



Name \_\_\_\_\_

# Dry My Fruits



# PUT IT UP!

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! Dry My Fruits* contains:

- ◇ Beginning Activity: Dry My Fruit
- ◇ Advanced Activity: Dry My Fruit Leather
- ◇ Additional Activities: Dry My Fruits



Name \_\_\_\_\_

Date \_\_\_\_\_

Teacher \_\_\_\_\_

# Dry My Fruit



## Credits and Acknowledgments

### Written by:

Kasey A. Christian, M.Ed., Project Assistant, National Center for Home Food Processing and Preservation (NCHFP), University of Georgia

Susan Barefoot, Ph.D., Extension Food Safety and Nutrition Program Team Leader, Clemson University

### Edited by:

Elizabeth L. Andress, Ph.D., Director, NCHFP and Extension Food Safety Specialist, University of Georgia

Judy A. Harrison, Ph.D., Extension Foods Specialist, University of Georgia

### Designed by:

Kasey A. Christian, M.Ed., Project Assistant, NCHFP, University of Georgia

### Special thanks to:

Pilot Program Leaders (and youth participants!)

from Clemson Cooperative Extension

& University of Georgia Cooperative Extension

and Advisory Committee members



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This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement No. 2011-51110-30995.

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# Dehydrating: A Preservation Exploration

Have you ever had a dried fruit roll-up from a grocery store?  
Look at the ingredients listed on the box –  
Can you pronounce all those ingredients? Do you know what they are?

In this food science exploration, you'll get to learn how to dry fruits at home, from 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 canning, making jam, pickling, and drying (or dehydrating).

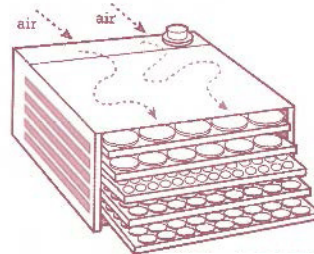
**Dehydrating** is another term for drying. In general, fresh fruits and vegetables contain a lot of water. When fruits and veggies are placed in a hot environment, heat transfers from the hot air to the flesh and water inside the food. Heat causes the energy of water molecules to increase. Once the energy of a water molecule reaches a certain level, it changes phase from liquid (water) to gas (water vapor). This phase change is called evaporation.

If we use clean hands, clean equipment, and clean ingredients, then our dried food products will be safe to eat and enjoy.

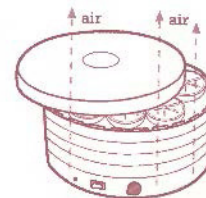
Properly dehydrated foods have very low water activity, which means that even the small amount of water left after drying is not available to microorganisms that might be on the food. This is important to preserving the food overtime because microorganisms, like mold, need water to grow. Without water, microorganisms cannot grow and spoil food.



Dried foods are sometimes called "Nature's candy"! Why do you think they have that nickname?



Horizontal Airflow



Vertical Airflow

# Beginning Drying Activity: Fruit

Time required:  
1-1½ hour procedure + 8-36 hours additional drying time

## Ingredients:

- Grapes (1 serving = 1 cup = 1/3 pound = 25 grapes...multiply as needed) and/or
- Blueberries (1 serving = 1/2 cup = 1/6 pound = 35 berries...multiply as needed)
- Vegetable oil cooking spray (optional)
- Any additional ingredients from 'Want to Experiment?' (optional)

## Equipment needed:

- Electric food dehydrator (or an oven that registers 140°F)
- Dehydrator trays (or 12"x 17", or 13"x 15" cookie sheets if using an oven)
- Small electric fan (only if using an oven)
- Thermometer (may be built into dehydrator or oven)
- Sink, dishcloth, and soap
- Colander
- Medium size bowl(s)
- Towel
- Dry measuring cups
- Cutting board(s)
- Small paring knife(s) (only if drying grapes)
- Toothpicks (only if drying blueberries)
- Masking tape
- Pen or marker
- Ruler (if using an oven)
- Kitchen timer (may be on dehydrator or oven)
- Sealable bag/s or containers such as freezer bags or canning jars



