HEALTH AND NUTRITION

FOR CATHOLIC STUDENTS

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Health and Nutrition

for Catholic Students

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Table of Contents

Introduction 1

Chapter 1. Foundations of Human Health 2

Chapter 2. Exercise 20

Chapter 3. Personal Health 34

Chapter 4. Disease. 50

Chapter 5. Personal Protection and Exercise Safety. 64

Chapter 6. First Aid. 80

Chapter 7. Food for Energy 98

Chapter 8. Food for Health 114

Chapter 9. Food Safety 138

Chapter 10. Water 174

Chapter 11. Macronutrients: Proteins 200

Chapter 12. Macronutrients: Carbohydrates. 218

Chapter 13. Macronutrients: Fats 238

Chapter 14. Micronutrients: Vitamins. 258

Chapter 15. Micronutrients: Minerals 282

Chapter 16. Diet. 312

Chapter 17. Foods to Avoid 330

Chapter 18. Careers Related to Food 356

Image Attributions 377

Glossary 381

Index 405

Chapter 2
Exercise

Chapter Outline

I. Introduction

II. Energy

III. Anaerobic Exercise

IV. Aerobic Exercise

V. Beneficial Activities
- A. Warm-Up
- B. Stretching
- C. Exercises
- D. Cool-Down

VI. Appropriate Equipment
- A. Protective Gear
- B. Proper Clothing

VII. Restful Relaxation

VIII. Benefits of Exercise
- A. Skeletal-Muscular Benefits
- B. Mental Benefits
- C. Other Health Benefits

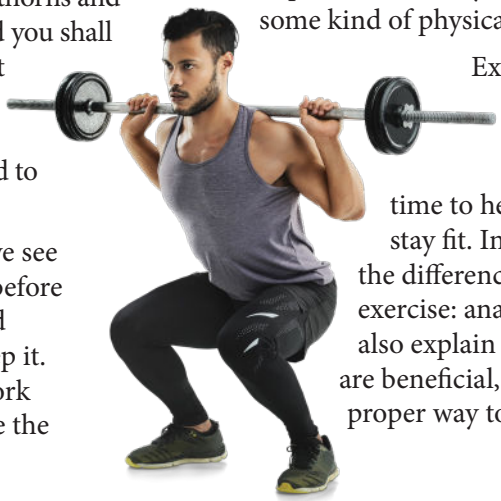
I. Introduction

"The Lord God took the man and put him in the Garden of Eden to till it and keep it" (Gen 2:15).

After Adam, in cooperation with Eve, committed the original sin, God said to him: "Because you have listened to the voice of your wife, and have eaten of the tree of which I commanded you, 'You shall not eat of it,' cursed is the ground because of you; in toil you shall eat of it all the days of your life; thorns and thistles it shall bring forth to you; and you shall eat the plants of the field. In the sweat of your face you shall eat bread till you return to the ground, for out of it you were taken; you are dust, and to dust you shall return" (Gen 3:17-19).

From these two Bible citations, we see that God made man to work. Even before the original sin was committed, God told Adam to till the garden and keep it. However, because of original sin, work would be difficult and would require the "sweat of your face."

Even today, with many modern inventions and machines, some people still have jobs that require physical labor. These workers need to keep their bodies in shape so that they can adequately handle this physical labor. Others have jobs that involve very little physical activity, and it is all too easy to get out of shape. For them, it is perhaps even more important that they exercise their muscles through some kind of physical activity.



Exercise is an important part of maintaining a healthy body and lifestyle. Various exercises have been developed over time to help people get in shape and stay fit. In this chapter, we will discuss the differences between two main types of exercise: anaerobic and aerobic. We will also explain how these two types of exercise are beneficial, how to exercise safely, and the proper way to cool down after exercise.

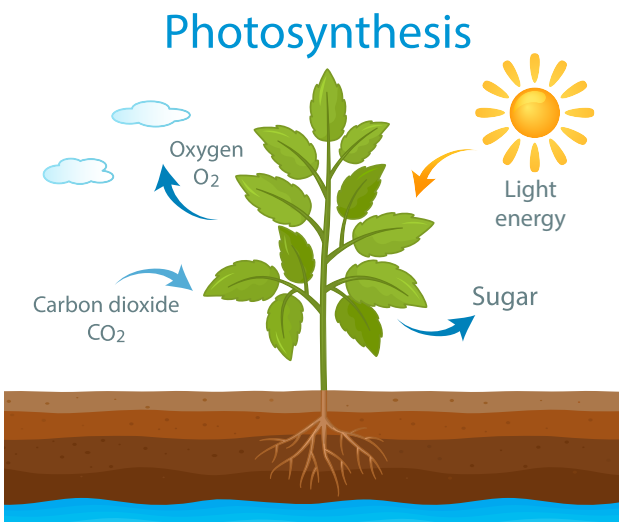
II. Energy

All things require energy for movement or work, and the human body is no exception. However, not every machine uses the same supply of energy. Your family car runs on gasoline. This is a store of chemical energy that is released by burning—actually, exploding—inside the car's engine. The lights in your house receive energy from electricity. Food gets cooked in a microwave oven by the energy in the microwaves that the oven produces. Nuclear submarines have nuclear reactors which harness the energy of large atoms, such as uranium, by breaking them down through nuclear fission into smaller atoms. Airplanes burn jet fuel for energy.

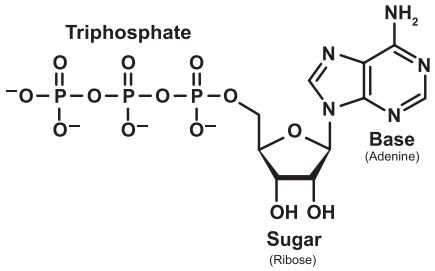
The human body, however, requires a unique form of energy. This energy is supplied to the body mostly by a substance called **ATP (adenosine triphosphate)**. The body converts some of the nutrients in the food we eat into a form of sugar called *glucose*, which is in turn converted into ATP. The body uses ATP for fuel.

God's plan for us involves marvelous interactions with the world around us—a world which He created just for us. Consider for a moment some of the wonders of God's intricate design. Plants use water and nutrients, which they absorb from the ground. They use carbon dioxide, which they absorb from the air. They use sunlight for their power source. And they convert all of these nonliving, inert things into organic matter for living cells.

People then can eat the plants and absorb the organic matter as nutrients, which are changed into human organic matter for human cells. Much of the organic plant matter is in the form of carbohydrates,



Adenosine Triphosphate Molecule



especially sugars like glucose, which can be transformed in the human body into ATP. Some of the organic plant matter is in the form of proteins, which can be used for body cells, like muscle cells and bone cells.

Plants use a process called **photosynthesis**, which is powered by sunlight, to convert carbon dioxide and inert matter into organic matter. The human body converts organic plant matter and other food into energy by a process called **cellular respiration**. In photosynthesis, plants use carbon dioxide and make organic matter with oxygen as a byproduct (or waste product). Human beings breathe in oxygen from plants and use that in cellular respiration to make ATP for energy, with carbon dioxide as a waste product. Thus, human beings inhale oxygen and exhale carbon dioxide, whereas plants take in carbon dioxide and release oxygen. We see here, again, the interconnectedness of human beings with the world God created for us.

