A skydiver prepares to jump from 23 miles above Earth.

LEAP FROM SPACE

If he succeeds, he will shatter world records for the highest, fastest, and longest free fall.

THE SKY IS NO LIMIT: Baumgartner does a test jump out of a helicopter at 7,620 meters (25,000 feet) so he can try out his pressurized suit.

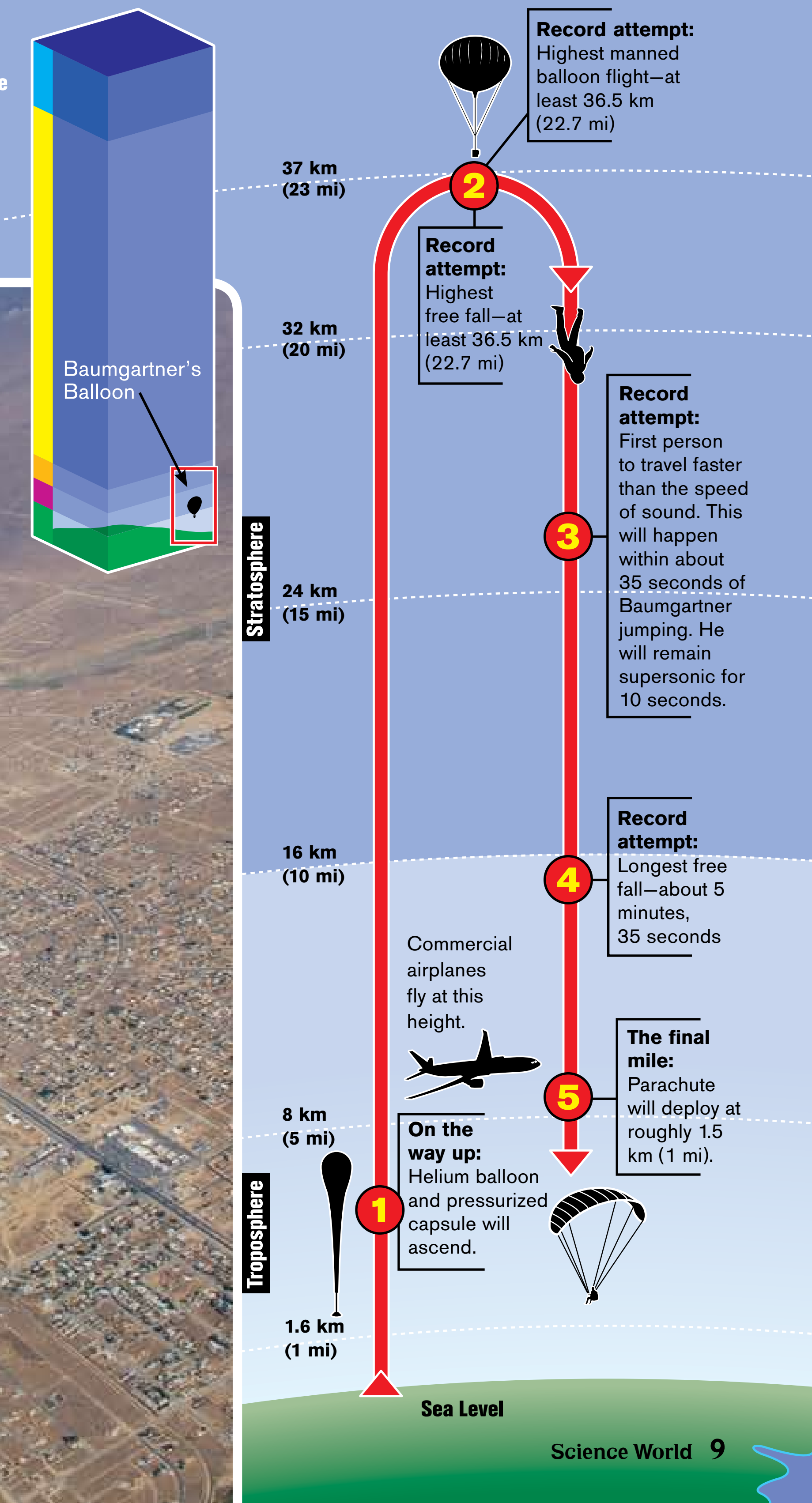
How would you like to try this stunt? Hitch a ride to the edge of space in a capsule attached to a helium balloon, jump out of the aircraft when it is at least 36.5 kilometers (22.7 miles) above solid ground, break the sound barrier within the first minute of your free fall, and finally land safely on the ground with the help of a parachute. While this dangerous leap would likely be fatal to an untrained thrill-seeker, elite Austrian skydiver Felix Baumgartner thinks he has what it takes to pull off the jump—and live to tell about it.

Baumgartner has already parachuted from many of the world's tallest buildings and bridges. In 2003, his free fall across the English Channel with a carbon wing was a first. But his latest feat is by far his most daring: As *Science World* went to press, Baumgartner was busy training to skydive from the edge

nuts&bolts

ONE GIANT LEAP

Felix Baumgartner is preparing to set four sky-high world records with his leap from Earth's stratosphere. Here's how he plans to do it.