# The Procedure:

## Just Follow These Steps...

### Part One: Preparation

1. Plug in dehydrator (so that it is not touching anything) with lid on the base or slide oven racks to be 2 to 3 inches apart and turn on oven. Preheat to 140°F.
2. Wash hands thoroughly with soap under running water for at least 20 seconds, rinse well, and dry. Wash and dry trays or sheets and cutting board.
3. Discard any pieces of fruit that are discolored or moldy. Remove stems from berries.
4. Place fruit in colander and rinse under cool water.
5. Lay a towel out on a counter-top and gently pour fruit onto it. Fold the towel in half over the fruit and very gently roll it forward and back over the fruit until the fruit has no water on it.
6. If portioning individual servings, then measure 1 cup grapes or  $\frac{1}{2}$  cup blueberries per person.
7. Use a small knife to cut grapes in half. Poke blueberries with a toothpick, carefully inserting the toothpick all the way through to the other side of each berry, then removing it.
8. Lightly spray dryer trays or sheets with cooking spray if desired, then place fruit on them, leaving space between pieces so that none are touching. Each individual portion will cover  $\frac{1}{3}$  to  $\frac{1}{2}$  of a dehydrator tray.

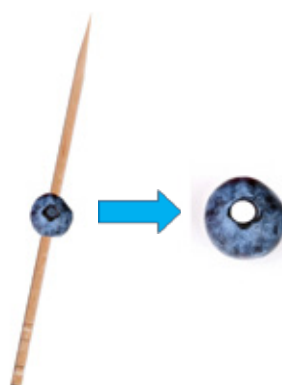
### Safety Tip:

*The oven gets very hot! Do not touch inner surfaces of the hot oven.*



### Why Does the Temperature Matter?

If the heat gets much above 140°F, then you will be cooking instead of drying. When fruit is cooked, its outer layer hardens and moisture can't get out. This is called "case hardening". Fruits that are case-hardened will grow mold because water is still trapped inside.



### Fun Fact!

Blueberries are closely related to wild huckleberries.





### Is It Done Yet?!

Fruit is done drying when there is no visible wetness and you cannot squeeze any moisture out. Fruit pieces will be bendable, but not sticky. If you fold a piece in half, it should not stick to itself. A tray of berries will make a rattling sound if gently shaken. Do not let fruit dry so long that it becomes brittle.



**After the fruit has dried for 6-8 hours, it's okay to turn the dehydrator off overnight, then turn it back on in the morning, though this may increase the total drying time.**

## Part Two: Drying and Packaging

9. Use masking tape and a pen to label trays or sheets. Include the time so that you know when to start checking for doneness, and possibly your name.

10. Lift the lid off the dehydrator base and place trays onto the base. Once all trays are stacked, place lid back on top and turn on dehydrator, setting to 140°F if given the option. If using an oven, place the sheets on racks and leave the oven door open 2 to 6 inches. Place a fan outside the oven near the door to speed up drying time.

11. Check the time and plan to begin checking for doneness (with clean hands!) in 8 hours. Continue to check every hour or half-hour until done. Grapes may take 12-20 hours and blueberries may take 20-36 hours in a dehydrator. Oven drying may take twice as long.

12. Once fruit is done, turn off the dehydrator or oven and let the fruit cool for 30 to 60 minutes. If the fruit is still warm when sealed in a package, it could sweat moisture and lead to mold growth.

13. Put dried fruit into sealable containers. Label the packages with your name, the product name, and the date.

14. Dried fruit will last 6 to 12 months, depending on the temperature you store it and how often you open its container. Keep dried fruit at a comfortable room temperature (60°F-80°F). Once you open a package of dried food, moisture and air may get in and lead to growth of mold more quickly.