Cellular respiration in the human body occurs in two ways: *aerobic* (meaning "with oxygen") and *anaerobic* (meaning "without oxygen"). **Aerobic cellular respiration** requires oxygen; **anaerobic cellular respiration** does not. The aerobic process is more efficient and is intended to be the body's normal means of developing energy. The anaerobic process is intended for intense activities in which energy is needed quickly.

Aerobic cellular respiration produces far more energy than anaerobic cellular respiration. In the aerobic process, one glucose molecule produces up to 36 to 38 ATP molecules. The anaerobic process produces only two ATP molecules per glucose molecule. However, the anaerobic process is significantly faster than the aerobic process.

One byproduct of anaerobic cellular respiration is *lactic acid*, or lactate. Lactic acid may be related to the burning sensation that is sometimes felt in muscles during intense exercise, although some researchers now believe that this burning sensation is actually caused by other factors. It also was once commonly believed that lactic acid buildup was responsible for muscle soreness and fatigue after strenuous exercise. Thus, it was thought to be a waste product that had negative effects on the muscles involved in the exercise, and perhaps elsewhere in the body. However, recent studies have shown that this is not the case.

Lactic acid, or lactate, actually benefits the body by providing energy to cells during strenuous exercise, helping to coordinate whole-body metabolism, and facilitating the production of more glucose. It has also been identified as a multipurpose signaling molecule. Signaling molecules, like certain hormones, can target specific cells and signal them to start a particular activity. Some of the activities that lactate molecule signaling initiates are increased exercise performance, improved immune response, anti-inflammation activities, and wound healing.

Lactic acid is removed very quickly by the body after exercise has been completed, and thus is not the reason muscles are sometimes sore after exercise. Muscle soreness is typically due to tiny tears in the muscles, called *microtears*, which the body can repair, provided those muscles are given sufficient time to rest before being worked out again.

III. Anaerobic Exercise

Have you ever been playing a sport or working out and reached a point at which you felt absolutely breathless? Whether or not you realized it at the time, you were exercising anaerobically. (Remember, *anaerobic* means "without oxygen.") **Anaerobic exercise** is any intense physical activity that requires a burst of energy over a short period of time.

The first step in all cellular respiration is anaerobic; it does not require oxygen. This step is called **glycolysis**. The reason this first step is anaerobic is that the aerobic system always lags a little bit. Thus, all efforts involving muscles are anaerobic to start, even if they are mild movements such as walking.

As the muscles start to work, they require ATP, which is immediately supplied by anaerobic glycolysis. At the same time, a signal goes to the brain to ramp up the aerobic cycle. The breathing rate and depth increase, the heart pumps faster, and oxygen is sent to those muscles to restore ATP aerobically. However, the aerobic process takes time to work, so the muscles work anaerobically until the aerobic process catches up. When the aerobic process has caught up, it enables the muscles to continue this mild work for quite some time.

One example of anaerobic exercise is sprinting in a race. The sprinter runs as fast as he can,

maximizing the use of the muscles in his legs. While he is breathing during the race, the normal, aerobic process of replacing the ATP being used in his leg muscles is insufficient to meet this high demand, so those muscles take a short cut. They turn to the anaerobic process, which makes ATP very quickly in order to support the sprint. But the ATP produced by anaerobic cellular respiration is limited. So this runner can hold this sprint for only a short distance.

Other activities that are often anaerobic include jumping, shot-putting, and weightlifting, whether for work or for exercise. For instance, a farmer lifting hay bales into a barn loft is doing hard, short-term work requiring powerful use of his muscles. However, since this is anaerobic work, he cannot hold those hay bales up for very long.

Anaerobic exercises cause your body to need more oxygen than it can supply. They are more powerful, shorter-term exercises than aerobic exercises. During anaerobic exercises, the body works at a high intensity, but only for a short time.

Football games are full of anaerobic exercises. Linemen push against each other as hard as they can, but only for a few seconds of the play. Running backs and receivers sprint as hard as they can, but typically only for a matter of seconds. Then everyone on both sides has a short recovery period while they huddle together and call a new play. Sometimes this recovery period is insufficient, though, and the coach has to put in a substitute player for a few plays so that the first player can have a longer recovery period on the bench. The football game may take an hour, but the players work at full capacity for only seconds at a time.

An exercise routine designed for anaerobic exercise will help develop strength in the muscles targeted. It will improve the circulatory system to bring more oxygen to that area sooner. This will give those muscles more endurance. These exercises may also increase the body's storage of glucose in those muscles so that they can operate anaerobically harder or longer when the need arrives.

Many benefits come from performing anaerobic exercises. Benefits include developing muscles, making muscles more efficient, burning calories, and improving mental health. However, there is another kind of exercise that is even more beneficial and helps improve circulatory and respiratory systems. This form of exercise is called aerobic exercise.

V. Beneficial Activities

A. Warm-Up

Before beginning a rigorous exercise or activity, it is important to warm up for about 5 to 10 minutes. If you have ever seen a video about the Japanese economy, you may be aware that, even in factories, the entire group of workers will do stretching and other exercises to prepare for the physical demands of their jobs. The idea is to be as physically prepared as possible in order to avoid injuries.

The warm-up session should include some mild stretching and light levels of exercise that will start the muscles moving. This will increase heart rate and circulation, heat up the body, and advance the rate of breathing. Since all activity starts with anaerobic work by the muscles, this warm-up session also has the benefit of getting the aerobic system working before the anaerobic conditions become too advanced.

The warm-up can include low-speed jogging, along with low-level activities targeting the muscles that will be used. For example, during a baseball game, when a relief pitcher begins "warming up" in the bullpen, you might see him doing *arm circles*, in which he moves his arms around in a circle several times. He might then add more arm circles with a weight or ball, followed by some leg squats or similar exercises.

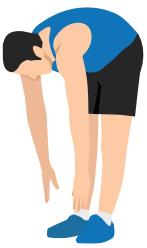
Next, he will start throwing softly for a short distance. As the warm-up progresses, he will move back for longer throws, but still not at full speed. When he finally feels warmed up, he will throw from the same full distance of the pitcher's mound and start to throw pitches at full speed. Then he will add pitches that are more stressful to the body, such as curve balls. The reason these pitches stress the body more is that the wrist and elbow must twist as they are thrown. These pitches make it harder for a batter to hit the ball, but they also put stress on the pitcher's arm and can cause injuries.

B. Stretching

Before any intense exercise or sports competition, you should stretch your muscles to increase flexibility and reduce potential injury to them. Do not force your muscles beyond what they can do. Stretching should not hurt, but you should feel a slight pull. It is also important to drink water before, during, and after you exercise.

