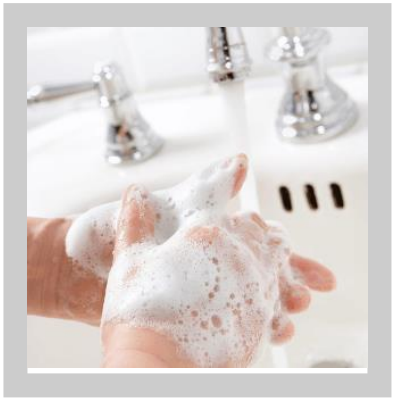
Name _____

Date _____

Wash Up!



Whether it's a sign in the restroom at work or the nagging voice of parents, most of us are reminded several times each day to wash our hands. Though the benefits of hand-washing are obvious—the most important being protection from disease-causing bacteria and viruses—very few people understand the scientific principles that underlie the way hand-washing works. The chemistry can, indeed, be quite complex, but the principles behind this mundane task start with a premise that almost everyone understands: oil and water don't mix.

Most chemical compounds fall into one of two categories: Hydrophilic and hydrophobic. Hydrophilic, or water-loving, compounds can dissolve in water, while hydrophobic, or Water-fearing, compounds such as oils do not dissolve in water. Hydrophilic and hydrophobic substances cannot dissolve into one another, hence the saying, "oil and water don't mix." Human skin and hair secrete oils that trap dirt, bacteria, and other undesirable substances close to the body, where it can be accidentally inhaled or swallowed. Washing your skin and hair with ordinary water will not dissolve these oils, so whatever is trapped in them remains stuck in place.

Soap is special in that it is, strictly speaking, neither hydrophilic nor hydrophobic. Instead, it is an emulsifier; it can help hydrophilic and hydrophobic substances dissolve into one another. How does soap accomplish this task? The answer lies in soap's unique molecular structure. The soap molecule contains two parts: a carboxylate group and a long hydrocarbon chain. The carboxylate group is hydrophilic, or water-loving, and can interact with water through hydrogen bonding. The hydrocarbon chain, however, is hydrophobic, and can break up oil molecules, causing them to dissolve. So, when you wash your hands, the soap's hydrocarbon chains dissolve the oils that exist naturally on your skin and hair, freeing the dirt and germs that the oils have trapped. Then, the soap's hydrophilic carboxylate group allows the whole mess—water, the oils on your skin, and the germs the oils have trapped there—to wash safely down the drain.

This is the process by which traditional soap works, but anti-bacterial soap operates in a different way. Bacteria are living organisms, and anti-bacterial soaps contain a chemical additive—usually Triclosan—that disrupts the biological operations of bacteria they come into contact with, causing the bacteria to die. Health experts disagree, however, about the benefits of anti-bacterial soap. First of all, not all bacteria are virulent, and anti-bacterial soaps kill both good and bad bacteria. Humans need contact with certain good bacteria to survive and remain healthy. In addition, many diseases are caused not by bacteria, but by viruses that are not killed by anti-bacterial soaps. Finally, most anti-bacterial chemicals like Triclosan need up to two minutes of direct contact with bacteria in order to kill it. Most people do not leave the solution on their hands this long, in which case it will not have the desired effect.

While it is not necessary to know exactly how soaps work to appreciate their benefits, it can be fascinating to consider the complex chemical reactions that are taking place each time you wash your hands.

1) Paragraph 1 can best be described as a(n)

A. map introduction, in which the author puts forth a claim, and then summarizes the major points behind that argument

B. background introduction, in which the author gives important information the reader needs to know about the topic

C. question introduction, in which the author poses a question that he or she will answer in the main part of the passage

D. personal introduction, in which the author explains how he or she relates to the topic

E. anecdotal introduction, in which the author relates the topic to everyday life in order to get the audience interested

2) At the end of paragraph 1, the author writes, “oil and water don’t mix.” Which of the following sentences from the passage best outlines the scientific explanation behind this expression?

A. “Instead, it [soap] is an emulsifier; it can help hydrophilic and hydrophobic substances dissolve into one another.”

B. “Hydrophilic, or water-loving, compounds can dissolve in water, while hydrophobic, or water-fearing, compounds such as oils do not dissolve in water.”