15. Clean the rest of the equipment with soap and water.

Fun facts from:  
Anderson, J. and Deskins, B. *Nutrition Bible*. 1995. New York, NY: William Morrow and Co.

Dehydrator and oven illustrations from:  
Andress, E.L., Harrison, J.A., eds. (2014). *So Easy to Preserve*, 6th ed. Athens, GA: University of Georgia Cooperative Extension.



# Time to Reflect...

Write your responses to these questions.  
Then, share your reflections with someone else.

What was your favorite part of drying fruit?

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For you, what was the most challenging part of drying fruit?

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What surprised you most in this activity?

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

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Do you think that drying fruit is a useful skill?  
Why or why not?

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How will you use what you have learned about dehydrating fruit?

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## Want to Experiment?



Use the same procedure to dry cherries! Use a cherry pitter to remove the pits from the cherries, and cut cherries in half.



Dry apple or pear slices. Wash, core and peel the fruits, then carefully cut to 1/8-inch thick pieces, either as slices or rings. To prevent browning, soak in vitamin C enriched apple juice for 3 to 5 minutes then remove, place briefly on paper towels, then place on dryer trays. The drying time for apples is estimated to take 6-12 hours and could be as long as 36 hours for pears.



Compare products. Describe the flavor, texture, and appearance of store-bought and homemade dried fruits. How do tastes, textures, and appearances differ? Do you like one more than another? Why?

Try rehydrating dried fruit by soaking it in a bowl of clean, room temperature water. Use  $1\frac{1}{2}$  to 2 times as much water as fruit and let it soak for about an hour. Refrigerate the soaking fruit if it takes over an hour.



Add your dried fruit to a baked good recipe or a salad.



Dry veggies! For a list of pretreatments and estimated drying times, use University of Georgia's publication *Preserving Food: Drying Fruits and Vegetables* (available online at [http://nchfp.uga.edu/publications/uga/uga\\_dry\\_fruit.pdf](http://nchfp.uga.edu/publications/uga/uga_dry_fruit.pdf)) or the chapter on Drying in *So Easy to Preserve*.



Did you really like drying fruits? Brainstorm, research, or just ask your leader about careers in which you get to play with food, like food science, cooking, or catering.