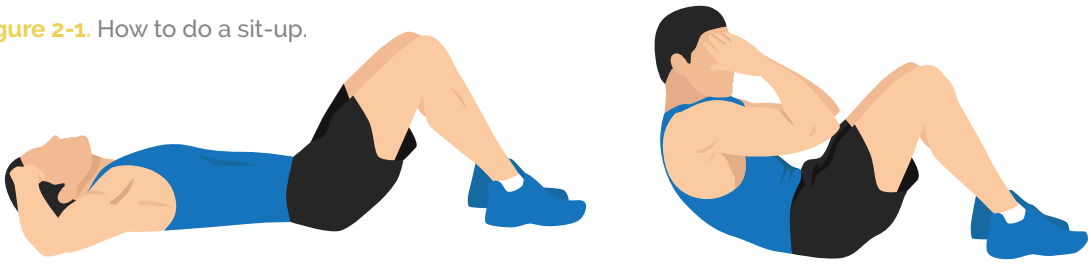
To properly stretch your muscles, you should hold each stretch for 30 seconds. It is important not to "bounce" when you stretch. A slow stretch at the limit of the range of motion is best. If you bounce, you might pull or tear a muscle, which not only will cause that muscle to hurt but also will probably prevent you from continuing with your workout.

The main muscle groups you should stretch before a workout are your back, shoulders, neck, calves, hamstrings, and quadriceps. Here are a few examples of stretches that you can do:

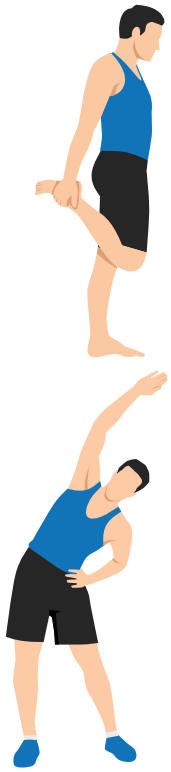


- *Stretch your back.* Stand with your feet together and your back straight. Then slowly touch your hands to your toes, or reach down as far as you can. If you keep doing this stretch, you will eventually be able to touch your palm to the floor. (This will impress your friends!)

Figure 2-1. How to do a sit-up.



- *Stretch your quadriceps.* Stand upright and flex one leg. Use one hand to hold onto your foot and pull it as close to your back as you can. Use your other hand to hold onto something in order to keep your balance.
- *Stretch your shoulders.* Extend one arm above your head and use your other arm to slightly pull the extended arm further.



C. Exercises

Once you are properly warmed up and stretched, you can begin your intense workout or participate in the sport you are playing. For a workout, here are some basic exercises that can help keep you in shape:

- *Sit-ups.* This exercise will strengthen your abdominal muscles (abs) and increase the flexibility of your back. Lie on your back with your knees bent, put your hands behind your head with your elbows sticking out, and slowly lift your head and shoulders toward your knees until your elbows touch. You might need a weight or a friend to hold your feet down when you first start.
- *Push-ups.* This exercise will help maintain muscle tone in your arms, shoulders, chest, abdominal muscles (abs), and lower back. Lie on the floor face down, with your palms shoulder width apart. Keep your back and legs straight and slowly extend your arms, pushing yourself up from the floor. Lower your chest to the floor by bending your elbows, and then push up again.
- *Sprints.* This exercise will help maintain and build your leg muscles, while also increasing your agility and your ability to quickly change direction. Start in a runner's stance (see Figure 2.3), and run as fast as you can for 90 feet. Time yourself to see how quickly you can sprint. Then see if you can beat your original time.

Figure 2-3. Runners stance

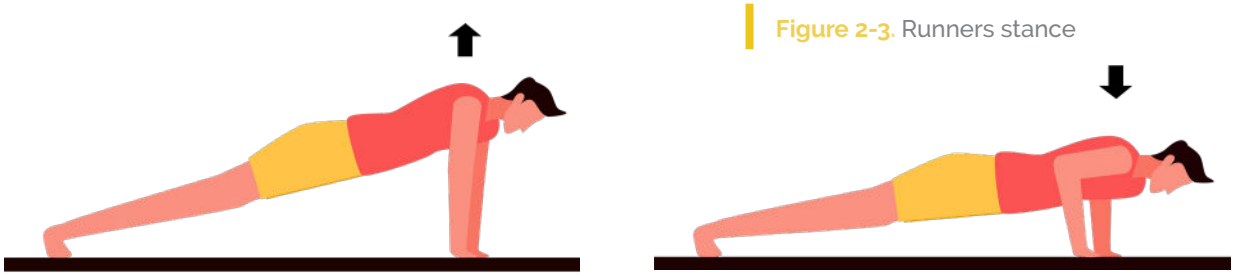
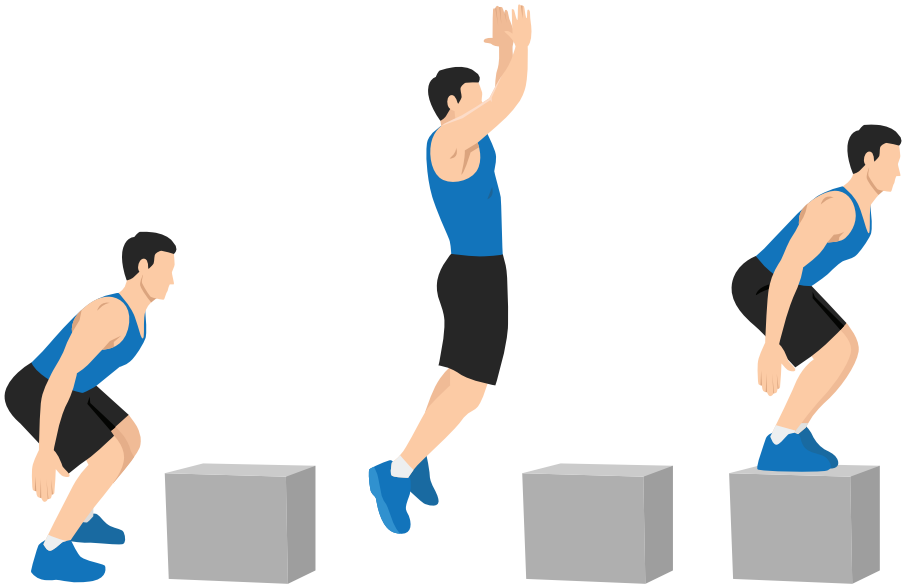


Figure 2-2. How to do a push-up.



- *Box jumps.* This exercise will help tone and strengthen your calf muscles, which are used for jumping and aid in agility. Find or purchase a solid, sturdy box about 1 foot tall that can hold your weight. Stand in front of it with your feet together, then jump as high as you can and land on top of the box.

D. Cool-Down

Just as it is important to warm up before your workout, it is important to cool down after it. The cool-down session should take about 5 to 10 minutes. This will help you to slowly bring your heart rate back to a normal pace and reduce muscle soreness. A good way to cool down is to simply walk for several minutes and stretch again. Light exercise or jogging can also help to gently keep the muscles working.

This cool-down session is important in order to help you avoid injuries. If this cool-down period is skipped, your muscles may hurt more after the workout, and there may even be some slight swelling in those areas.

