

The Wet-Bulb Number

By the rock. August 21, 2026. Grounded in National Weather Service definitions.

The short version

The wet-bulb temperature is the lowest temperature the air can reach by evaporating water into it. Dry air accepts a lot of evaporation, so its wet-bulb runs far below the thermometer and sweating works. Humid air accepts almost none, the two readings converge, and sweating quits. Wet-bulb globe temperature, WBGT, folds in sun and wind on top of that, which is why it, and not the plain thermometer, is the number the National Weather Service issues for heat safety and the number athletic trainers and drill instructors actually schedule around.

Evaporation is a heat tax

When water evaporates, the molecules that leave are the fastest ones, and they take their energy with them. Whatever they leave behind gets colder. This is not a metaphor; it is an energy budget, and it is the entire reason sweating works. Your body wets its own surface and lets physics collect the tax.

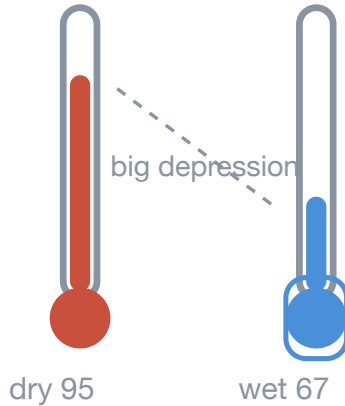
How much tax physics can collect depends on how much room the air has left for water vapor. Dry air has room to spare, so evaporation runs fast and the cooling is strong. Air already loaded with moisture has almost no room, evaporation crawls, and the cooling all but stops. The [dew point](#) tells you how loaded the air is. The wet-bulb temperature tells you what that load does to the cooling.

Two thermometers, one wet sock

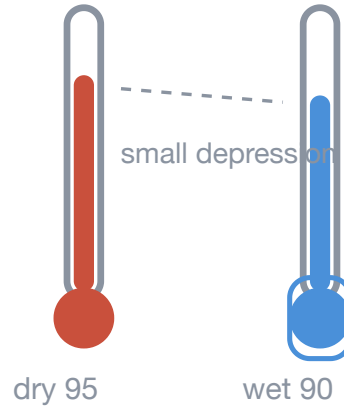
The measurement is almost embarrassingly direct. Take two identical thermometers. Leave one dry: that is the dry-bulb, the ordinary air temperature. Wrap the other's bulb in a wet wick and move air past it, classically by whirling the pair on a handle, an instrument called a sling psychrometer. Water evaporates off the wick, the tax gets collected, and the wet thermometer drops until the cooling from evaporation exactly balances the warmth the air feeds back. Where it settles is the wet-bulb temperature: the lowest reading evaporation can buy in that air.

The gap between the two readings is called the wet-bulb depression, and the gap is the story. A big depression means dry air and effective sweat. A small depression means the air is nearly full. At saturation, when the air holds all it can, the depression closes to zero: dry-bulb, wet-bulb, and dew point all meet at one number, and evaporative cooling has nothing left to offer anyone.

DRY AIR: the tax collects



HUMID AIR: the tax stalls



Same air temperature, different moisture. The gap between the dry and wet readings is the wet-bulb depression, and it is a direct measurement of how well sweating is going to work today.

WBGT: the number safety runs on

The plain wet-bulb still is not the whole outdoor story, because a body in the sun is also being heated by the sun, and a body in the wind is being cooled by it. Wet-bulb globe temperature, WBGT, was built in the 1950s to cut heat casualties in military training, and it measures all of it at once. The recipe is a weighted blend: 70 percent natural wet-bulb temperature, 20 percent black globe temperature, a thermometer inside a matte black globe that soaks up radiant heat the way a body in the sun does, and 10 percent ordinary dry-bulb temperature.

$WBGT = 0.7 Tw + 0.2 Tg + 0.1 Td$. Seven parts evaporation, two parts sunshine, one part air. The weighting is the point: the formula is saying, in arithmetic, that for a working human body the dominant question is whether sweat evaporates.

This is a different tool from the [heat index](#). The heat index models a person at rest in the shade; WBGT models a person working or exercising in the sun. The National Weather Service issues WBGT forecasts on its own point forecast pages alongside temperature and heat index, and WBGT thresholds are what athletic associations, occupational safety guidance, and the military use to decide when practice shortens, when rest breaks lengthen, and when the session is cancelled. When a number decides whether the team runs at 3 pm, it is this one.

