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The Chemistry of Hand Sanitizer and Soap Active Learning Activity

Before Completing the Activity:

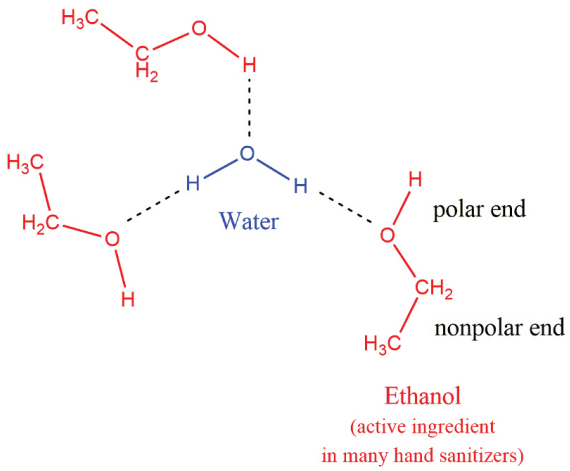
Before your students begin this active learning activity, have them watch the following two videos:

1. bit.ly/sanitizer4hands
2. bit.ly/soapvscoronavirus

Activity:

The behavior of soaps and hand sanitizers is an application of the principle "like dissolves like." Polar molecules such as alcohols contain certain functional groups (-OH in the case of alcohol) that are attracted to water, forming strong intermolecular interactions. In contrast, nonpolar molecules such as oils and biomolecules (e.g., fats, proteins) are composed of hydrocarbon groups ($-C_xH_y-$), which are not attracted to water.

The active ingredients of soaps and hand sanitizers feature the best of both worlds, with both polar and nonpolar regions in their molecular structures. As a result, part of the molecule is attracted to organic molecules such as proteins and fats, whereas the other part is attracted to water:



So, what happens when soaps and sanitizers interact with a virus? Since viruses are coated with a variety of fats and proteins, the nonpolar regions of soaps and sanitizers are attracted to this coating, effectively pulling apart the virus structure. To model this behavior, perform the following activity:

1. Add tap water to two empty paper plates and sprinkle black pepper flakes onto the water surfaces. The black pepper represents virus particles, which are coated with nonpolar fats and proteins and are therefore not soluble in water.
2. Add a drop of soap to the first plate. Describe what happens, based on the "like dissolves like" principle.
3. Add a drop of hand sanitizer to the second plate. Describe how this differs from adding soap.

For a video walkthrough of this activity, watch this video on YouTube: **bit.ly/soapvssanitizer**

Discussion Questions:

1. It is widely reported that washing your hands with soap is more effective against bacteria and viruses than using hand sanitizer alone. Is this premise plausible based on what you observed in the activity?
2. Use the Internet to find out more about the structures of soaps and detergents. Explain why hand sanitizers would not be as effective as detergents to clean your clothes in washing machines.

Activity courtesy of Brad Fahlman (Central Michigan University) and the American Chemical Society (ACS).