Remember, you should always warm up before participating in any athletic event, and cool down afterward.

VI. Appropriate Equipment

A. Protective Gear

When playing sports or doing serious workouts, it is important to use the appropriate protective equipment. You would not want to come away with a severe injury. For example, some activities require a mouth guard. Others, such as batting in baseball, require a helmet. If you are the catcher, you will need to wear a helmet, face mask, chest protector, and shin guards. You should wear shin guards while playing soccer, and you should wear all of the proper padding when playing football or hockey. If you are a runner, make sure you wear the proper running shoes, not only for comfort but also for support. Many different injuries occur from failing to use the proper protective gear.

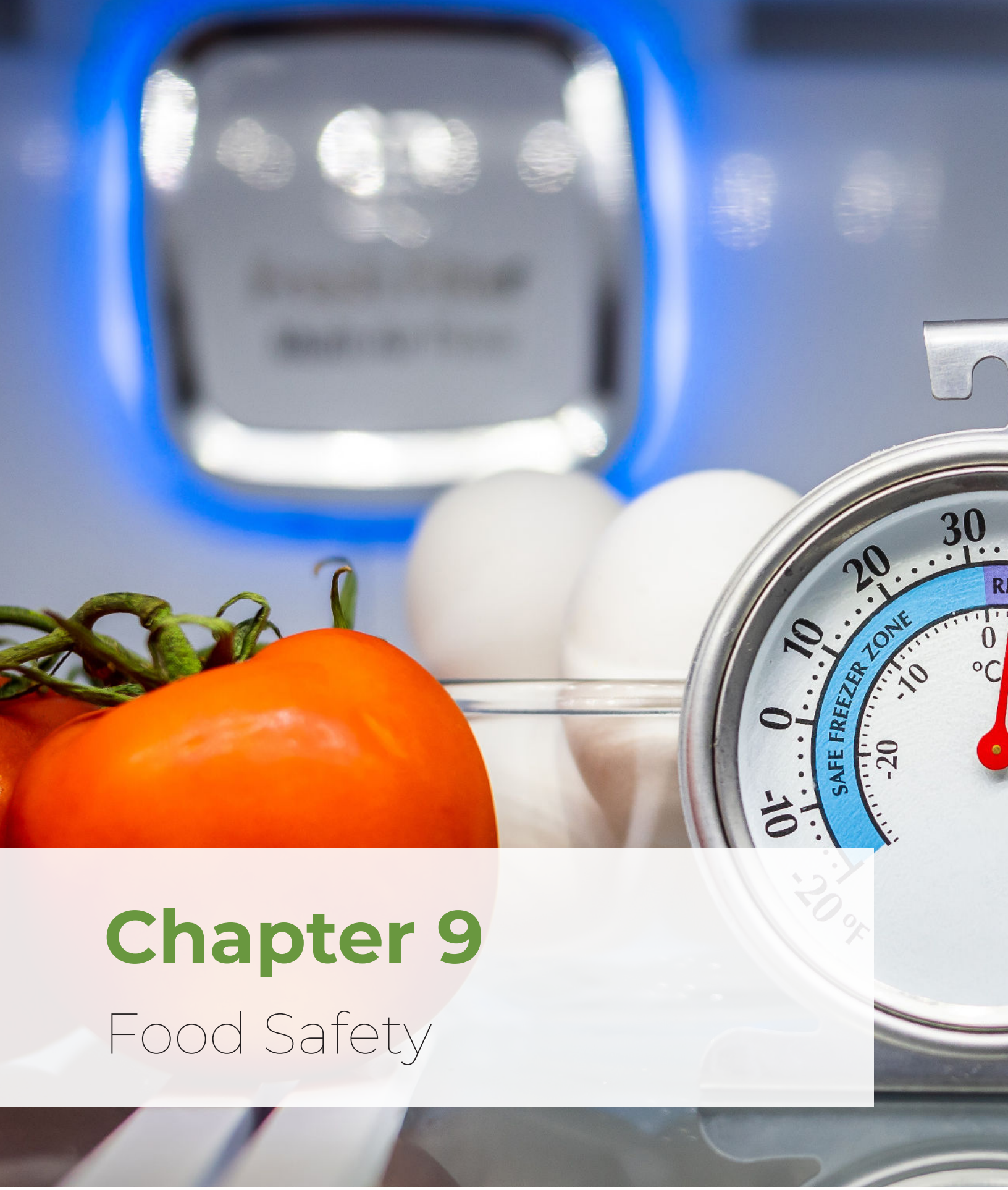
B. Proper Clothing

Proper athletic clothing is also an important part of proper equipment. Athletic clothing should allow you enough freedom to be able to move around without restraint, but it also should be modest. Wearing comfortable but snug-fitting socks will

Chapter 2 Review Questions

Answer the following questions.

1. (a) What is cellular respiration? (b) What is photosynthesis?
2. What is the difference between aerobic cellular respiration and anaerobic cellular respiration?
3. (a) What is aerobic exercise? (b) Give an example of an aerobic activity, or one that is often aerobic.
4. (a) What is anaerobic exercise? (b) Give an example of an anaerobic activity, or one that is often anaerobic.
5. (a) How long should you hold a stretch? (b) Should you bounce when you stretch? Why or why not?
6. (a) How long should you warm up before exercising? (b) How long should you cool down after exercising?
7. (a) What is BDNF (brain-derived neurotropic factor)? (b) How is BDNF affected by intense exercise?
8. List three sports or positions of a sport and the protective gear required for them?
9. How can you provide stability to weak joints during exercise?
10. (a) What is the name of the section of the brain near the hypothalamus gland which can be strengthened through exercise? (b) Besides being involved in our emotions, what is this section of the brain believed to be the center of?
11. How many hours of sleep are sufficient for teenagers to get a good night's rest?
12. (a) How is ATP (adenosine triphosphate) formed in the body? (b) For what does the body use ATP?
13. (a) How does exercise train the nervous system? (b) This training contributes to what phenomenon?
14. How does exercise strengthen our bones?
15. How is exercise beneficial to the skin?
16. (a) How do sit-ups help your body? (b) How do push-ups help your body?
17. (a) How do sprints help your body? (b) How do box jumps help your body?
18. (a) What do stress hormones such as adrenaline and cortisol do? (b) What effect does exercise have on these stress hormones, and hence on stress?
19. (a) What is glycolysis? (b) Is it aerobic or anaerobic?
20. Why should you stretch your muscles before any intense exercise or sports competition?
21. (a) What do humans exhale that is beneficial to plants? (b) What do plants release that is beneficial to humans?
22. How many ATP molecules per glucose molecule are produced by (a) aerobic cellular respiration and (b) anaerobic cellular respiration?
23. Which process is significantly faster: aerobic cellular respiration or anaerobic cellular respiration?
24. What are the main muscle groups you should stretch before a workout?
25. What is the best type of exercise for maintaining the health of your heart and lungs?



