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Snoopy, its Dinnertime!

OBJECTIVES

Students will:

- Read *Snoopy, First Beagle on the Moon!* and *Shoot for the Moon, Snoopy!* to learn some background knowledge.
- Dehydrate fresh foods and calculate the percentage of water reduction.
- Understand how dehydrating food allows us to survive in severe situations by providing a consistent food source.
- Reproduce the dehydration process used by NASA to prepare food.
- Follow a line of scientific inquiry by following the precise steps of an experiment.
- Compare and contrast the states of food before, during, and after the dehydration process.
- Observe and share observations using scientific terms and processes in their journals.
- Demonstrate the abilities necessary to perform scientific inquiry.

SUGGESTED GRADE LEVELS

K – 5th

SUBJECT AREAS

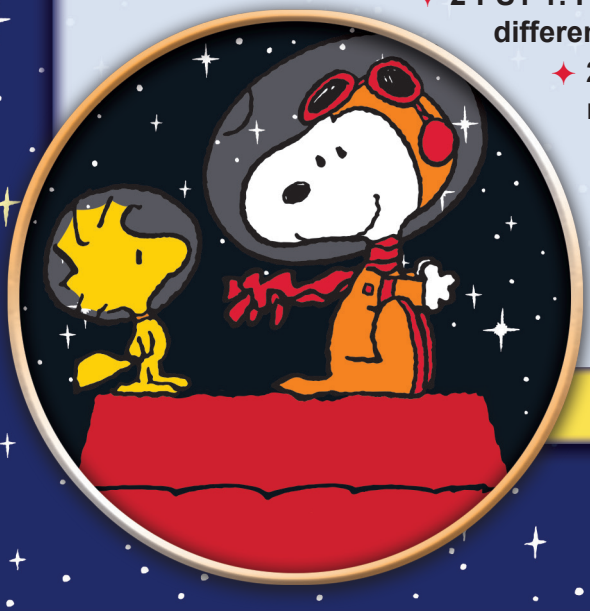
Science, Math, Language Arts, and Speaking/Listening

TIMELINE

45 – 60 minutes (More time may be required to dehydrate the food.)

NEXT GENERATION SCIENCE STANDARDS

- K-LS1-1: Use observations to describe the patterns that plants and animals (including humans) must follow in order to survive.
- 1-LS1-1: Use materials to design a solution to a human problem by mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs.
- 1-LS1-2: Read texts and use media to determine patterns in the behavior of parents and their offspring that help the offspring survive.
- 2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for the intended purpose.



21st CENTURY ESSENTIAL SKILLS

Critical thinking/Problem solving, Collaboration and Teamwork, carrying out investigations, peer communication, and constructing explanations.

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BACKGROUND

- According to NASA.gov, NASA has proudly shared an association with Charles M. Schulz and his American icon Snoopy since Apollo missions began in the 1960s. Schulz created comic strips depicting Snoopy on the Moon, capturing public excitement about America's achievements in space. In May 1969, Apollo 10 astronauts traveled to the Moon for a final trial run before the lunar landings took place on later missions. Because that mission required the lunar module to skim within 50,000 feet of the Moon's surface and "snoop around" to determine the landing site for Apollo 11, the crew named the lunar module Snoopy. The Command Module was named Charlie Brown, Snoopy's loyal owner.
- These books are a united effort between NASA and Simon & Schuster to generate an interest in space among today's younger children. The character of Snoopy has been allowed to be reimagined for this special partnership.
- Early in history, humans discovered that food would remain edible longer if it was dried and stored in a cool, dry place until it is consumed. Early food dehydration was achieved by cutting meat, fish, and certain fruits into thin strips and drying them in sunlight. Food was cured by rubbing it with salt or soaking it in saltwater. Also, early techniques were developed for cooking, processing, preserving, and storing food in sealed containers. With the developments of pasteurization and canning, a much larger variety of foods could be stored and carried on long journeys. More recently, refrigeration and flash-freezing have been used to help preserve food flavor and nutrients, and to prevent spoilage.
- While these forms of packaged food products are fine for travel on Earth, they are not always suitable for use on space flights. There are limitations to weight and volume when traveling, and the microgravity conditions experienced in space also affect food packaging. To meet the challenges of limited storage space and no refrigeration, special procedures for the preparation, packaging, and storing of food for space flight were developed.
- Mercury Missions: In the early days of the space program, provisions were known to be unappetizing, and there were problems with rehydrating freeze-dried foods. Tube foods created many challenges for food development. First, a method of removing the food from the tube was needed, so a small straw was placed into the opening. This allowed astronauts to squeeze the contents from the tube directly into their mouths—similar to drinking your favorite soda from a straw, except that the food was a thicker substance. Special materials were developed

