

Name: \_\_\_\_\_

Class: \_\_\_\_\_

# Olympic ski racers use chemistry to enhance their performance

*Waxes allow athletes to control how their skis glide under some conditions and grip in others*

By Eric Niiler  
2018

*It takes a lot of be an Olympic skier, but what about the right wax? In this informational text, Eric Niiler discusses why skiers use wax on their skis. As you read, take notes on the effect ski wax has on skis.*

- [1] When the world's top skiers face off this week at the Winter Olympics, they will be relying on years of training, mental preparation — and a good deal of chemistry. The chemistry of ski wax. The fastest skiers usually have the fastest skis. And speedy skis need their bottoms waxed with the right stuff.

All ski wax is not the same. The recipe an athlete uses must be tailored to match the feats they'll attempt and the snow they'll encounter. A wetter snow, for instance, will require a different wax than dry fluff. And downhill racers get a different recipe than cross-country skiers.



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Chemicals in the wax help skis glide downhill. The wax does this by repelling water that forms as a ski slides across the snow. Cross-country skiers, in contrast, must go both uphill and downhill. Their ski wax, therefore, must help the athlete also grip the snow while climbing short hills during a race.

One type of wax makes skis slippery. Another makes it grip. A racer who uses the wrong formula risks lagging<sup>1</sup> behind. This also can happen if the snow's properties change during a race. Maybe it gets colder. Or starts snowing. It may even rain. Such weather changes can alter the surface of the snow in ways that can make it harder on racers.

- [5] That's what happened to Kikkan Randall. She is a cross-country ski racer from Anchorage, Alaska. Beginning February 10, she'll be competing in PyeongChang, South Korea, as part of the 2018 U.S. Winter Olympics team.

Randall remembers her skis picking up new-fallen snow in Finland earlier this season. They were like chunks of mud during a race.

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1. **Lag (verb)** to fall behind

"I had 3 inches [8 centimeters] of snow on the bottom of my skis and had to scrape it off and keep going," she notes. "It was clear that I had the ability to have a better race. But my skis were making it impossible. I would have been better off with no wax."

Randall attributes<sup>2</sup> some wins that brought her to the Olympics to the waxes she used. It allowed her to glide faster than other racers on the downhill part of the course. The recipe she and others use is critical. Racers get only one chance to wax their skis before a race begins.

Long before a race, various waxes will be tested. Then, technicians and racers pick a mix that they think will best match the snow on race day. They rub and melt layers of the chemicals onto the bottom of each ski. Then they scrape and polish each layer to make it super-smooth. Sometimes they add a sticky wax called "klister" — or kick wax — to the part of the ski below the boot. This helps racers grip if and when they need to climb.

## Choices, choices

- [10] Like gasoline and natural gas, wax contains one or more hydrocarbons. As their name suggests, these molecules are made from a chain of hydrogen and carbon atoms. The first layer of wax applied to the bottom of a ski is similar to the paraffin wax<sup>3</sup> used in candles. It forms a bond with the bottom of the ski to keep out dirt and water.

The next layer contains fluorocarbons. These are molecules made from a mix of fluorine, hydrogen and carbon. These wax ingredients are designed for speed. They cut friction<sup>4</sup> between the ski and the surface of the snow. (These chemicals are related to additives that manufacturers sometimes use to make rain gear repel<sup>5</sup> water.)

Fluorocarbon waxes are softer than some other types. They may be used as fluids or as powders. For a two-minute downhill race, skiers want the slipperiest surface possible. They will need a different formula for a two-hour-long, cross-country event. Indeed, cross-country racers may apply six or more layers of wax to give a competitor control in moving up and down across a course.

Some fluorocarbon ski waxes also have extra hydrocarbons, such as acetone (ASS-eh-toan), benzene or toluene (TAAL-yu-een). These chemicals can be harmful if a person touches or inhales them a lot or over long periods. Yet they must be used repeatedly. After all, most of these chemicals will rub off a ski by the end of a race.

## The chemistry of wax

Jeffrey Bates studies how ski waxes work. He is a materials scientist<sup>6</sup> at University of Utah in Salt Lake City. He has invented a ski wax that can stick onto skis for the whole winter, not just for one race.

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2. credits
  3. a type of soft, colorless wax
  4. the resistance one surface experiences when it moves over another surface
  5. to resist mixing with or allowing fluid to soak through
  6. a scientist who studies the chemicals in natural and manmade materials

- [15] To do this, Bates pored over the bottom of plastic skis using a scanning electron microscope. It can display the surface of materials to a resolution of 1 nanometer (a billionth of a meter). For comparison, a human hair is 75,000 nanometers wide.

Under high magnification, the molecules on the bottom of the ski “looked like balls of spaghetti,” Bates says. Those spaghetti-like strands are *polymers*.<sup>7</sup> Bates’ new liquid wax fills in the tiny nooks and crannies between the polymer strands. When exposed to sunlight, this coating chemically bonds to the ski. And that attachment is so strong it can last for months.

“We are not making this for racers,” Bates says. “We are making this for the regular person who goes to the slopes several times a year and doesn’t want to be bothered with waxing.” Why wouldn’t Olympians want it too? Its formula is set. It can’t be tweaked based on the particular conditions a competitor may need when going for the gold.

At the Olympics in South Korea, many teams will tweak their waxes’ chemistry in their bid to win a medal in ski racing. Each team will mix up its own secret recipe of waxes before the race starts.