Chapter 9

Food Safety

Chapter 9
Food Safety

Chapter Outline

I. Introduction

II. Proper Food Handling

A. Hand Washing

B. Correct Temperatures for Food Preparation

C. Clean Food Preparation Surfaces

III. Kitchen Safety

IV. You Are What You Eat

V. Food Preservation Methods

A. Dehydration

B. Freezing and Refrigeration

C. Fermentation

D. Pickling

E. Curing

F. Canning

G. Other Food Preservation Methods

VI. How Long Are Foods Safe to Eat?

VII. Safe Food Storage Containers

VIII. Conclusion

I. Introduction

When God created our first parents, Adam and Eve, He blessed them and said: "Be fruitful and multiply, and fill the Earth and subdue it; and have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the Earth" (Genesis 1:28). God created everything on the Earth as a gift for mankind. When food is grown and handled in a manner that reduces waste and preserves the land and resources of the Earth, more food can be distributed to all of God's children, including those who need nourishment the most but often receive the least.

Food is essential for energy and health. Food should also be enjoyable, not only to provide nourishment but also as a way to share meals with loved ones. But, to be fit for human consumption, food must be handled, cooked, and stored in a safe and healthy manner. This chapter focuses on food safety, including the proper handling and storage of food, methods for preserving food, and other safety considerations regarding the food we eat. Food is a precious resource, and it must not be wasted. Our life depends on it.

II. Proper Food Handling

When we handle food properly, we reduce the risks of spreading germs to other food and surfaces, thus lessening the chance for bodily infection or food spoilage. Microorganisms naturally live on the surface of the skin, and could **contaminate** (make unclean by the exposure of chemicals, pollutants, or poisons) food surfaces. (A *microorganism* is a living being that can be seen only with a microscope, if at all.) For example, the bacteria ***Staphylococcus aureus*** (or ***S. aureus***) naturally lives on human and animal bodies in areas such as the skin, throat, and nose. This bacteria can produce toxins that cause human infections and diseases, such as staphylococcal (staph) food poisoning and wound infections. (A **toxin** is a poison that is produced by a microorganism and causes illness in the body.)

A **foodborne illness** is an illness that stems from eating food that is spoiled or contaminated by bacteria, viruses, parasites, molds, or chemicals, which can cause irritation or infection of the gastrointestinal tract. (**Gastrointestinal** means involving the stomach and the intestines. The *gastrointestinal tract*, or *digestive tract*, is a long passageway that extends from the mouth to the anus

and encompasses the mouth, the esophagus, the stomach, the small intestine, and the large intestine.) Symptoms of foodborne illnesses may begin anywhere from 30 minutes to 2 weeks after exposure, depending on which pathogen caused the illness. They may include headaches, nausea, vomiting, diarrhea, stomach pain, body aches, and a fever. Some foodborne illnesses may cause more severe symptoms, such as convulsions, loss of balance, blood in stools (i.e., in solid waste), muscle weakness, and blurred vision, among others. Anyone experiencing these or any other severe symptoms should seek professional medical assistance as soon as possible.

The spread of the *S. aureus* bacteria is often due to improper food handling. Foods that are more susceptible to *S. aureus* being present are those higher in protein, such as poultry or other meat, dairy, fish, cream sauces, puddings, custards, and salads containing meat. There are two practices that can help prevent the spread of *S. aureus* toxins. First, always properly wash hands before handling food. Second, always store food at appropriate temperatures.

Other bacteria that are known to cause foodborne illnesses include *Escherichia coli* (*E. coli*) O157:H7, *Salmonella enteritidis*, and *Campylobacter jejuni*. Something to remember is that bacteria and other microorganisms are present everywhere: water, air, soil, animals, humans, and food. So it is important to take precautions, especially when handling food.

A. Hand Washing

To help prevent the spread of foodborne illnesses, make sure your hands are clean before you handle any food. Clean hands can help prevent many illnesses. When dealing with food preparation, clean hands are essential. The Centers for Disease Control and Prevention (CDC) lists **five steps for washing hands**: (1) wet, (2) lather, (3) scrub, (4) rinse, and (5) dry.

Step 1. Thoroughly wet your hands with clean, running water. For food preparation, the temperature of the water is not very important; it may be warm or cold. Using clean water, though, is essential. Keeping your sleeves rolled back prior to hand washing will help keep your shirt clean and dry.

Step 2. Lather your hands with soap. This helps remove the germs from your hands, as the bubbles can get into all of the creases in your hands. The type of soap is not significant. Studies have shown that an antimicrobial soap is no more efficient at removing surface bacteria than a non-antimicrobial soap. The key to proper hand washing is the physical removal of the germs using soap and water, not extra unnecessary chemicals in the soaps themselves. Many companies have removed the chemical triclosan from their soaps after studies showed links to hormone disruption in the body. Triclosan has not been completely removed from other beauty products, though, such as some toothpastes, body washes, and acne washes. So caution should be taken regarding the use of these products.

Hand sanitizers are popular today as a means to clean one's hands if soap and water are not available. Hand sanitizers do not remove all types of germs or chemicals that can be present on hands, however, and they are not very helpful when hands are greasy or have visible dirt on them. For food preparation, hand sanitizers would not be suitable, because any germs present need to be thoroughly removed physically with soap and water.