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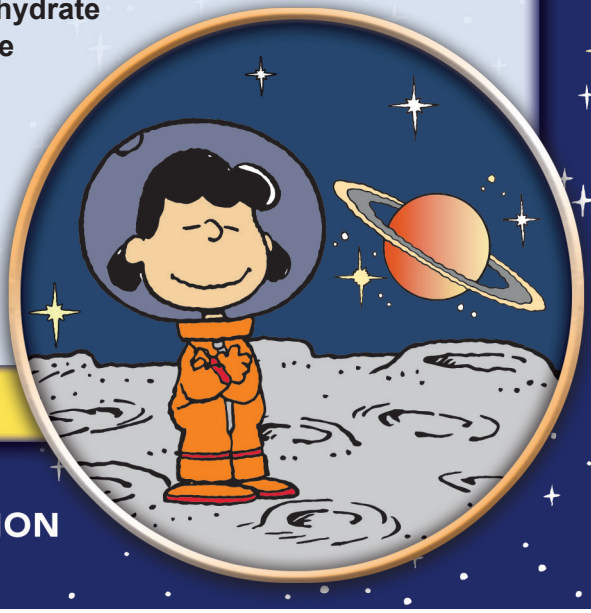
to coat the inner surface of the aluminum tubes to prevent the formation of hydrogen gas that resulted from contact between the metal tube and the acids contained in some foods, such as applesauce. This aluminum tube packaging often weighed more than the food it contained. Because of this, lightweight plastic containers were developed for future flights. During the later Mercury test flights, bite-size foods were developed and tested. These were solid foods processed in the form of compressed, dehydrated bite-size cubes. The cubes would then be rehydrated by the saliva secreted in the consumer's mouth as food was chewed. Foods floating around in a microgravity environment could damage equipment or be accidentally inhaled, so to avoid this, the cubes were coated with edible gelatin to reduce crumbling. These foods were then vacuum-packed into individual serving-size containers sealed with clear, 4-ply, laminated plastic film for storage. This packaging also provided a barrier against moisture, loss of flavor, and spoilage.

- Gemini Missions: The major food advancements during the Gemini period included more variety and improved packaging. The dehydration process provided foods that were similar in appearance, color, taste, shape, and texture to freshly prepared food products. Some examples of the food provided on Gemini missions included grape and orange drinks, cinnamon-toasted bread cubes, fruit cocktails, chocolate cubes, turkey bites, applesauce, cream of chicken soup, shrimp cocktail, beef stew, chicken and rice, and turkey with gravy.
- Dehydration occurs naturally in hot climates, but also occurs in cold climates and is called freeze-drying. Freeze-drying techniques in the space program consist of slicing, dicing, or liquefying prepared food to reduce the preparation time. After the food has been cooked or processed, it's flash-frozen and then placed on drying trays and put into a vacuum chamber where the air pressure is reduced. Heat is then applied through heating plates. Under these conditions of reduced pressure and increased temperature, the ice crystals in the frozen food boil off, and the water vapor left is condensed back to ice on cold plates in the vacuum chamber. Because water is the only thing removed in this process, the freeze-dried food retains all of its characteristic oils and flavors. The texture is porous and can be easily rehydrated with water for eating. To rehydrate the food, water was injected into the package through the nozzle of a water gun. The other end of the package had an opening from which the food could be squeezed out into astronauts' mouths. Because of the size of the opening, food particle size had to be limited. After the meal had been completed, germicidal tablets were placed inside the empty package to inhibit microbial growth on any leftovers. The advantages of freeze-dried foods were paramount in their