One honest sentence on limits, because the internet is full of confident ones: peer-reviewed laboratory work is still revising how much wet-bulb heat a human body can actually tolerate, the tolerable line varies with the person and the work being done, and any single survivability number you meet in a headline is carrying more certainty than the research does.

Try it on your own skin

Two wrists, one experiment. Wet a cloth and lay it over one wrist, leave the other wrist dry, and hold both in moving air: a fan, a breeze, an open car window. Before you do, commit to a prediction: which wrist will feel cooler, and why? Then check. The wet wrist is running the wet-bulb experiment, evaporation collecting its tax; the dry wrist is running the dry-bulb control. On a humid day, repeat it

and notice the difference shrink. You have just measured, with your own nervous system, the number this whole page is about.

Check your understanding

1. What is the wet-bulb temperature?

- ☐ A. The temperature of rain when it lands
- ☐ B. The lowest temperature the air can reach through evaporation
- ☐ C. The temperature inside a cloud

2. Why does a wet thermometer read lower than a dry one right next to it?

- ☐ A. Water blocks the sun
- ☐ B. Evaporation off the wick carries heat away
- ☐ C. Wet glass conducts heat differently

3. On a very humid day, the gap between dry-bulb and wet-bulb readings is:

- ☐ A. Large
- ☐ B. Small
- ☐ C. Unchanged from a dry day

4. What does WBGT measure that the heat index does not?

- ☐ A. Barometric pressure
- ☐ B. Direct sun and wind on a working body
- ☐ C. The temperature of the ground

5. In the WBGT formula, the heaviest weighted ingredient is:

- ☐ A. The dry air temperature
- ☐ B. The natural wet-bulb temperature
- ☐ C. The black globe temperature

Answer key

1. What is the wet-bulb temperature?

B. The lowest temperature the air can reach through evaporation — It is the reading a wet thermometer settles at once evaporative cooling balances the warmth the air feeds back: the floor that evaporation can buy in that air.

2. Why does a wet thermometer read lower than a dry one right next to it?

B. Evaporation off the wick carries heat away — The fastest water molecules leave the wick and take their energy along. The bulb cools until that loss balances what the air returns.

3. On a very humid day, the gap between dry-bulb and wet-bulb readings is:

B. Small — Loaded air accepts little evaporation, so the gap barely collects and the two readings converge. At saturation they meet.

4. What does WBGT measure that the heat index does not?

B. Direct sun and wind on a working body — The heat index models rest in the shade from temperature and humidity. WBGT adds a black globe for radiant sun and responds to wind, which is why it governs outdoor work and sport.

5. In the WBGT formula, the heaviest weighted ingredient is:

B. The natural wet-bulb temperature — The blend is 0.7 wet-bulb, 0.2 globe, 0.1 dry-bulb. Seven tenths of the safety number is the question of whether sweat can evaporate.

Questions people actually ask

Is wet-bulb temperature the same as the dew point?

No, though they are cousins. The dew point is where cooling air saturates with its moisture untouched. The wet-bulb is where air lands when you cool it by evaporating water INTO it, which adds moisture as it cools. The wet-bulb always sits between the dew point and the air temperature, and all three meet at saturation.

Where can I find a WBGT forecast?

The National Weather Service publishes WBGT on its point forecast pages, the same place you get temperature and wind for your exact spot. Look for wet bulb globe temperature in the hourly graphs.

Why do athletic trainers use WBGT instead of the heat index?

Because their athletes are neither resting nor in the shade. WBGT was built for bodies working in open sun and wind, and its thresholds map onto practice decisions: shorter sessions, mandatory rest and water breaks, and cancellation at the top of the scale.

Does a fan always help in heat?

Moving air helps as long as evaporation has room to work, which is exactly what the wet-bulb number measures. When the air is near saturation and also hotter than skin, wind delivers more heat than evaporation removes, which is why health guidance turns against fans in the most extreme humid heat.

Can I measure wet-bulb temperature myself?

Yes, with two thermometers, a shoelace worth of wet cotton wick, and motion: the classic sling psychrometer. Whirl it until the wet reading stops falling. The wrist experiment on this page is the same physics with your skin as the instrument.

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