“You try to do everything behind closed doors,” explains Andrew Morehouse. He’s a wax technician for the U.S. Olympic Nordic Ski Team. “I don’t know if there are spies, but it’s a natural thing to want to know what the other teams are waxing. Everyone keeps to themselves.”

- [20] For Randall and the other skiers, they hope that good chemistry will speed their path to the finish line.

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7. a chain-like molecule made up of small similar molecules

## Text-Dependent Questions

**Directions:** For the following questions, choose the best answer or respond in complete sentences.

1. PART A: What is the central idea of the text?
  - A. Ski wax has a greater effect on a skier's performance than practice does.
  - B. Ski wax can help skiers move more quickly through the snow or stick to it.
  - C. Ski wax has caused many arguments as some people think using it is unfair.
  - D. Ski wax is made of dangerous chemicals that should only be applied by professionals.
  
2. PART B: Which quote from the text best supports the answer to Part A?
  - A. "they will be relying on years of training, mental preparation — and a good deal of chemistry." (Paragraph 1)
  - B. "One type of wax makes skis slippery. Another makes it grip. A racer who uses the wrong formula risks lagging behind." (Paragraph 4)
  - C. "These chemicals can be harmful if a person touches or inhales them a lot or over long periods." (Paragraph 13)
  - D. "'I don't know if there are spies, but it's a natural thing to want to know what the other teams are waxing.'" (Paragraph 19)
  
3. How does the author introduce the subject of ski wax?
  - A. He describes his personal experiences using ski wax.
  - B. He acknowledges the risks of using ski wax during a race.
  - C. He stresses the important role that ski wax plays in races.
  - D. He discusses how difficult it is to develop the right ski wax formula.
  
4. How does the discussion of Randall in paragraphs 6-8 contribute to the development of ideas in the text?
  - A. It shows how dangerous it is to use ski wax.
  - B. It proves that skiers need ski wax to win races.
  - C. It encourages readers to apply wax to their skis.
  - D. It shows how ski wax can affect a skier's performance.
  
5. What is the meaning of "pored" in paragraph 15?
  - A. cleaned
  - B. copied
  - C. discovered
  - D. studied

6. Which statement describes the chemistry of ski wax, as discussed in the text?
- A. The chemical makeup of ski wax affects how the wax reacts to the skis and the elements.
  - B. Ski wax is made of dangerous chemicals that make it unwise for skiers to use the substance.
  - C. Ski wax requires a perfect balance of chemicals that only a professional chemist can achieve.
  - D. The chemical makeup of ski wax only affects the ski and not the snow it comes in contact with
7. Which statement best describes the author's overall purpose in the text?
- A. to recommend specific ski wax formulas to readers that might ski
  - B. to question whether or not it is fair for skiers to use ski wax during races
  - C. to compare the benefits and disadvantages of using ski wax during a race
  - D. to discuss the different ski wax formulas and how they affect skiers' performance
8. What is the connection between the first and second layer of wax on skis? (Paragraphs 10-13)

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## Word Study

### Open and Closed Syllables V/CV and VC/V

An open syllable (V/CV) ends in a vowel and has a long vowel sound. Examples include the first syllable of the words *even* (e/ven), *vital* (vi/tal) and *donut* (do/nut).

A closed syllable (VC/V) ends in a consonant and has a short sound. Examples include the first syllable of the words *living* (liv/ing), *honest* (hon/est), and *element* (el/e/ment).

**My TURN** Tell whether the first syllable in each word is open or closed. Then use what you know about syllables to decode, or read, each word.

1. remaining \_\_\_\_\_

2. before \_\_\_\_\_

3. malice \_\_\_\_\_

4. musical \_\_\_\_\_

**My TURN** Read the following paragraph:

My mom is vital to our community because she makes her living as a police officer. It is in her nature to help other people, and she gets to do that with her job. Before she leaves for work, she makes sure that my brother and I get off to school. When she's working, she spends a lot of time driving a squad car. Toward the end of the work day, her remaining time is spent filling out important paper work. You can believe me when I say that police officers don't have time to stop and eat donuts!

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# Spelling

## Spell Words with Open and Closed Syllables

An **open syllable (V/CV)** ends in a vowel. It has a long vowel sound—as in the first syllable of the word *even*. A **closed syllable (VC/V)** ends in a consonant. The vowel in a closed syllable has a short sound—as in the first syllable of the word *living*.

### SPELLING WORDS

recent

topical

honest

lavish

vital

rotate

musical

element

minimum

donut

energetic

solar

vacation

register

slogan

malice

recommend

apex

enemy

agent

**My TURN** Spell three words with open syllables and three words with closed syllables from the word list. Then add a slash between each syllable of each word. Use what you learned about syllable patterns to check your spelling.

1. Open Syllables V/CV: \_\_\_\_\_

2. Closed Syllables VC/V: \_\_\_\_\_

**My TURN** For each word, choose the answer option that shows the correct syllable breaks and type of syllable break (V/CV or VC/V).

### 1. topical

a. to/pi/cal (V/CV)

b. top/i/cal (VC/V)

c. top/ica/l (VC/V)

d. t/op/ical (VC/V)

### 2. slogan

a. sl/o/gan (VC/V)

b. slog/an (V/CV)

c. slo/gan (VC/V)

d. slo/gan (V/CV)