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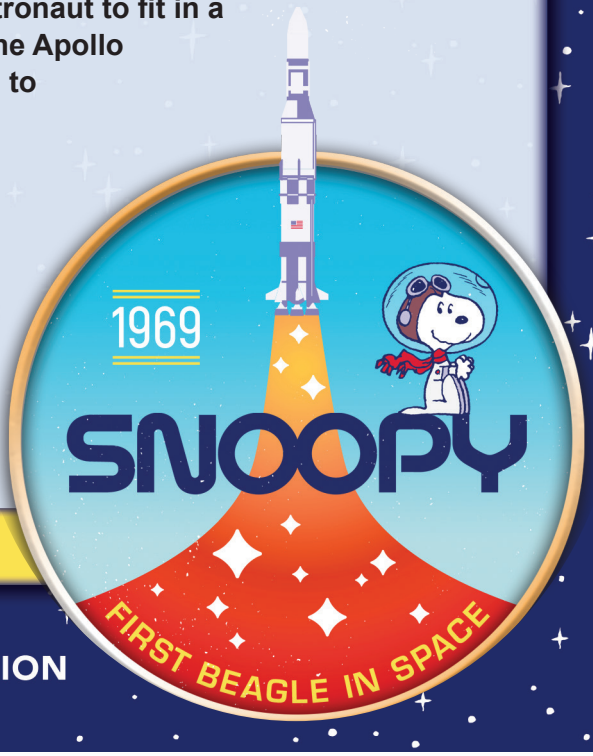
development. The food was lightweight because the water was removed, it had a longer shelf life, and it could be stored at room temperature. The food also had flavors and textures more closely resembling the original fresh food items. With extended space flights in the Gemini program, adequate nutrient intake became a health concern. Each crew member was supplied with 0.58 kilograms of food per day. These included dehydrated juices, freeze-dried and dehydrated foods, and compressed, non-crumbling, bite-size foods. These made up the 3 meals a day that the astronauts consumed. Meals were planned in advance, and the menu was repeated every 4 days.

- Apollo Missions: The preparation, handling, and consumption of space foods during the Mercury and Gemini missions provided valuable experience that was applied toward the further development of space foods. The Apollo program used food packages similar to those used on Gemini, but the variety of food was considerably greater. Rehydratable food was encased in a plastic container referred to as the spoon bowl. Water was injected into the package through the nozzle of a water gun. After the food was rehydrated, a pressure-type plastic zipper was opened, and the food was removed with a spoon. The moisture content allowed the food to cling to the spoon, making eating in a more traditional manner possible. Another new package, the "wet pack" (or thermostabilized flexible pouch), required no water for rehydration because water content was retained in the food. There were 2 types of thermostabilized containers: A flexible pouch made of a plastic and aluminum foil laminate, and a can with a full panel pullout lid. A disadvantage to the canned products was the added weight, which was approximately 4 times that of rehydratable foods. With these new packages, Apollo astronauts could see and smell what they were eating, as well as eat with a spoon for the first time on space voyages. This added enjoyment to the meals, which had been missing from earlier packaging and products. The storage space required for the new packaging allowed for 1 weeks' worth of rations for 1 astronaut to fit in a pressure-resistant container the size of 3 shoe boxes. The Apollo missions to the Moon presented an enormous challenge to producing space food. The Mercury feeding tube was reintroduced as a backup food system. It contained a special formulation rather than the natural food purees used during Mercury. On Apollo flights, food and drinks were reconstituted with either hot or ambient (room-temperature) water. Some of the foods consumed on Apollo were coffee, bacon squares, cornflakes, scrambled eggs, cheese crackers, beef sandwiches, chocolate pudding, tuna salad, peanut butter, beef pot roast, spaghetti, and hot dogs.