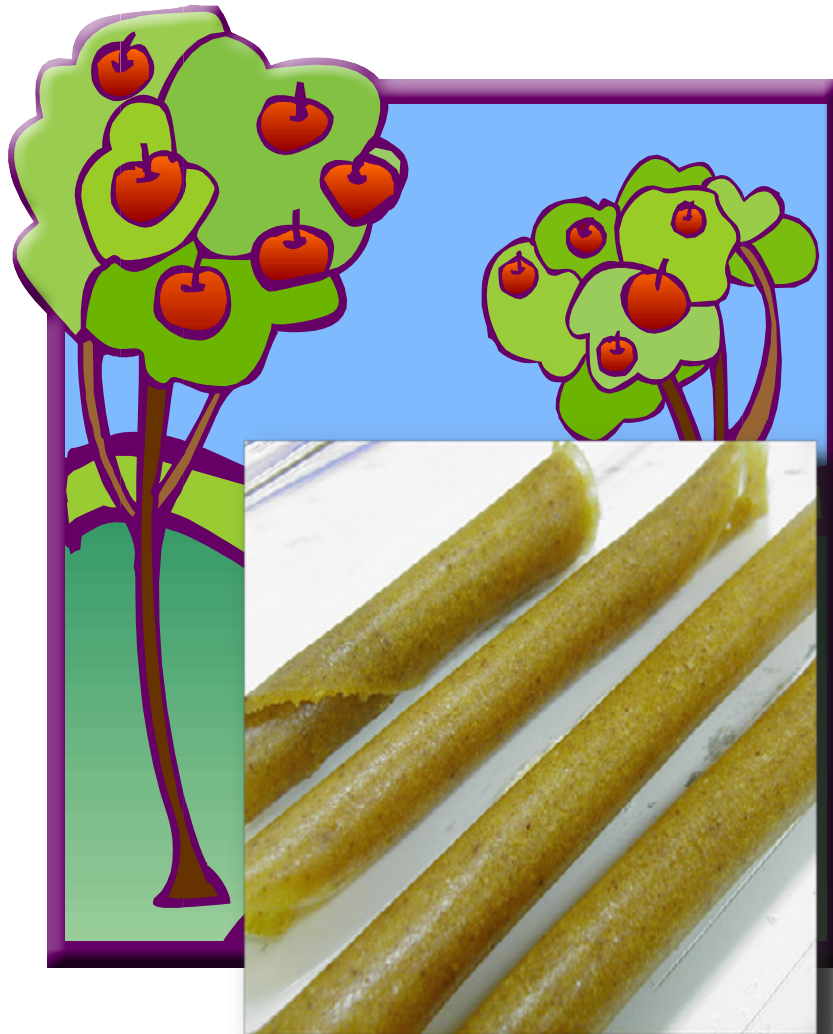


Name \_\_\_\_\_

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# Dry My Fruit Leather



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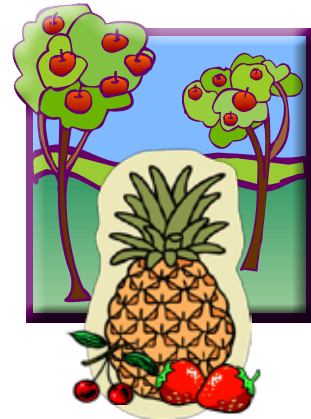
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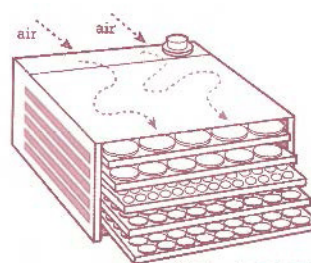
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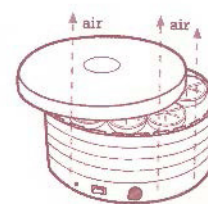
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Dried foods are sometimes called "Nature's candy"! Why do you think they have that nickname?



Horizontal Airflow



Vertical Airflow

# Advanced Drying Activity: Fruit Leather

Time required:  
1 hour procedure + 4-12 hours additional drying time

## Ingredients:

For about 1 tray/4 rolls; multiply as needed

- 2 cups (one pint) apples, peaches, pears, pineapple, cherries, or strawberries, prepared (stems, cores, pits, and/or peels removed, cut into chunks)
- 2 teaspoons lemon juice or  $\frac{1}{4}$  teaspoon ascorbic acid (375 mg)
- Vegetable oil cooking spray
- Any additional spices or toppings from 'Want to Experiment?' (optional)

You can mix any of these different fruits for a total of 2 cups.

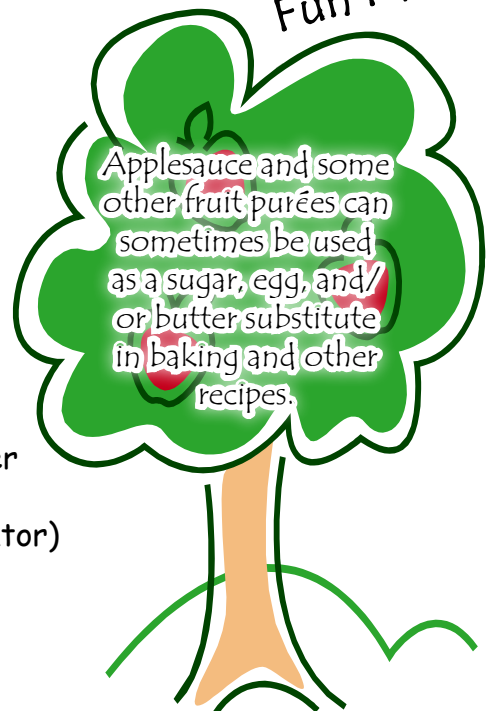
## Equipment needed:

