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## 12. How Do Teeth Whiteners Whiten Teeth?

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### Explanation

Your teeth have more than one layer. There is an external layer, called the enamel, which is very hard. The enamel is the grinding and cutting surface that breaks up food as we chew it. Enamel is made mostly from the mineral hydroxyapatite ( $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$ ). The next layer in the teeth is the dentin, which is somewhat softer than enamel. It acts as a barrier between the hard enamel and the pulp, where we find the nerves and blood vessels of the tooth.

As you eat, you build up a layer over the top of the tooth enamel that consists of food particles, acids, sugars, bacteria and other staining materials. You can brush your teeth to remove some of this layer. Toothpastes usually have an abrasive in them to help scrape it away. A dentist's cleaning tools can get even more of the buildup. Even with those tools, however, it is hard to remove all of the staining substances every time you eat or drink. To make matters worse, the enamel of your teeth is slightly porous. This means that staining materials can soak into the teeth below where a toothbrush or a dentist's tool can reach.

Whiteners that use chemicals all use essentially the same process to remove the stains. Chemicals such as hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) and carbamide peroxide ( $\text{CH}_6\text{N}_2\text{O}_3$ ) attack the surface of the teeth. They sink into the pores of the enamel where they act as oxidisers when they come into contact with the stains. Chemically speaking, this means that when the bleaching agents hit the stains, they break up the molecules into smaller pieces that are no longer capable of discolouring the teeth.

You can have the whitening done in a dentist's office, or get materials from the dentist to do the bleaching at home. You can also buy bleaching kits over the counter and use them at home. Most forms of teeth whitening are not permanent because the buildup of stains will resume after the treatment is over. Constant bleaching is not recommended as it will damage teeth over time.

**STUDENT PAGE****12. How Do Teeth Whiteners Whiten Teeth?**

Answer the following.

1. Describe the outer layer of the tooth, the enamel.
2. Describe the purpose of the dentin.
3. What structures are found in the pulp of the tooth?
4. What are some of the things that cause stains in teeth?
5. What materials in toothpastes help prevent the buildup of staining materials on your teeth?
6. Why can staining materials get into the enamel of the teeth?
7. What are some chemicals used to whiten teeth? What kind of chemicals are they?
8. What do bleaching agents do to the molecules that make up the stains in your teeth?

## 18. Why Is There an Expiration Date on Bottled Water?

### Topics

permeability, safety

### Goal

to explain the potential chemical processes, if any, that would require a freshness date on bottled water.

### Context

Students understand that polluted or contaminated water is unsafe to drink, but usually do not understand how water that is sealed in an airtight bottle can go bad. The contamination in this case is strictly chemical in nature, assuming the bottles do not have their seals broken, and does not necessarily have a biological component as for other kinds of food.

### Teaching Notes

- Have students speculate about all the ways that food or drinks can become unfit to be consumed by people. Get them to see that some methods are biological (for instance, spoiling), while others are chemical in nature (for instance, contamination).
- Explain how a permeable membrane might allow some materials to pass through it while restricting the passage of other substances.
- Clarify that some materials react when exposed to light. As a consequence, we see things such as the yellowing of newspaper left in a location where sunlight shines on it and the breaking down of some plastics when exposed to light.

### Extension Activity

Have students look at food containers at home and find out what food products have the expiration dates that are furthest in the future. Compare the packaging of food that will pass the date soon with the packaging of the food that will not pass its freshness date for quite some time.

### Answer Key

1. Expiration dates provide guidelines for when it is safe to consume a product and guarantee the safety and quality of the food.
2. The bottling of water in Australia is carefully regulated, and the water is treated for safety.
3. Bottled water can last indefinitely if stored somewhere cool, dark and away from chemicals that produce fumes.
4. Exposure to high temperatures can compromise the quality of the plastic in the bottles that contain the water.
5. Many plastic bottles are gas permeable and the flavour of the water may be compromised, or the water may pick up toxic chemicals when chemicals in the fumes get into the water.
6. Australian bottled water has an expiry date.
7. Most companies that bottle water have settled on two years as the longest time they are willing to guarantee the quality and flavour of the water they sell.