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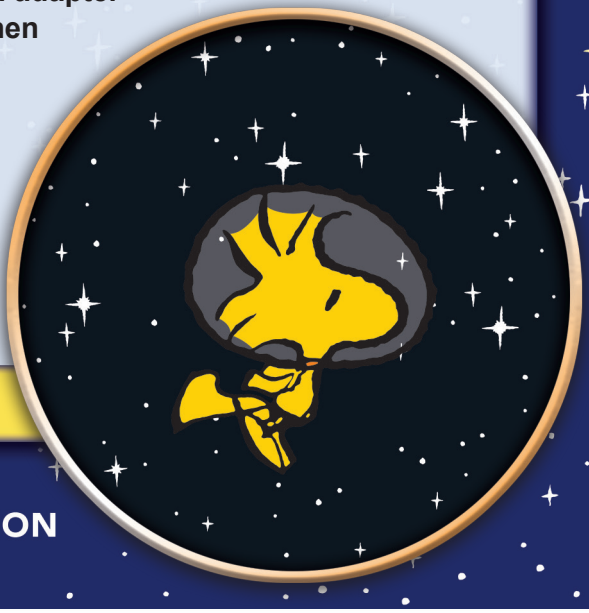
- **Skylab:** The dining experience on Skylab was unlike any other previous space flight. The Skylab laboratory had a freezer, refrigerator, warming trays, and a table. Eating a meal on Skylab was more like eating a meal at home. The major difference was the microgravity environment. The supply of food onboard was sufficient to feed 3 astronauts for approximately 112 days. The menu was designed to meet each astronaut's daily nutritional requirements based on age, body weight, and anticipated activity level. Each astronaut's caloric intake was 2,800 calories per day. These nutritional requirements were part of the life-science experiments conducted on Skylab. Skylab foods were packaged in specialized containers, and the rehydratable beverages were packaged in collapsible accordion-like drink dispensers. All other foods were packaged in aluminum cans of various sizes, or rehydratable packages. To prepare meals, the Skylab crew placed desired food packages into the food-warmer tray. This was the first device capable of heating foods (by conduction) during space flight. Foods consisted of items such as ham, chili, mashed potatoes, ice cream, steak, and asparagus.
- **The International Space Station (ISS):** The ISS is fully operational on a full-time basis, with a crew of 7 people who reside in the Habitation Module (HAB). Food and other supplies are resupplied every 90 days by the Multi-Purpose Logistics Module (MPLM). The MPLM is a pressurized module carried in the Space Shuttle payload bay that's used to transport materials and supplies. The fuel cells, which provide electrical power for the space shuttle, produce water as a byproduct, which is then repurposed for food preparation and drinking. However, on the ISS, the electrical power is produced by solar arrays, and this power system does not produce water, so water will be recycled from a variety of sources, but not enough for use in the food system. Therefore, most of the food planned for the ISS is frozen, refrigerated, or thermostabilized (heat processed, canned, and stored at room temperature), and does not require the addition of water before consumption. Although many of the beverages are in the dehydrated form, concentrated fruit juices are available and stored in the onboard refrigerator. The ISS drink package is made from a foil and plastic laminate which provides for a longer shelf life. An adapter located on the package connects with the galley, or kitchen area, so that water can be dispensed into the package and mix with the drink powder inside. The adapter that adds the water also holds the drinking straw for the astronauts. The food package is made from microwaveable material. The top of the package is cut off with a pair of scissors, and the contents are then eaten with a fork or spoon.