- Food dehydrator (or oven that registers 140°F)
- Small electric fan (only if using an oven)
- Dehydrator trays (or 12"x 17", or 13"x 15" cookie sheets if using an oven)
- Fruit roll tray liners (or 12"x 17" or 13"x 15" cookie sheets)
- Colander
- Blender or food processor
- Sink, dish cloth, and soap
- Small paring knife(s)
- Medium size mixing bowl
- Peeler (for apples, peaches, pears)
- Apple corer (for apples only)
- Cherry pitter (for cherries only)
- Large knife (for fresh, whole pineapple only)
- Measuring spoon
- Measuring cup
- Small spoon or spatula
- Ruler or headspace tool
- Large cutting board
- Dull knife and/or cookie cutters
- Roll of plastic wrap
- Sealing freezer bag/s or other sealable container
- Permanent marker or pens and labels
- Kitchen timer (may be built into oven or dehydrator)
- Thermometer (only if using oven)

Fruit can be fresh, frozen, or canned.

Fun Fact!

Applesauce and some other fruit purées can sometimes be used as a sugar, egg, and/or butter substitute in baking and other recipes.



# The Procedure:

Just Follow These Steps...

## Part One: Preparing the Purée

1. Plug in dehydrator with lid on the base or slide oven racks to be 2 to 3 inches apart and turn on oven. Preheat to 140°F.

2. Wash hands thoroughly with soap under running water for at least 20 seconds, rinse well, and dry. Wash and dry liner or sheet and cutting board.

3. Use a colander to rinse and drain fruit.

4. ★ Carefully remove core and outer skin from apples, peaches, pears, and pineapples. Always push peeler and knife blades away from your fingers. Pull stems from cherries and use pitter to remove pits. Remove leafy caps of strawberries.

5. ★ Carefully cut fruit into chunks. Put chunks into blender or food processor.

6. ★ Measure and add 2 tsp. of lemon juice or 1/8 tsp. of ascorbic acid to the fruit. If desired, measure and add 1/8 tsp. of chosen spice. Purée until blended.

## Part Two: Drying the Leather

7. Lightly spray liner or sheet with cooking oil spray, or line sheet with plastic wrap.

8. ★ Place liner on dryer tray. Pour purée onto tray or sheet. Spread evenly to measure 1/4-inch thickness. Pour smaller (1/2 cup) portions for faster drying.

9. ★ Remove lid from dehydrator and place tray on the base or slide sheet into the oven. Place lid on dehydrator or leave oven cracked 2 to 6 inches, with a fan directed near the opening.



### Leader demonstration: Knife skills

Grip the knife handle with dominant hand, wrapping fingertips behind knuckles for tight grip. Slice with a rocking motion, not a chopping down action. Always pay attention to what you are doing and keep your hands out of the path of the blade.

### Why Do You Add Lemon Juice or Ascorbic Acid?

Lemon juice and ascorbic acid prevent the enzymatic reactions that cause browning. Browning is caused by oxidation, which happens when oxygen comes in contact with enzymes in the flesh of the apple. Enzymes are molecular parts of plants and animals that regulate reactions.





After the fruit has dried for 6-8 hours, it's okay to turn the dehydrator off overnight, then turn it back on in the morning, though this may increase the total drying time.

### Fun Fact!

Astronaut John Glenn was the first American to orbit the Earth, and on that first flight he carried pureed applesauce in squeezable aluminum tubes.



Feeling creative?  
Make up a company name for your products.

10. Allow to dry. Check that temperature stays at 140°F, adjusting as needed.

11. Wash used equipment and tools.

12. After 4 hours for individual portions or 6 hours for full sheets, begin testing for doneness by gently touching the leather with a **clean** fingertip near the center of the leather. It is ready when no fingerprint is left. Continue to test until it is done, which may take up to 12 hours.

