Layering Basics

Layering your clothing is a tried-and-true way to ensure your comfort in the outdoors. The beauty of this simple concept is that it allows you to make quick adjustments based on your activity level and changes in the weather.

Each layer has a function. The **base layer** (against your skin) manages moisture; the **insulating layer** protects you from the cold; the **shell layer**(outer layer) shields you from wind and rain. You simply add or subtract layers as needed.

For a deeper understanding, read on.

Your Base Layer: Moisture Management

This is your next-to-skin layer. It helps regulate your body temperature by moving perspiration away from your skin.

Keeping dry helps you maintain a cool body temperature in the summer and avoid hypothermia in the winter. If you've ever worn a cotton T-shirt under your raincoat while you hiked, you probably remember feeling wet and clammy, even though you weren't getting wet from the rain itself. Cotton is a fabric that retains perspiration and can leave you chilled.

For outdoor comfort, your base layer should be made of **merino wool**(popularized by brands such as SmartWool, Ibex and Icebreaker), **synthetic fabrics** (such as REI MTS, Capilene, PowerDry and CoolMax polyester) or, for less-active uses, **silk**. Rather than absorbing moisture, these fabrics transport (or "wick") perspiration away from your skin, dispersing it on the outer surface where it can evaporate. The result: You stay drier even when you sweat, and your shirt dries faster afterwards.

Examples: A base layer can be anything from briefs and sports bras to long underwear sets (tops and bottoms) to tights and T-shirts. It can be designed to fit snugly or loosely. For cool

conditions, thermal underwear is available in light-, mid- and expedition-weights. Choose the weight that best matches your activity and the temperature.

Shop REI's selection of men's underwear or women's underwear; or shop men's fitness tops or women's fitness tops.

Your Middle Layer: Insulation

The insulating layer helps you retain heat by trapping air close to your body.

Natural fibers such as wool and goose down are excellent insulators. Merino wool sweaters and shirts offer soft, reliable warmth and keep on insulating even when wet. For very cold and dry conditions, goose down is best. It offers an unbeatable warmth-to-weight ratio and is highly compressible. Down's main drawback is that it must be kept dry to maintain its insulating ability. A new innovation—water-resistant down—promises to change this.

Classic fleece such as Polartec 100, 200 or Thermal Pro polyester and other synthetics such as Thinsulate provide warmth for a variety of conditions. They're lightweight, breathable and insulate even when wet. They also dry faster and have a higher warmth-to-weight ratio than even wool. Classic fleece's main drawbacks are wind permeability and bulk (it's less compressible than other fabrics).

Like thermal underwear, fleece tops are available in 3 weights:

- Lightweight for aerobic activity or mild climates.
- Midweight for moderate activity or climates.
- Expedition-weight for low activity or cold climates.

Examples: For high-energy activities such as cross-country skiing, cycling or running, choose lightweight fleece (Polartec 100 or PowerDry) to avoid overheating. For cold conditions, try thicker fleece such as Polartec 200 or 300.

Wind fleece such as Polartec WindPro polyester or Gore WindStopper adds a high level of wind resistance to fleece. How? It uses a hidden membrane that does not affect breathability.

Shop REI's selection of men's fleece or women's fleece garments.

Your Shell Layer: Weather Protection

The shell or outer layer protects you from wind, rain or snow. Shells range from pricey mountaineering jackets to simple windproof jackets. Most allow at least some perspiration to escape; virtually all are treated with a durable water repellent (DWR) finish to make water bead up and roll off the fabric.

An outer shell is an important piece in bad weather, because if wind and water are allowed to penetrate to your inner layers, you begin to feel cold. Furthermore, without proper ventilation, perspiration can't evaporate but instead condenses on the inside of your shell.

Fit is another consideration. Your shell layer should be roomy enough to fit easily over other layers and not restrict your movement.

Shells can be lumped into the following categories:

Waterproof/breathable shells: The most functional (and expensive) choices, these are best for wet, cool conditions and alpine activities. Shells using laminated membranes such as Gore-Tex and eVent offer top performance; those using fabric coatings are a more economical alternative. Shells are categorized by REI as either **rainwear**, which emphasizes low weight and packability, or **mountaineering wear**, which is more abrasion-resistant and has additional features.

Water-resistant/breathable shells: These are best for light precipitation and high activity levels. Less expensive than waterproof/breathable shells, they're usually made of tightly woven fabrics (such as mini-ripstop nylon) to block wind and light rain.

Soft shells: These emphasize breathability. Most feature stretch fabric or fabric panels for added comfort during aerobic activities. Many offer both shell and insulative properties, so they in effect combine 2 layers into 1. Soft shells include cold- and mild-weather options.

Waterproof/non-breathable shells: These economical shells are ideal for rainy days with light activity (e.g., fishing, sports viewing). They are typically made of a sturdy, polyurethane-coated nylon which is water- and windproof.

Insulated shells: Some outer shells have a layer of insulation built in—such as fleece—making them convenient for cold, wet conditions, but not as versatile for layering in fluctuating temperatures.