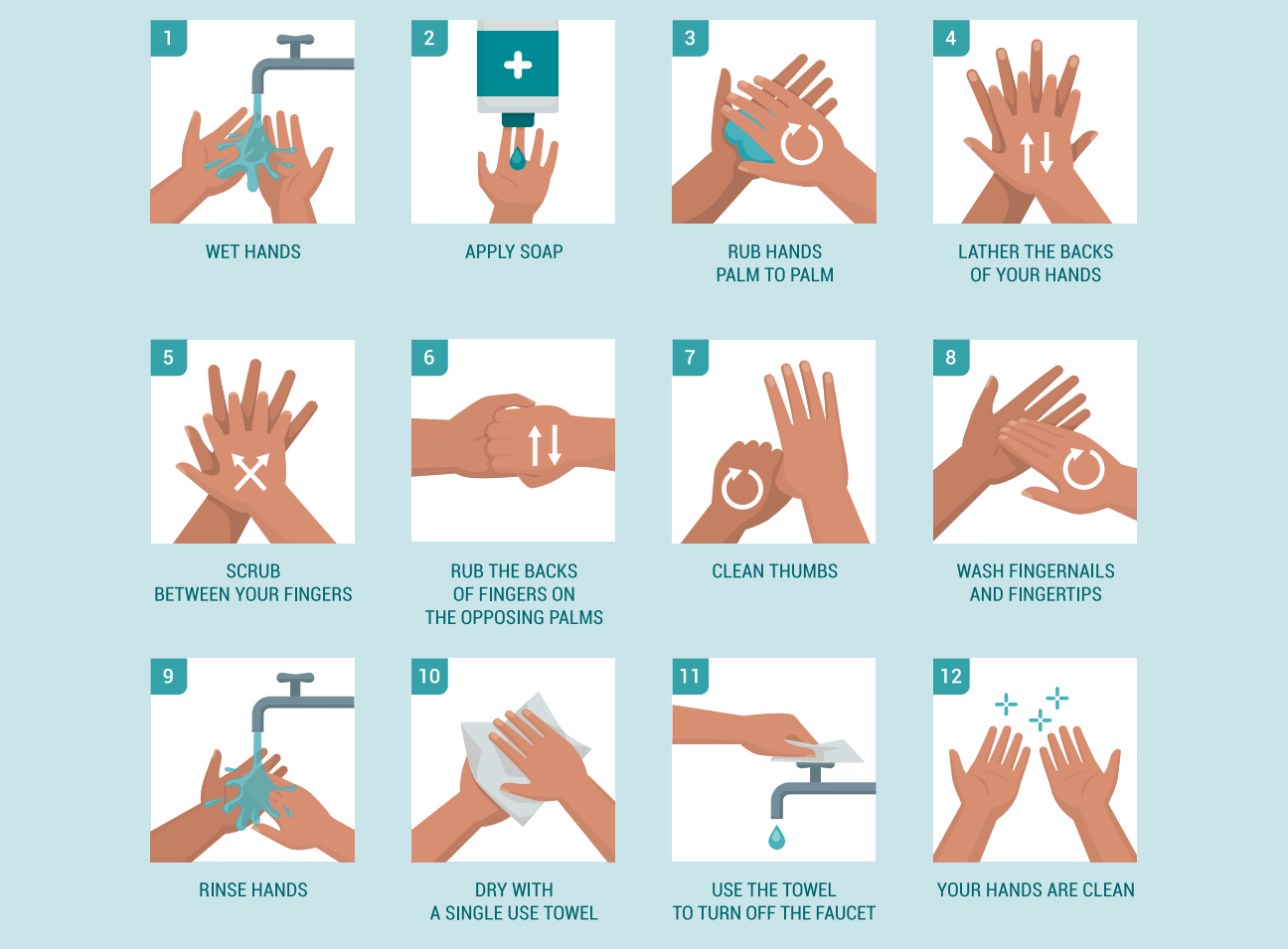


Figure 9-1. How to properly wash your hands.

Step 3. Scrub your hands. This is the most important part of hand washing. The entire surfaces of the hands need to be washed, including between the fingers, the backs of the hands, and under the fingernails. A fingernail brush can help remove any dirt that may be present and hard to reach under the fingernails. An easy way to make sure your hands are cleaned well enough to handle food is to lather and scrub for at least 20 seconds. One way to ensure this is to silently sing "Happy Birthday" to yourself twice while scrubbing your hands. A more edifying way is to say your favorite prayers for long enough to scrub for about 20 seconds—for example, pray the Hail Mary twice.

Step 4. Rinse your hands with more clean, running water. To ensure that all germs are removed, thoroughly rinse off all surfaces of the hands and out from under the nails. This should take about 10 seconds, or about the time it takes to pray one Hail Mary or Glory Be.

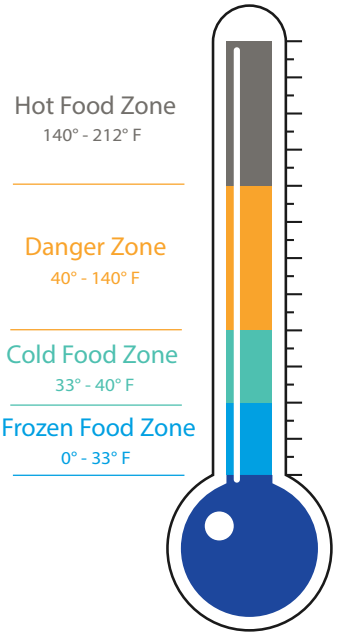
Step 5. The final step is to dry your hands. Make sure you use either a clean, dry hand towel (not a damp one that has already been used several times) or disposable paper towels. Drying your hands should not be skipped, because this step can remove any remaining germs that might still be present after the other steps.

There is one more step to consider, especially if you are in a public restroom or one that is shared by many people: use a paper towel to turn off the sink faucet. This can protect you from any germs that may be present due to you or others turning on the faucet; the paper towel acts as a barrier. This is why many public restrooms have automatic faucets and soap dispensers, so that no contact needs to be made with these surfaces. You should also use a paper towel to open the door of a public restroom when you are leaving. This is even more important than using a paper towel to turn off the faucet, because, unfortunately, some people do not wash their hands after using the bathroom.

Not only should hands be washed before working with food, but hands should also be washed during food preparation and afterward. In some situations, gloves that are **sterile** (clean and free from living microorganisms) may be needed if you are working in the restaurant or catering business. Gloves help to prevent germs on the hands from being transferred to the foods being prepared. However, you should also be cautious when wearing gloves. You need to keep them extremely clean, and replace them with a new pair of gloves if they come in contact with a nonfood surface, such as part of the body (hair, skin, nose, eyes, ears, etc.); if they touch an uncleaned countertop or other surface; or if you are working with raw meat.

B. Correct Temperatures for Food Preparation

When you prepare food at a temperature that is consistent with keeping bacteria and other microorganisms at bay, you can make a meal that is not only delicious but also safe to eat. Temperature is one of the major factors in the growth of bacteria. **Room temperature** is a generally comfortable temperature indoors of approximately 68°F to 77°F (20°C to 25°C). This is the most common temperature at which food is typically prepared in the home. Room temperature, though, is often the perfect environment for foodborne illnesses, as many bacteria grow and thrive at this temperature. The time food is left exposed to room temperature should be kept at a minimum to avoid **food spoilage** (the process in which food becomes unsuitable to be eaten, often because of improper handling or storage).



In the food industry, the **danger zone** refers to the temperature range in which bacteria grow extremely rapidly, which is from 40°F to 140°F (4°C to 60°C). Bacteria double in as little as 20 minutes in the danger zone! Room temperature falls directly in this range. The maximum time that food should remain at room temperature during food preparation is 2 hours. Any longer than this would

increase the risk of spoilage due to bacteria. If food is exposed to temperatures of 90°F or more (for example, outside on a hot summer day), then food should not be left out for more than 1 hour.

Temperature plays a role in the correct thawing of meat as well. To **thaw** means to change food from frozen to unfrozen. The time to thaw a solid piece of meat varies per pound. Normally, this time exceeds the 2-hour maximum of food being left at room temperature. Therefore, meat should not be thawed at room temperature, but rather at refrigerated temperatures. Temperatures in a refrigerator are generally around 33°F to 40°F (0.6°C to 4°C). Some refrigerators may be a bit warmer, but this is not safe, because any temperature above 40°F (4°C) is in the danger zone. Many refrigerators can be set to never exceed 40°F. This can help prevent many bacteria from growing or at least slow their rate of growth.

However, some bacteria (such as *Listeria monocytogenes*, *Bacillus cereus*, and *Clostridium botulinum*) grow optimally at refrigerated temperatures. To help limit the growth of these types of bacteria in a refrigerator, time is an important factor to consider for perishable foods, such as poultry and other meat, fish and other seafood, fruits, vegetables, eggs, milk, and other dairy products. Some food can also be cooked safely from a frozen state (for example, frozen chicken breasts and frozen pizza). But the cooking time may be twice as long as when the food has first been completely thawed.