13. Once leather is done, turn off dehydrator or oven. Gently peel leather from tray or sheet and place on a clean cutting board while still warm.

## Part Three: Packaging the Leather

14. ★ If leather has not already been portioned into individual sizes, then cut leather into quarter sheets or use cookie cutters to cut out shapes.

15. Prepare pieces of plastic wrap to be about 2 inches longer and wider than the pieces of leather.

16. Lay each piece of leather on a piece of plastic wrap and roll them together. Twist each end of plastic wrap tightly to close.

17. To store fruit leather rolls, seal them in a plastic bag or an airtight container. Label bags or containers with your name, type of fruit leather, and date.

18. Clean the rest of the used equipment with soap and water.

19. Store fruit leather in a cool, dark, dry place (like a food pantry) for up to one month. Enjoy with friends and family!

Fun Fact from:  
National Aeronautics and Space Administration. *John Glenn's Apple Sauce*. (2008). National Aeronautics and Space Administration. [http://education.ssc.nasa.gov/fft\\_halloffame.asp](http://education.ssc.nasa.gov/fft_halloffame.asp).

Dehydrator and oven illustrations from: Andress, E.L., Harrison, J.A., eds. (2014). *So Easy to Preserve*, 6th ed. Athens, GA: University of Georgia Cooperative Extension. Adv.6



# Time to Reflect...

Write your responses to these questions.  
Then, share your reflections with someone.

What was your favorite part of making fruit leather?

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For you, what was the most challenging part of making fruit leather?

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What surprised you most in this activity?

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

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Do you think that drying fruit leather is a useful skill?  
Why or why not?

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How will you use what you have learned about dehydrating fruit leather?

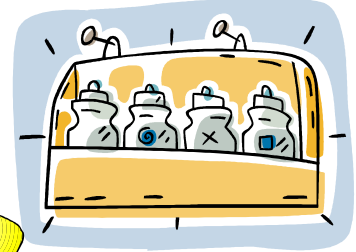
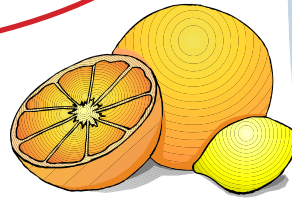
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## Want to Experiment?

Start simple:

Instead of making your own fruit puree, buy a jar of applesauce. You can measure 2 cups and pour it directly onto a prepared tray liner or cookie sheet, or you can mix 1 cup of applesauce with 1 cup of your choice of chopped fruit from the ingredients list.



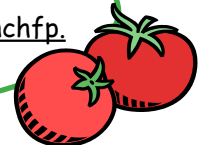
Play with spices and flavorings. Try cinnamon, nutmeg, ginger, or pumpkin pie spice. Or try lemon juice, lemon peel, orange extract, orange peel, or vanilla extract. Use sparingly; just add 1/8 teaspoon for each 2 cups puree.



Add toppings like granola, sunflower seeds, hazelnut spread, or peanut butter. These ingredients would affect drying time if added to the mix, so save them until the fruit leather is peeled off the tray, just before rolling up.

Compare products. Describe the flavor, texture, and appearance of store-bought and homemade fruit leathers. How do tastes, textures, and appearances differ? Do you prefer one more than another? Why?

Experiment with a vegetable leather recipe from *So Easy to Preserve* or the National Center for Home Food Preservation website ([http://nchfp.uga.edu/how/dry/veg\\_leathers.html](http://nchfp.uga.edu/how/dry/veg_leathers.html)).



