important relationships: MICROORGANISMS cause food to spoil and heat kills microorganisms, preventing them from being able to spoil food.

- The heat from the boiling water prevents food spoilage by killing the microorganisms MOLDS and YEASTS and also destroying molecules called ENZYMES which cause chemical change.

- In the late 1800s and early 1900s much work was done to develop COMMERCIAL processes (in big factories) for canning foods. Little attention was paid to home canning.

- It was not until 1917 that the United States Department of Agriculture (USDA) made the first RECOMMENDATIONS using a boiling water process in HOME canners for fruits and tomatoes.
Boiling Water Canning

Who Are You Calling Spoiled?!

You can’t see it with your bare eyes, but inside a boiling water canner, enzymes and microorganisms are destroyed by the high heat. Both are microscopic, so you would need a microscope to look at them.

Enzymes are actually a part of the basic structure of living things and are necessary for life and growth. Enzymes activate change in fruits and veggies that lead to ripeness, but over time they cause foods to over-ripen and spoil. High temperatures inactivate enzymes and stop them from spoiling foods.

Microorganisms are tiny creatures that live everywhere on earth that there is water, including oceans, streams, and even in your body! Many types of these little critters are harmless and even necessary for life, but certain kinds cause food spoilage or food poisoning. Bacteria, yeast, and mold are the types of microorganisms which commonly cause food to spoil. You may have seen masses of mold as fuzzy spots on spoiled bread; pink shiny spots on spoiled cream cheese may be thousands of yeasts; slime on spoiled ground beef is caused by bacteria. Microorganisms that cause food poisoning are called pathogens.

What does your body do when you get a “bug”?
(A “bug” is another term for a pathogen.)

You might get a fever!

Why?
The increased heat in your body helps kill the pathogens making you feel sick. In the same way, the heat of boiling water in a canner transfers into the food inside the jars and destroys pathogens living there.

Danger! Beware of C. bot.!

Pathogens can be very dangerous. For example, the bacteria called Clostridium botulinum (C. bot.) is deadly. This bacteria is harmless when in soil or water, but when it is sealed in a jar with moist, low-acid food stored at room temperature, it can produce a toxin that causes botulism, a potentially deadly food poisoning. C. bot. is difficult to detect, like a secretive villain that leaves no sign of being there. It’s important to use only tested canning recommendations and follow them exactly to be sure that canned foods do not have any pathogens that would make you sick.
**Glossary**

**Acid foods** are foods with a pH value at or below 4.6.

**Acidified foods** are foods that acid is added to in order to lower the pH to 4.6 or below.

**Bacteria** are a type of microorganism that grow on food and can cause spoilage or sickness.

**Boiling water canning** is the process of filling jars with food then processing the closed jars in a boiling water canner for a long enough time to heat the product and destroy microorganisms.

**Enzymes** are natural proteins that speed up the rate of reactions necessary for life.

**Food preservation** protects food from spoilage by microorganisms and enzymes.

**Low-acid foods** are foods with a pH value above 4.6.

**Microorganisms** are creatures so small they cannot be seen except with a microscope.

**Mold and Yeast** are types of microorganisms that grow on food and can cause spoilage.

**pH** is a measure of acidity, on a scale from 0 to 14.

**USDA** is the acronym for the United States Department of Agriculture; a reliable source for scientifically tested home food preservation recommendations, including canning.

**Vacuum** is empty space created when air is pushed out of a container and is unable to re-enter.

**Sources and Resources**


Clemson University Home and Garden Information Center factsheets about canning. HGIC 3020, HGIC 3025, HGIC 3030, HGIC 3040, HGIC 3050, HGIC 3051. [http://www.clemson.edu/extension/hgic/food/food_safety/preservation/](http://www.clemson.edu/extension/hgic/food/food_safety/preservation/).


National Center for Home Food Preservation, University of Georgia. [http://nchfp.uga.edu/](http://nchfp.uga.edu/).


What Do You Know About Boiling Water Canning?

If you think the statement is true then circle “True”, and if you think the statement is not true then circle “False”.

Boiling water canning is based on science. True False

Canned tomatoes last longer than fresh, uncanned tomatoes at room temperature. True False

Low temperatures (like in refrigerators) and high temperatures (like in canners) speed up the growth of microorganisms (like bacteria, molds, and yeasts) that spoil foods. True False

Most microorganisms grow best in very acidic conditions. True False

It is not safe to can low-acid foods in a boiling water canner. True False

When filling jars for canning, it is a good idea to fill the jar with food product all the way up to the lid. True False

If you agree with a statement below then circle “I agree”, and if you don’t agree with the statement then circle “I disagree”. There are no correct answers, just answer honestly with what is true for you.

I like to make my own snacks and other foods at home. I agree I disagree

It’s fun to prepare and preserve food. I agree I disagree

I know how to can tomatoes (with the help of an adult). I agree I disagree

I can get everything I need to can tomatoes at home. I agree I disagree

I will use canning recipes and instructions from USDA or other science-based sources. I agree I disagree

Sometime when I am at home, I will try to can tomatoes (with the help of an adult). I agree I disagree