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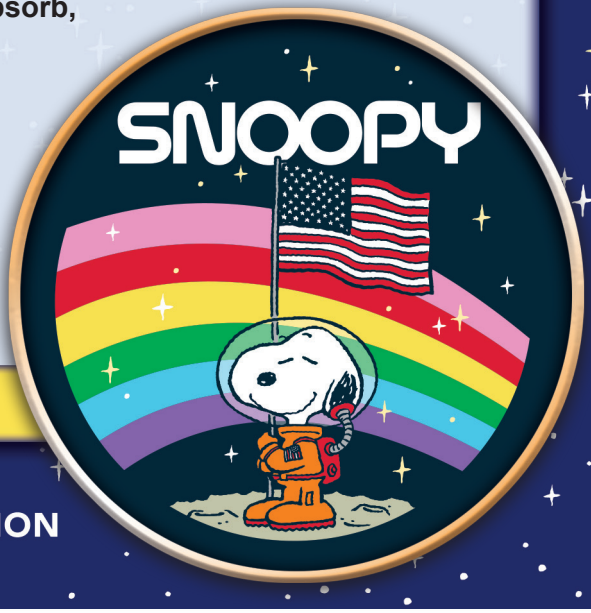
- There are 8 categories of space food.
  a. Rehydratable Food: The water is removed from rehydratable foods to make them easier to store. This process of dehydration (also known as freeze-drying) is described in the earlier Gemini section. Water is replaced in the foods before they are consumed. Rehydratable items include beverages, as well as food items. For example, oatmeal is a rehydratable food.
  b. Thermostabilized Food: Thermostabilized foods are heat processed, so they can be stored at room temperature. Most of the fruits and fish (tuna) are thermostabilized in cans. The cans open with a pull tab, similar to fruit cups that can be purchased at your local grocery store. Puddings are packaged in plastic cups.
  c. Intermediate Moisture Food: Intermediate moisture foods are preserved by taking some water out of the product while leaving enough to maintain a soft texture. This way, it can be eaten without any preparation. These foods include dried peaches, pears, apricots, and beef jerky.
  d. Natural Form Food: These foods are ready to eat and are packaged in flexible pouches. Examples include nuts, granola bars, and cookies.
  e. Irradiated Food: Beef steak and smoked turkey are the only irradiated products being used at this time. These products are cooked and packaged in flexible foil pouches, and sterilized by ionizing radiation, so they won't spoil. Other irradiated products are being developed for the ISS.
  f. Frozen Food: These foods are flash-frozen to prevent a buildup of large ice crystals. This maintains the original texture of the food and helps to maintain freshness. Examples include quiches, casseroles, and chicken pot pies.
  g. Fresh Food: These foods are neither processed nor artificially preserved. Examples include apples and bananas.
  h. Refrigerated Food: These foods require cold or cool temperatures to prevent spoilage. Examples include cream cheese and sour cream.

VOCABULARY

Dehydrate, Rehydrate, Moisture, Evaporate, Consistent, Absorb, Absorption



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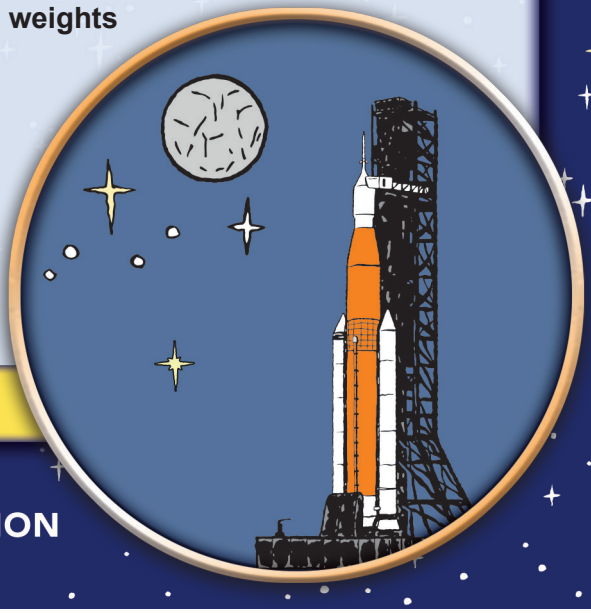
MATERIALS

- Fresh fruits (e.g. peaches, strawberries, apples, grapes, or bananas)
- Fresh vegetables (e.g. green beans, zucchini, squash)
- A food dehydrator (an oven at 220° degrees can be used)
- Balance scale
- Plastic zip-lock sandwich bags (enough for all the food samples)
- For Extension:
  - Already dehydrated food
  - Containers with measured water to rehydrate food