Did you really like making fruit leather? 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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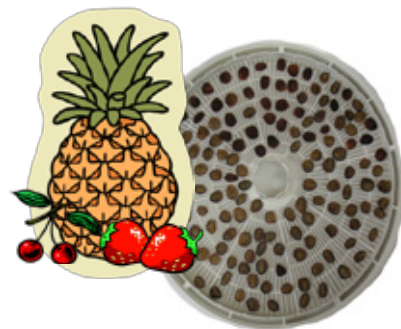
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# All About Drying

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What's the Story of Drying?.....	A.A.5
Why Dry?.....	A.A.6
Glossary, Sources, and Resources.....	A.A.7
What Do You Know About Drying?.....	(A.A.8)



Drying (also called dehydrating) is a science, so there are important facts and concepts at play. These FUNdamentals will help you understand the steps of the drying procedure.



## FUNdamentals of Drying

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 removes moisture from foods to prevent spoilage, so that foods keep a higher quality for a longer time.

\_\_\_\_\_ need water to grow.

\_\_\_\_\_ is the phase change when the energy of heat causes liquid to turn into gas.

The movement of \_\_\_\_\_ (think about wind on a sunny day) increases the rate of evaporation.

Apple slices turn brown when they come into contact with oxygen because \_\_\_\_\_ happens when the enzymes in apples are exposed to air.

\_\_\_\_\_, Cooperative Extension, and the National Center for Home Food Preservation have science-based recipes for drying, like the recommendations in the book *So Easy to Preserve*.

**Word bank:** HOT AIR, MICROORGANISMS, EVAPORATION, OXIDATION, USDA, DEHYDRATING

# What's the Story of Drying?



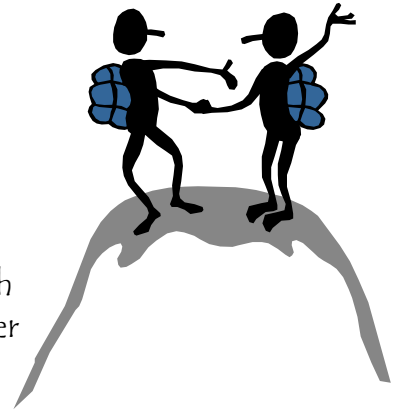
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Search the puzzle for the 13 UPPERCASE, underlined words from the history notes below!

- DEHYDRATING (another word for drying) is one of the oldest methods of food preservation. The earliest people in history dried vegetables, fruits, fish, wild game, and domesticated animals.
- In 12,000 B.C., Middle Eastern and Oriental cultures dried foods by the SUN and WIND.
- In the Middle Ages, people built smoke houses for drying foods using heat from FIRE.
- Before the invention of the THERMOSTAT, there was no way to accurately measure and control the TEMPERATURE in a closed system, such as in a room or an appliance. Thermostats are an important technology in modern ovens and dehydrators.
- Engineers in the late nineteenth century applied their advanced scientific understanding of electrically charged particles to energize EQUIPMENT. By the 1950s, nearly all rural farms in America were wired with ELECTRICITY.
- The popular cylindrical dehydrator DESIGN that is available commercially was patented in 1980.
- Do you think you could actually make sun-dried tomatoes dried under the sun in our modern times? Yes, but the outside temperature needs to be at least 85°F and the air needs to be both windy and dry (you might hear meteorologists refer to dry air as "low relative HUMIDITY").
- Technological developments over the years led to equipment that makes drying simple, safe, and easy for a wide range of foods in any climate. Conventional kitchen OVENS and dehydrators dry foods relatively conveniently and EFFICIENTLY. Except for drying herbs, microwaves do not work well for drying because air cannot escape from the closed door, trapping in MOISTURE.

## Why Dry?

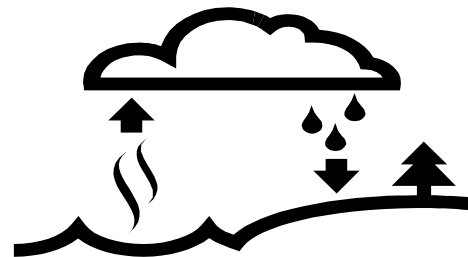
Eating dried fruits and vegetables can help keep us healthy and happy! Like fresh fruits and vegetables, these foods are still rich in nutrients and flavor when dried. Dried food is smaller and lighter in weight than un-dried food, so it is an ideal snack for hikers, campers, or other travelers. Because their natural sugars are so concentrated, dried fruits give us quick energy -- this is why dried fruit is called "nature's candy"! As long as we use clean hands, clean equipment, and ingredients that are free of disease-causing microorganisms, then our dried foods will be safe to eat and enjoy.