C. “Bacteria are living organisms, and anti-bacterial soaps contain a chemical additive—usually Triclosan—that disrupts the biological operations of bacteria they come into contact with, causing the bacteria to die.”

D. “Human skin and hair secrete oils that trap dirt, bacteria, and other undesirable substances close to the body, where it can be accidentally inhaled or swallowed.”

E. “The soap molecule contains two parts: a carboxylate group and a long hydrocarbon chain.”

3) Which of the following statements does NOT describe one of soap’s unique chemical properties?

A. It is an emulsifier.

B. Its molecules contain a hydrocarbon chain.

C. It disrupts the biological operations of bacteria.

D. Its molecules contain a carboxylate group.

E. It is neither hydrophilic nor hydrophobic.

4) As used in paragraph 4, which is the best synonym for **virulent**?

A. water-loving

B. water-hating

C. disgusting

D. alive

E. harmful

5) Which of the following subtitles would be most appropriate for this passage?

A. Soap Through the Ages: A Brief History of Clean
B. The Many Forms and Uses of Soap
C. The Science Behind Soap's Cleaning Power
D. The Fall of Anti-bacterial Soap
E. Why Oil and Water Don't Mix

6) The author likely writes about anti-bacterial soaps in paragraph 4 to

A. explain that some types of soap work differently
B. prove to the reader that he or she knows about many different types of soaps
C. warn readers about the dangers of inferior soaps
D. inform readers about the new and improved, "next generation" of soaps
E. establish that viruses are more dangerous than bacteria

7) Explain in your own words how soap works. Why is soap necessary when washing one's hands? Why is water alone ineffective?

Answers and Explanations

1) E
Core Standard: Key Ideas and Details

In the first paragraph the author writes, “Whether it’s a sign in the restroom at work or the nagging voice of parents, most of us are reminded several times each day to wash our hands.” The author uses a familiar image that most of us can recognize: signs in public restrooms and our parents’ voices. Using this information, we can see that the author is trying to relate the topic to our everyday life to get us interested. Therefore **(E)** is correct.

There is no claim put forward in the first paragraph, rather the author introduces a topic that will be explained throughout the paragraphs to follow. The last sentence of the introduction—often called the thesis statement—can sometimes provide clues about the focus and nature of the passage. In this case, the author writes, “The chemistry can, indeed, be quite complex, but the principles behind this mundane task start with a premise that almost everyone understands: oil and water don’t mix.” Using this information, we can see that the principles behind how soap works, summed up here by the premise that “oil and water don’t mix,” will be explained in more detail in the following paragraphs. This introduction cannot be considered a “map introduction” because there is no argument being made; instead, the science behind the topic is explained in an informative essay style. Therefore **(A)** is incorrect.

The author gives very little background information about soap in the first paragraph, only mentioning that it protects us from disease-causing bacteria and viruses. The anecdote in the first sentence is much more prominent. Therefore **(B)** is incorrect.

The author poses no questions in the first paragraph. Using this information, we can see that this could not be a “question introduction.” Therefore **(C)** is incorrect.

The author does not include any personal information in the first paragraph. Using this information, we can see that this could not be a “personal introduction.” Therefore **(D)** is incorrect.

2) B
Core Standard: Key Ideas and Details

In paragraph 2, the author explains that most chemicals fall into one of two categories, hydrophilic and hydrophobic, writing that, “Hydrophilic, or water-loving, compounds can dissolve in water, while hydrophobic, or water-fearing, compounds such as oils do not dissolve in water.” This sentence describes a dichotomy—a division into two parts—that exists between compounds. In the first part of the sentence, the author notes compounds that love water, and in the second part of the sentence the author describes oils, which fall into the category called hydrophobic—meaning they do not dissolve in water. Using this information, we can see that choice **(B)** best outlines the scientific explanation behind the expression “oil and water don’t mix.” Therefore it is correct.

In paragraph 3, the author writes “Instead, it [soap] is an emulsifier; it can help hydrophilic and hydrophobic substances dissolve into one another” to describe how soap helps oil and water mix.

Using this information, we can see that this is not a good restatement of the premise that “oil and water don’t mix.” Therefore **(A)** is incorrect.