Once meats and other foods have been properly thawed, temperature is a key component once again, in the next stage of the process: cooking. Cooked foods are measured according to their **internal temperature** (the temperature inside the food, near the center). Ovens do not always cook at the temperatures shown in their settings. An oven thermometer is a handy kitchen tool, which can be left in the oven hanging on a rack to give a more accurate temperature reading. Not only would an oven thermometer help ensure that foods reach the correct minimum internal temperatures, but knowing the exact oven temperature can help you to avoid the opposite extreme: overcooked foods (such as burned cookies or a roasted chicken that is too dry).

In addition, a food thermometer could be inserted into meat (such as a turkey) or other foods to ensure that the minimum internal temperature has been reached for this food to be eaten safely. However, keep in mind that if foods and raw meats have not been handled safely with proper hand washing or have been allowed to remain at room temperature for longer than 2 hours, toxins such as those produced by *S. aureus* will not be destroyed by any amount of cooking, because they are heat resistant.

Some people choose to eat undercooked meats and foods as part of their customs or preferences. However, many restaurant menus include a warning that choosing to do so can result in illness. Those most susceptible to illness from eating raw or improperly cooked foods are young children, the elderly, pregnant women, people who are currently undergoing medical treatment, and people who have a weakened immune system. Foods that should be of particular concern for anyone in one of these categories include hot dogs, raw meat (beef, poultry, etc.), raw or smoked fish or other seafood, raw eggs, foods containing raw eggs (such as homemade salad dressings and cookie dough), sprouts (such as radish sprouts and alfalfa sprouts, which can be thriving places for salmonella, *E. coli*, and listeria if they are not fresh and washed thoroughly), and unwashed fruits and vegetables.

Other raw foods that should be avoided or consumed only with caution are raw milk and raw cheese. Many families choose to milk their own goats or cows and drink their milk raw. When proper precautions are taken, including making sure all dairy animals are up-to-date on the proper vaccinations, this can be a wholesome way to obtain one's daily dairy intake. However, if the milk is not pasteurized, the risk of

illness still remains, especially for those over 65, children under 5, and people with weakened immune systems.

You should also be careful when eating sushi to ensure that all raw fish and seafood have been prepared properly. This includes a required freezing step, in which the fish must be frozen at –4°F (–20°C) for seven days or at –31°F (–35°C) for 15 hours, to kill any parasites present.

Raw Food Category	Minimum Internal Temperature to Cook	Other Helpful Information
Poultry (chicken, turkey, etc.)	165°F (74°C)	—
Ground meat (pork, beef, lamb, veal, etc.)	160°F (71°C)	—
Steaks, chops, and roasts (pork, beef, lamb, veal, etc.)	145°F (63°C)	For safety and quality, allow meat to rest for at least 3 minutes before carving or consuming. Some may desire to cook food in this category at a higher temperature, according to their own personal preference.

Figure 9-2. Minimum internal temperatures for cooking different kinds of meat, according to the USDA Food Safety and Inspection Service.

The chart in Figure 9-2 shows some minimum internal temperatures for the proper cooking of meat, according to the U.S. Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS).Temperature is also important for reheating foods. In order for food to be properly reheated, its internal temperature must reach at least 165°F (about 74°C). Usually, food that has been correctly reheated to this temperature is hot and steamy. A food thermometer would be helpful to check internal temperature when casseroles or large pieces of meat are reheated.

If you use a microwave, you should cover the food (with a paper towel, for instance) and make sure it is rotated so that it is heated evenly. Many microwaves today have a turntable inside, which automatically rotates the food throughout the heating process. When foods have been reheated, a 2-minute stand time (during which the food is not cut into or eaten) should be observed, as foods continue to cook once removed from the heating source. This stand-time step can also help you to know whether the food has been reheated correctly.

How can you determine whether food spoilage has occurred? There are three ways to check for this. First, smell the food to check whether it smells any different from how this kind of food normally smells. Foods that have spoiled usually do not smell the same as they normally would, but rather emit a foul odor. Knowing what that type of food naturally smells like can be helpful for detecting when food has spoiled.

Second, see if the food has changed in color. Spoiled lunch meat can take on a shiny appearance, for example, and spoiled raw beef might be somewhat gray in color instead of red or pink. Look for mold on breads and cheeses, as well as fruits and vegetables.

Third, touch the food and make sure it doesn't feel sticky or slimy; if it does, then it is likely going bad. (Make sure you thoroughly wash your hands immediately afterward.) Bacteria or molds are the culprits of most food spoilage. A good motto regarding food spoilage is this: *When in doubt, throw*

it out! If the food is questionable as to whether spoilage has occurred, the wisest course of action is to throw it away rather than risk the chance of becoming sick from a foodborne illness. It is very important to use good judgment regarding whether food is still safe to eat.

C. Clean Food Preparation Surfaces

One way to ensure that foods being prepared for consumption do not become contaminated is to start with a clean food preparation area, meaning one that is free of dirt and germs. Microorganisms that cause foodborne illness can live on hands, countertops, cutting boards, and utensils. Make sure these have all been properly cleaned before you begin your preparations for a meal. For most home environments, countertops can be cleaned with a clean rag or paper towel that has been soaked in hot, soapy water. The hot water and the detergent from the soap help to remove any germs that have landed on the counter surface. Next, the counter should be wiped dry with a clean, dry rag or a paper towel.

To further remove any germs, you could disinfect or sanitize the food surface area. Sanitizing and disinfecting a surface are similar in that they both use chemicals to fight *pathogens* (bacteria, viruses, and other microorganisms that cause diseases). **Sanitizing** means destroying or reducing bacteria on a surface by using chemicals. **Disinfecting** means destroying or reducing bacteria, viruses, and fungi on a surface by using chemicals. However, neither of these methods can kill a **bacterial spore** (a dormant form of bacteria that is highly resistant to heat, chemicals, and radiation, and is very difficult to destroy).

Presoaked wipes and all-purpose cleaners can be used for disinfectants. Disinfecting a surface appropriately depends on the chemical being used and the recommended surface contact time. Disinfecting works well for most food preparation surfaces. But sanitizing is a faster method of cleaning and decontaminating a surface.

Sanitizing can reduce the number of microorganisms to a safe level. According to the Association of Official Analytical Chemists, to actually sanitize a food contact surface, the process must reduce the contamination level by 99.999 percent in 30 seconds. The two bacteria used in the food industry to test for surface cleanliness are *S. aureus* and *E. coli.*

Bleach is a common household chemical that can be used as both a disinfectant and a sanitizer. It can kill a plethora of microorganisms, including the cold and flu viruses. Although bleach is highly effective for cleaning, it can also be dangerous; respiratory problems and birth defects have been associated with bleach use. Therefore, this chemical should be used only with caution and in a well-ventilated area. All recommendations on the bottle should be followed, including properly diluting the bleach with water. Water is the main component of all disinfectants and sanitizers for cleaning. Water serves the purpose of bringing the chemicals to the surface in order to clean and remove the germs from the surface.