READY, SET, DIVE: Once Baumgartner's test jumps (*below*) prove that his suit is up to the task, a pressurized capsule (*above*) attached to a helium balloon will lift him up to the stratosphere for his unprecedented space dive.

of space—higher even than airliners fly (*see Nuts & Bolts, p. 9*). A team of experts who have worked with NASA and the Air Force were helping him get ready for the big jump.

A successful leap would shatter world records for the highest, longest, and fastest free fall. Even the ascent itself would break the record for the highest balloon flight with a human on board. But the Red Bull Stratos team, which includes scientists, engineers, and doctors, has another goal. Baumgartner says, "Of course we want to break records with Red Bull Stratos, but also, lots of data will be gathered, so the mission could benefit future space exploration." He and his support team's technology and techniques could help develop ways for high-flying jet pilots and astronauts to eject safely in the event of an emergency.

When *Science World* spoke to Baumgartner, he could reveal only that he plans to take the leap sometime this year. The exact timing depends on how his preparations go. Baumgartner knows there's no guarantee that his jump won't turn deadly—but he is confident that he and his team have done their best to ensure his survival.

INTO THIN AIR

Dangers await Baumgartner high in the *stratosphere*—an atmospheric layer that extends from roughly 12 km (7.5 mi) up to 50 km (31 mi) above Earth. The stratosphere's hazards include freezing temperatures ranging between –60°C (–76°F) and –15°C (5°F) as well as the dangers of thin air. "It is somewhere between cold and really, really cold and you can't breathe up there," says Edward Dunlea, an atmospheric chemist at the National Oceanic and Atmospheric Administration. That's because at Earth's surface, air molecules—oxygen, nitrogen, and other atmospheric gases—are at their densest. As you rise higher, air molecules become fewer and farther apart. At only 5.5 km (3.4 mi) from the ground, in the atmosphere's lowest level called the *troposphere*, humans would lose consciousness and die from lack of oxygen.

Those aren't the team's only worries. Air molecules constantly move, bombarding each other and other objects to create *pressure*. Fewer air molecules higher in the atmosphere means lower pressure. A liquid more easily changes to gas under lower pressure, which is why water boils at a lower temperature on a mountaintop than it does at sea level.

At around 18.5 km (11.5 mi)—only half the height Baumgartner is planning to reach—the pressure is so low that gases in bodily fluids would begin to escape. "Your blood would actually boil," says Mike Todd, the Red Bull Stratos life support engineer. "It's not hot to the touch; it's just that the gases inside your bloodstream, and anyplace else that you have liquid in your body, would come out of solution, and [your body] would basically turn to foam." That makes the design of the suit Baumgartner will wear for his free fall ultra-important.

THE PRESSURE IS ON

Scientists have designed Baumgartner's suit to be pressurized. Oxygen flows into his helmet so he can breathe. The air he exhales goes through a valve down into the suit, where it helps maintain a safe pressure. An automatic control valve releases excess air so the pressure inside the suit always remains the same. The suit is so efficient at maintaining an artificial atmosphere that Todd says, "You can actually go to the moon with it."

Baumgartner's suit also includes an outer layer that insulates against extreme temperatures and an adjustable sunshade in the helmet. He will need the sunshade once he rises above the *ozone layer*, a band of gas in the stratosphere that Dunlea likens to an umbrella because it prevents one type of the sun's harmful ultraviolet radiation from reaching Earth. He says, "When you are above the ozone layer, above the umbrella, then you are hit by all of the sun's rays."

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ALL PHOTOGRAPHS: ©GARTH MILAN FOR RED BULL STRATOS

WIND-TUNNEL TEST: A wind tunnel allowed Baumgartner to see if he could maneuver in his bulky suit while in midair. If not, he could spin wildly out of control during his free fall—risking death. He succeeded in his test.

PREPARING FOR THE UNKNOWN

Despite its advantages, the suit is bulky, making maneuvers challenging. Baumgartner explains, "You usually can control a skydive by adjusting your body position, but in the pressurized suit, every movement is slower."

To help Baumgartner learn how to maneuver in the suit during the estimated five-and-a-half minutes he'll spend in free fall, the team has carried out a high-tech testing program. This includes flights in a wind tunnel—where air blowing at 210 km (130 mi) per hour holds Baumgartner up—and helicopter, airplane, and balloon drops for practice.

One key factor the team can't test is the effect of breaking the speed of sound. Once Baumgartner jumps, he expects to accelerate to *supersonic* speeds in half a minute—when he is roughly 30,480 m (100,000 ft) above ground. At this height, the speed of sound is more than 1,110 km (690 mi) per hour. The catch: "No one has ever become supersonic in free fall," Todd says. When planes approach the speed of sound, they catch up to the sound waves they produce, which bunch up in front of them. As the plane punches through the waves to go supersonic, it creates a *shock wave*. How will the shock wave affect a human body? Todd says, "We don't know if it's going to set up any turbulence or exactly what's going to happen. Nobody does."

But the mission's unknowns won't stop Baumgartner from trying. "I like a challenge!" he says.

For an update on Baumgartner's world-record attempt, visit www.scholastic.com/scienceworld.

—Jacqueline Adams