In paragraph 4, the author writes, “Bacteria are living organisms, and anti-bacterial soaps contain a chemical additive—usually Triclosan—that disrupts the biological operations of bacteria they come into contact with it, causing the bacteria to die.” This sentence does not speak to the premise that “oil and water don’t mix,” rather it describes how anti-bacterial soaps work. Since “anti-bacterial soap operates in a different way,” and the premise applies to regular soap, we know that **(C)** is an incorrect choice.

In paragraph 2, the author writes, “Human skin and hair secrete oils that trap dirt, bacteria, and other undesirable substances close to the body, where it can be accidentally inhaled or swallowed.” We can see that oil is discussed in this sentence, but the place or function of water in relation to it is missing. Using this information, we can see that this choice is not a good restatement of the premise that “oil and water don’t mix,” since water is not even mentioned. Therefore **(D)** is incorrect.

In paragraph 3, that author writes “The soap molecule contains two parts: a carboxylate group and a long hydrocarbon chain.” This sentence, in and of itself, does not give any indication of what the “carboxylate group” or a “long hydrocarbon chain” actually is. Using this information, we can see that we need more information to determine whether or not this choice is a good restatement of the premise that “oil and water don’t mix.” Therefore **(E)** is incorrect.

3) C
Core Standard: Key Ideas and Details

In paragraph 4, the author explains how anti-bacterial soaps work: “Bacteria are living organisms, and anti-bacterial soaps contain a chemical additive—usually Triclosan—that disrupts the biological operations of bacteria they come into contact with, causing the bacteria to die.” Using this information, we can see that it is not the soap itself, but the additive Triclosan in anti-bacterial soap, which kills bacteria. Thus, **(C)** is correct because it contains a statement that does not describe one of soap's unique chemical properties.

In paragraph 3, the author writes, “Soap is special in that…it is an emulsifier.” Using this information, we can see that being an emulsifier is one of soap’s unique chemical properties. Because it contains information present in the passage, **(A)** is incorrect.

In paragraph 3, the author writes, “The soap molecule contains two parts: a carboxylate group and a long hydrocarbon chain.” Using this information, we can see that one of soap’s unique chemical properties is that it contains a hydrocarbon chain. Because it contains information present in the passage, **(B)** is incorrect.

In paragraph 3, the author writes, “The soap molecule contains…a carboxylate group.” Using this information, we can see that one of soap’s unique chemical properties is that it contains a carboxylate group. Because it contains information present in the passage, **(D)** is incorrect.

In paragraph 3, the author writes, “Soap is special in that it is, strictly speaking, neither hydrophilic nor hydrophobic.” Using this information, we can see that one of soap’s unique chemical properties is that it is neither hydrophilic nor is it hydrophobic. Because it contains information present in the passage, **(E)** is incorrect.

4) E
Core Standard: Craft and Structure

Virulent (*adjective*): dangerous; harmful.

In paragraph 4, the author states, "…not all bacteria are virulent, and anti-bacterial soaps kill both good and bad bacteria." The second part of the sentence draws a distinction between good and bad bacteria, and we can assume (since it is in the same sentence), that the word virulent is somehow related to this distinction. In the next sentence, the author writes that, "Humans need contact with certain good bacteria to survive and remain healthy." This makes it clear that the author is distinguishing between regular soaps and anti-bacterial soaps, which kill both helpful and harmful bacteria. The statement, "not all bacteria are virulent," then, might be restated as "not all bacterial are harmful." Using this information, we can see that harmful is an appropriate synonym for virulent. Therefore **(E)** is correct.

In paragraph 2, the author mentions, "Hydrophilic, or water-loving, compounds [that] can dissolve in water." These compounds do not relate to the bacteria killed by the anti-bacterial soaps, however, so we can see that *water-loving* is not a good synonym for virulent. Therefore **(A)** is incorrect.

In paragraph 2, the author mentions, "hydrophobic, or water-fearing, compounds such as oils." These compounds do not relate to the bacteria killed by the anti-bacterial soaps, however, so we can see that water-fearing (or *water-hating*) is not an appropriate synonym for virulent. Therefore **(B)** is incorrect.

Disgusting is an adjective meaning gross or offensive. Using the above information, we can see that we are looking for a word that most nearly describes bad bacteria, which is killed along with the good bacteria when we use anti-bacterial soaps. Since disgusting relates to a matter of taste, and is subjective in nature, it does not adequately describe bad or harmful bacteria. Therefore **(C)** is incorrect.

