Your Turn 10.13 Dangers from Chemical Leaching?

Modernist Cuisine at Home, one of the defining volumes for *sous vide* cooking, claims that bags made expressly for cooking are safe.

a. What type(s) of polymers are used in such specialized *sous vide* bags?
b. Using the Internet as a resource, are these specialized cooking bags immune to the leaching of unwanted chemicals into our food? Consider what happens to the polymer(s) at the temperatures commonly used for *sous vide* cooking.
c. Would the threat of chemical leaching into food be greater if other inexpensive bags (e.g., Ziploc) were used instead of the specialized *sous vide* variety? Explain.

Some common types of polymers and their properties were described in Chapter 9.

Section Spirals

10.7 | Microwave Cooking: Fast and Easy

As our work schedules get busier and workdays get longer, many of us do not always have sufficient time to prepare a complex meal from scratch. In our increasingly busy society, microwave cooking has risen to become the most popular form of cooking because of its speed and simplicity. However, food quality is not nearly as desirable as that cooked over a stove or in an oven, where one has more control over the chemical reactions and resulting development of flavors.

"What do you mean, you're not hungry? - Your mother spent two minutes cooking that in the microwave just for you!"

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Your Turn 10.14 The Electromagnetic Spectrum Revisited

In Chapter 3, we discussed the various regions of the electromagnetic (EM) spectrum.

a. Describe the relative energies and wavelengths of the UV, IR, and microwave regions, and diagram how each of these energies would affect a water molecule (i.e., bond breaking, bond stretching/vibration, or molecular rotation).
b. A company claims to have a new type of cooking apparatus using radio waves to cook food. Its claim is that the food is cooked more uniformly and that food quality is better than using microwaves. Do you believe its claims? Explain your answer.

Due to its lower energy and longer wavelength than UV, visible, or IR radiation, microwave radiation is not sufficient to cause rupturing of individual chemical bonds. Instead, the microwave radiation is absorbed by the water, fat, and sugar molecules in food, which causes these molecules to rotate (Figure 10.9). Because the molecules rotate some 2.5 million times per second, they can easily bump into and rub against

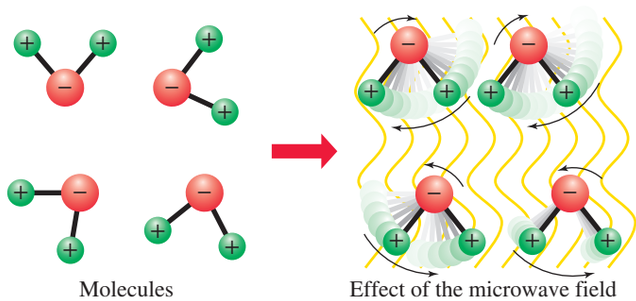

Figure 10.9
Illustration of the rotation of polar molecules in response to an applied external microwave field. Check out the animation at www.acs.org/cic for an animated simulation of microwave radiation.

DID YOU KNOW ?

If you look closely at the front window of your microwave oven, you will notice a metal mesh. This is designed to be transparent to visible light, but opaque to microwave radiation. That is, the holes in this mesh are smaller than the wavelengths of the microwaves, but large enough so that visible light may still pass through.

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Are microwave ovens dangerous? Check out this video: www.acs.org/cic.

one another, resulting in the production of heat due to frictional forces. Microwaves penetrate the food item to a depth of approximately 1–1.5 inches. Accordingly, in thicker pieces of food, the microwaves don't effectively reach the center. Unlike a conventional oven in which food is heated by hot air, food cooked in a microwave oven normally does not become brown and crispy because the air inside the oven is at room temperature.

Your Turn 10.15 Microwave Cooking Versus Conventional Ovens

Sketch and compare the differences in heat transfer occurring as food is cooked in a microwave oven versus a conventional oven. Some claim that microwave ovens cook food from the inside out. Is this accurate?

Metals do not absorb microwave radiation and, instead, reflect these wavelengths. Therefore, a metal such as aluminum is used on the sides of the oven to prevent the microwaves from escaping and irradiating objects outside the oven, such as yourself!

So, if metal is used inside the microwave oven, why is it so dangerous to place a metal object inside the oven? As you discovered in Chapter 1, metals are great conductors of electricity. Hence, when microwaves irradiate a metal, electrons on its surface move rapidly to the side, which prevents the microwaves from being absorbed by the food item. The radiation is reflected, which forms an arc (visible sparks) between the metal object and the metal walls of the oven. This can cause failure of the microwave source, known as a *magnetron*, and can often damage the walls of the oven.

Contrary to popular belief, it can actually be safe to place small amounts of a metal, such as aluminum foil, into a microwave oven. However, it should never be used to completely cover a food item, because the microwaves would not be absorbed and would result in the dangerous reflection/arcing situation described above. Small pieces of *nonwrinkled* aluminum foil may be used to cover certain areas of foods, such as poultry drumsticks, to prevent overcooking.

DID YOU KNOW ?

New, smooth aluminum foil should only be used; wrinkled foil can cause increased reflection of microwaves. Additionally, the foil should be placed no closer than one inch from the oven walls. If the oven has metal shelves or a metal turntable, foods should not be placed within foil containers or metal pans, and the foil used for food shielding should not touch the metal shelves/turntable.

Your Turn 10.16 Sustainability of Cooking Methods

Calculate how much electricity is consumed, and the amount of associated greenhouse gas (GHG) is produced, to boil water using a microwave versus using a standard electrical cooktop stove. Compare these values for the GHG emissions that would result from boiling water using a gas stove. Considering the average time spent per year on cooking, would there be a significant difference in the overall sustainability of each of these cooking methods?

10.8 Cooking with Chemistry: No-Heat Food Preparation

Just like us, the harmful microbes that may be present in food need water to survive. Accordingly, we can preserve food items by simply removing water. Drying and curing have long been a part of our human practices for helping to sustain our food supplies—especially during harsh environmental conditions when food items could not grow or