Are you wondering what exactly is a microorganism? **Microorganisms** are tiny creatures that live everywhere on earth that there is water, including oceans, streams, and even in your body! Bacteria, yeast, and mold are the types of microorganisms commonly found in food. Many microorganisms are harmless and even necessary for life, but certain microorganisms spoil food and cause sickness.

Like us, microorganisms need water to live. So, if there isn't enough water available (because it evaporated out as the food dried), then microorganisms cannot grow. Properly dehydrated foods have very low water activity, which doesn't mean that the water is lazy, it means that the small amount of water left in dried foods is not enough to be used by microorganisms to grow.

## We're Still Waiting... What's Happening?



In general, fresh fruits and vegetables contain a LOT of water. Your body is made of about 60% water, and that's quite a lot, but fruits and vegetables are made up of up to 90% water! To be considered properly dried, fruits must contain only about 20% water. Dried veggies will contain only about 10% water. So how does all that water get out of the fresh fruits and vegetables?

When fruits and veggies are placed in a hot environment (like an oven or dehydrator), heat transfers from the hot air to the flesh and water inside the foods. Heat causes the water molecules to bounce around and move quickly. Once the energy of water molecules gets very high, they change phase from liquid (water) to gas (water vapor), and escape into the air. This phase change is called **evaporation**.



# Glossary

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

**Case hardening** is when the outside of a food is dried and hardened, but the inside remains moist.

**Dehydrator** is an electric appliance designed to dry foods conveniently and efficiently.

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

**Evaporation** is when water changes phase from a liquid to a gas.

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

**Humidity** is the amount of water vapor in the air.

**Microorganisms** are living creatures so small that you need to use a microscope to see them.

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

**Oxidation** is chemical and physical changes caused by oxygen interacting with enzymes in foods.

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

## Sources and Resources

Andress, E.L., Harrison, J.A., eds. (2014). *So Easy to Preserve*, 6th ed. Athens, GA: University of Georgia Cooperative Extension.

Clemson University Home and Garden Information Center factsheets about food preservation: [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 publication *Preserving Food: Drying Fruits and Vegetables*. [http://nchfp.uga.edu/how/dry/fruit\\_leathers.html](http://nchfp.uga.edu/how/dry/fruit_leathers.html).

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National Academy of Engineering. (2013). *Greatest Engineering Achievements of the 20th Century*. <http://www.greatachievements.org/?id=2990>.

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Name: \_\_\_\_\_

Date: \_\_\_\_\_

## What Do You Know About Drying?

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

The practice of dehydrating food is based on science. True False

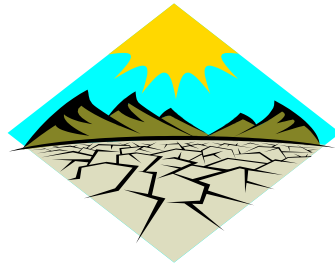
Food that is dried will last longer than if it were just left out at room temperature. True False

Foods spoil faster if water has been evaporated out of them. True False

Microorganisms (like molds, yeasts, and bacteria) need water to grow. True False

Keeping your hands clean while making fruit leather is important to the safety of the final product. True False

The quality of fruit leather is best when the air temperature inside the dehydrator is 160°F or higher. 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 dry fruits (with the help of an adult). I agree I disagree

I can get everything I need to dry fruit at home. I agree I disagree

I will use drying instructions from USDA or other science-based sources. I agree I disagree

Sometime when I am at home, I will try to dry fruit or fruit leather (with the help of an adult). I agree I disagree