Kitchen cleaning can be performed with certain foods as well. Distilled white

RECIPE FOR HOMEMADE CITRUS VINEGAR ALL- PURPOSE CLEANER

By Leigh Blankenburg

Ingredients:

1 gallon of distilled white vinegar

6 citrus fruits (oranges, grapefruits, lemons, limes, etc.)

Directions:

1. Wash and peel the citrus fruits. (The peeled fruit can be refrigerated for up to 2 or 3 days before being eaten.)

2. In a 1-gallon sealable container (plastic or glass), add the citrus fruit peels. Cover them with 1 gallon of distilled white vinegar. Seal the container.

3. Store the solution in a dark, cool place for two weeks. Remove the citrus peels.

4. For cleaning, fill half of a clean, empty spray bottle with the citrus vinegar solution. Add clean water to dilute the solution by 50 percent.

5. Prior to using the diluted citrus vinegar solution to clean any surface, test it first in an inconspicuous spot (for material such as granite, etc.).

6. To use the citrus vinegar solution for mopping, dilute the solution by 50 percent in a mop bucket with clean, hot water. Test in an inconspicuous spot for all floor types first to ensure no damage will come to the flooring.

vinegar, containing 5 to 20 percent acetic acid, is a safe alternative to bleach for disinfecting surfaces from most household germs, such as salmonella and *E. coli*. But it does not kill other germs, such as staphylococcus, which bleach does kill. (Distilled white vinegar is made from grain, such as corn.)

Hydrogen peroxide can also be an effective disinfectant. High concentrations of hydrogen peroxide can be hazardous, however, so only a solution of less than 3% concentration should be used; this is generally what can be purchased at a store.

Some people elect to use kitchen sponges for cleaning as opposed to paper towels or cloth rags. For a one-time cleaning, this is a reasonable option. Sponges are very absorptive, so quick cleaning of spills can make them handy. However, for long-term cleaning, sponges are not safe to use, because they can absorb harmful pathogens in their pores.

The safest method for using a sponge is to use it once and then discard it, as a sponge can never be completely rid of 100 percent of the germs present on the surface or inside. Sponges are also more costly than paper towels or cloth rags (which can be washed in hot water after each use, dried on high heat, and then reused).

If you decide to use a sponge more than once, then at least rinse it out with clean water after each use to remove any food debris, wring it out completely, and store it in a dry location. You can also disinfect a sponge daily by using one of three methods:

- Microwave a damp sponge on high for 1 minute.
- Allow a sponge to go through a dishwashing cycle programmed for a heat dry.
- Soak a sponge in a solution of 1/4 to 1/2 a teaspoon of bleach per quart of warm water.

If a sponge ever develops a bad or odd smell, it should be thrown away immediately. There a few other cautions to keep in mind when using sponges. First, never use a sponge to clean up anything on a countertop, because then the germs on the sponge will spread onto the countertop, increasing the chances of illness. Second, never use a sponge to clean up any spills from handling raw meat (beef, poultry, etc.), fish or other seafood, or eggs, because the

Chapter 9 Review Questions

Answer the following questions.

1. (a) What does *contaminate* mean? (b) What is a toxin? (c) What does *gastrointestinal* mean?
2. (a) What is a foodborne illness? (b) What is *Staphylococcus aureus* (*S. aureus*)?
3. (a) According to the chapter, what are two practices that can help prevent the spread of *S. aureus* toxins? (b) List and describe the five steps for washing hands recommended by the Centers for Disease Control and Prevention (CDC). (c) Which of these is the most important step?
4. (a) What does *sterile* mean? (b) What is food spoilage? (c) Describe three ways that you can check for food spoilage. (d) According to the chapter, what is a good motto regarding food spoilage?
5. (a) What is room temperature? (b) In the food industry, what is the *danger zone*? (c) To avoid food spoilage, what is the maximum amount of time that food should remain at room temperature during food preparation?
6. (a) What does *thaw* mean? (b) What is the internal temperature of food? (c) What are preservatives?
7. (a) What is the difference between sanitizing and disinfecting? (b) What is cross-contamination? (c) What is a bacterial spore?
8. (a) What is Legionnaires' disease? (b) Where is the bacteria (*Legionella*) that is responsible for this disease naturally present? (c) Why are many hot water heaters preset to 140°F (60°C)?
9. Describe the four steps you should follow when passing a knife, without setting it down, to the person *on your left*.
10. (a) Is it safe to use a sponge for long-term cleaning? Why or why not? (b) What are pesticides? (c) What are organic foods?
11. (a) What are shelf-safe foods? (b) What should you do with cans containing shelf-safe foods to help prevent illness, and how should you do this?
12. (a) What should you do if a can is bulging, leaking, or badly dented? Why? (b) What is the name of the illness that you can contract when traveling, especially while in another country, from unwashed produce or from unclean water or ice?
13. How do each of the following methods preserve food: (a) dehydration; (b) freezing; (c) pickling; (d) curing?
14. (a) What does *blanching* mean? (b) What is jerky? (c) What does *smoking* food mean?
15. (a) What is an MRE? (b) What does it stand for? (c) For whom are MREs primarily intended? (d) About how many calories are in each MRE?

Chapter 9 Review Questions (continued)

Answer the following questions.

16. (a) What are two methods used in the food industry to freeze foods? (b) Which of these was the first freezing method used in the food industry? (c) Which of these freezes foods very quickly by subjecting them to extremely low temperatures? (d) What is cryogenics?

17. (a) What is freezer burn? (b) What is sublimation? (c) What happens to the fat in meats when it is exposed to air? (d) What does *rancid* mean?

18. (a) Who discovered microbial fermentation? (b) What is zymology?

19. (a) What is canning? (b) For how long does canning sterilize the food contents inside the can? (c) What is headspace in a canning jar?

20. (a) What are the two main canning methods? (b) Which of these methods should be used to kill microorganisms such as *Clostridium botulinum* in low-acid foods? (c) Which of these methods should be used only for high-acid foods.

21. (a) What is homogenization? (b) What does immiscible mean? (c) What is the combined mixture resulting from homogenization called? (d) What is pasteurization?

22. (a) How is milk pasteurized? (b) Why is milk pasteurized? (c) What is ultrapasteurization? (d) Name five precautions that those drinking raw milk should make sure are taken by the persons from whom they obtain this milk.

23. (a) What are the two ways of dating foods? (b) Which of these is used on canned and boxed foods? (c) Which of these is generally used on poultry and other meat, eggs, and dairy products?

24. (a) What is irradiation? (b) What is the international symbol of irradiation called? (c) On which foods does the FDA require that this symbol be present?

25. (a) Why are plastics numbered from 1 to 7? (b) Which three categories of plastics are considered the safest for food? (c) Which two categories are considered the least safe for foods? (d) Which category may be safe for one-time use, but should probably not be used for reuse or long-term storage, and should not be exposed to heat?