Using the above information, we know that bacteria must be *alive* to be considered either good or bad. Thus, it would not make sense to substitute the word alive for virulent, because the sentence would read "…not all bacteria are alive, and anti-bacterial soaps kill both good and bad bacteria." Since this sentence doesn't make sense, we know that **(D)** is incorrect.

5) C
Core Standard: Integration of Knowledge

In paragraph 1, the author mentions that most people do not understand, "the scientific principles that underlie the way hand-washing works." Next, the author adds, "The chemistry can, indeed, be quite complex, but the principles behind this mundane task start with a premise." Words like "scientific," "chemistry," and "principles behind," help us infer that the science behind soap's cleaning power will be the focus of this passage. The author describes the chemistry and principles behind soap's cleaning power in the paragraphs to follow, using terms like, "Hydrophilic and hydrophobic substances," "chemical compounds," and "carboxylate group," which are also scientific in nature.

Using this information, we can see that the author writes about the chemical processes that make soap an effective cleaning product. We also know that chemistry is a particular branch of science, so we can infer that *The Science Behind Soap's Cleaning Power* is the most appropriate title for this informative passage. Therefore **(C)** is correct.

The passage does not provide any information about the history of soap or cleanliness, so *Soap Through the Ages: A Brief History of Clean* would not be an appropriate title for this scientific, informative passage. Therefore **(A)** is incorrect.

While the passage describes two different types of soaps—regular soap and anti-bacterial soap—it does not provide any information about various forms of soap. Soap type is different from soap form; the word type refers to the compounds in the soap, while form would relate to its being either solid or liquid. Also, the author does not mention any other uses for soap, outside of cleaning, in this passage. Using this information, we can determine that *The Many Forms and Uses of Soap* would not be an appropriate title. Therefore **(B)** is incorrect.

In paragraph 4, the author focuses on how "anti-bacterial soap operates in a different way" from regular soap. Although the author, in this paragraph, explains how anti-bacterial soap kills "good bacteria" and takes a while to kill germs, there is no information to indicate that this soap type will experience a "fall," or a slow decline in usage. Also, anti-bacterial soaps are the focus of only one of the paragraphs, whereas the science behind how soap cleans is explored throughout the passage. Therefore **(D)** is incorrect.

We should be able to read a title and have a general sense about the focus of the passage to follow. *Why Oil and Water Don't Mix* is an inappropriate title for this passage because it does not effectively describe what the passage is about; in fact, it doesn't mention soap or cleaning at all. Even though, in paragraph 1, the author mentions the premise, "oil and water don't mix," this underlying premise becomes the author's basis for a scientific explanation of how soaps clean. This makes choice **(E)** too specific of a title, therefore it is incorrect.

6) A
Core Standard: Integration of Knowledge

This passage is an informative essay, which means that its purpose is to give us more information about a topic. Because anti-bacterial soaps are a commonly used type of soap, it makes sense that the author would inform us about how this particular type of soap works differently from other soaps. At the beginning of paragraph 4, the author writes, "…anti-bacterial soap operates in a different way." Using this information, we can infer that the author likely writes about anti-bacterial soaps in paragraph 4 to explain that some types of soap work differently. Therefore **(A)** is correct.

The genre of this passage is an informative essay, which means that its purpose is to give us more information about a topic. The author's goal here is not to prove anything, because the essay is not argumentative. The author simply describes how anti-bacterial soaps work differently from a scientific standpoint. The passage does not provide any information that would lead us to infer that the author is trying to prove that he or she knows a lot about soap, so **(B)** is incorrect.

The genre of this passage is an informative essay, which means that its purpose is to give us more information about a topic. The author's goal here is not to warn us about anything, because the essay is not argumentative. Since the author is not trying to warn us about the dangers of inferior soaps, **(C)** is incorrect.

The passage does not provide information to indicate that any of the soaps described are in a category called "next generation" soaps. In fact, as the anecdote in paragraph 1 describes, soaps are something we've all been accustomed to seeing and hearing about. Therefore **(D)** is incorrect.

The passage does not provide any information to indicate that viruses are more dangerous than bacteria. Instead, the author merely notes that "viruses…are not killed by anti-bacterial soaps." Therefore **(E)** is incorrect.