LESSON PROCEDURES

1. Read *Snoopy, First Beagle on the Moon!* and *Shoot for the Moon, Snoopy!* to establish background knowledge for the entire class.
2. Open *Shoot for the Moon, Snoopy!* and refer to p. 9 and p. 21. Explain to the students that Snoopy is eating a sandwich (an Earth food) and ask if he could do that in space. Discuss the history of how space food has developed and the reasons for that. Discuss why the students think many of the changes to space food have occurred.
3. Display and explain the various fruits and vegetables you will be using for the experiment. Ask the students, "Why it is important for Snoopy, or any astronaut, to have fruits and vegetables available to eat during space travel? What would be some difficulties of taking fresh fruits and vegetables into space?"
4. Explain how dehydrating food means removing (most of) the water in foods, which makes them last longer and travel better. Discuss with students how using dehydrated foods for space travel gives astronauts access to more solid foods and a better, more nutritious, overall diet. Rehydratable foods and drinks also allow for a significant weight reduction during space travel.
5. Show the scale to the students. Explain that you are going to measure and weigh each piece of fruit/vegetable before you start to determine the amount of water in each piece. Carefully record the weights and measurements in your science journal.
6. Direct the students to cut or slice food into small pieces. Ensure that they record the exact weights and sizes in their science journals as they cut fruits and vegetables. Monitor the students as they weigh their samples to ensure accuracy.



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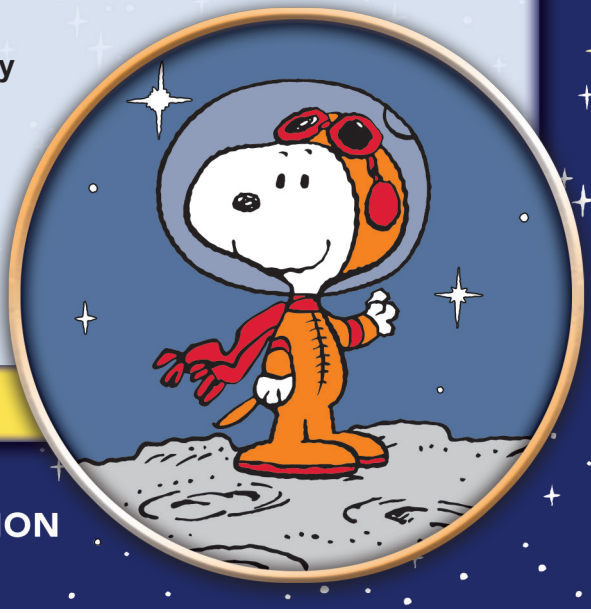
7. Explain and demonstrate what a food dehydrator does. If you do not have one, explain to the students that you'll be placing the samples in an oven set at 220 degrees so that the heat can slowly evaporate the water in the food. Place the food items in the dehydrator, and begin the process of dehydration. Explain that this will take several hours. You may want to already have pre-dehydrated food items available for the students to sample.
8. Dehydrate the food and then allow the food time to cool. Once cooled, place the food in a plastic sandwich bag so moisture will not be reabsorbed. Explain how the plastic bag is important as dehydrated food can absorb water directly from the atmosphere.
9. Demonstrate how to precisely weigh and measure the dehydrated food. Model how to weigh and then subtract the weight of the empty zip-lock plastic bag from the weight of the sample bag (the resulting number is the weight of the empty bag).
10. Calculate the percentage of moisture lost in each student's sample using the following equation:
    a. % of moisture loss = (original mass — dehydrated mass) x 100 (original mass)
    b. You may need to this formula step by step with your students. Monitor them as they complete the mathematics — using a formula to solve the problems may be a new skill to introduce to your students. Ensure that you go slowly and explain each step thoroughly to avoid confusion. Use calculators to facilitate the mathematics, and provide a skills review.
11. Discuss what the students observed during the experiment. Did the food samples change over time? Have the students taste several foods that are fresh, and then several that are dehydrated, and ask them to compare and contrast them in their journals.
12. Ask the class to pretend they are Snoopy. Explain that Snoopy needs to write a manual about the process of dehydration for future astronauts to use in space. Explain that they will need to recreate the steps involved in dehydrating food. Explain that the students may use a written paragraph or storyboard to show the process of dehydration from start to finish in their journals.

EXTENSIONS

Conduct this experiment in reverse by rehydrating already dehydrated foods (examples include pre-packaged, dehydrated camping foods).

- Weigh an amount of dehydrated food (without its packaging)
- Place the amount of food in a pre-measured container of water
- Allow the food to rehydrate completely



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- Carefully remove the food from the water, leaving any excess water in container
- Gently blot the food dry
- Weigh the rehydrated food
- Use the equation to calculate the percentage of rehydration:
  – % rehydration = gain in mass + original mass

RESOURCES

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