Underwear (Base Layer): How to Choose

Want a comfort boost on your next outdoor adventure? Ditch those cotton undies and that souvenir concert T-shirt and upgrade to a moisture-wicking base layer (also known as a first layer or performance underwear).

Wicking underwear can benefit any physically active person—from athletes to construction workers—and is a must for every earnest outdoor explorer, whatever the season. As the next-to-skin layer of any layering system, its role is to move moisture away from your body.

For more base-layer information, read the REI Expert Advice article on Layering Systems.

Why Wicking Underwear Beats Cotton

Wicking underwear:

- Efficiently transports perspiration away from skin.
- Dries much faster than conventional cotton underwear.
- Reduces the risk of dramatic swings in body temperature.

In very windy or extremely cold conditions, such advantages are potentially life-saving.

Underwear Comparison Chart

Here's how the primary fabrics used in most moisture-managing underwear stack up:

	Synthetics	Wool	Silk (Treated)
Leading brands	Capilene/ Patagonia; CoolMax; ExOfficio; Hot Chillys; Marmot; Mountain Hardwear; REI Polartec Power Dry; The North Face; Under Armour.	Ibex; Icebreaker; Patagonia,SmartWool; Teko (socks).	REI.
Moisture management (wicking)	**Excellent** Nonabsorbent fibers (usually polyester) transport moisture away from perspiring skin, spreading it over a large area on the garment's outer surface to speed evaporation.	**Excellent** The inner core of wool fibers absorbs moisture (as much as 36% of its weight), then gradually releases it through evaporation.	**Good** Transports moisture away from skin, though not as rapidly as polyester. Conventional (untreated) silk underwear is absorbent and retains moisture.
Drying time	**Excellent** Dries faster than any fabric on this list.	**Good** While slower to dry than synthetics, wool fibers have an outer sheath that resists water and often feels dry on skin.	**Fair to good** Silk absorbs some moisture and is thus fairly slow to dry.
Temperature regulation	**Fair to good** If breezes arise before it dries, a wearer could get chilled. In hot, humid conditions, faster-drying synthetic layers are usually best.	**Very good** Surprisingly comfortable on warm days; excellent for cool days. Offers more warmth than a synthetic garment of the same thickness.	**Very good (if temperature is low)** As nice as silk feels, people typically find it too warm for vigorous warm-weather activity. Good insulator when it's cool or cold out.
Odor	**Poor to fair**	**Excellent**	**Fair**

resistance	When worn for extended periods, synthetic fabrics readily collect bacteria that cause odors. Best if laundered after every use.	Wool, composed mostly of a protein, is naturally antibacterial, usually for the life of the garment. Can be worn on consecutive days with minimal odor buildup.	Best if laundered after every use.
Stretch	**Very good** Above-average elasticity. Retains shape after being stressed.	**Very good** Above-average elasticity. Retains shape after being stressed.	**Good** Moderate elasticity. Usually retains shape after being stressed.
Price	**Good** Moderately priced.	**Expensive** Natural fibers tend to be costly.	**Fair** Borderline expensive.
Suggested uses	* All activities, all conditions. * Best in this group for rainy conditions and for heat and high humidity. * Snug fit best for cold weather, loose fit for warm weather.	* Most activities, most conditions. If paddling or in rainy conditions, faster-drying synthetics are a better option. * Best in this group for cool conditions.	* Moderate cool-weather activities and snowsports. * When stationary (spectator sports) or post-activity lounging indoors.

Shop REI's selection of Men's Underwear and Women's Underwear.

Fabric Overview

Some additional details about your primary fiber options:

Synthetics

This refers principally to polyester and polyester blends. Some underwear blends use high percentages of nylon (as a means of increasing abrasion resistance), or they add small amounts of spandex or elastin (to enhance stretch). Polyester, though, is the dominant synthetic fiber used in wicking first layers. It's a soft, easy-care fabric with reliable moisture-management attributes.

Additional pros:

- Lightest in this group.
- Abrasion-resistant.
- Wrinkle-resistant.
- Easy care.

Additional cons:

- Odors may build if worn repeatedly on multiday outings.
- Potentially vulnerable to staining.
- Petroleum-based fiber.

Wool

Wool

This almost always refers to merino wool, which is popular due to its soft "ultrafine" fibers. Many people are surprised to learn that lightweight (even "microweight") merino wool creates a terrific all-season base layer.

Additional pros:

- Lightweight merino wool is soft on skin.
- Usually machine-washable.
- Stain- and wrinkle-resistant.

- Natural fiber.

Additional cons:

- Typically available only in darker colors.
- Potentially vulnerable to shrinkage.

For details, see the REI Expert Advice article about wool clothing.

Silk (Treated Silk)

Silk underwear is largely a specialty fabric, intended primarily for cool- and cold-weather usage. "Treated" indicates the silk has been chemically modified to enhance wicking (a fabric's capacity for moving perspiration off skin to speed its evaporation). Fans of silk are strongly attracted to its smooth texture.

Additional pros:

- Soft, luxurious texture.
- Thin; adds no bulk and layers well.
- Natural fiber.

Additional cons:

- Some styles require hand-washing; machine washing sometimes causes shrinkage.
- Potentially vulnerable to abrasion and sunlight.

Fabric Weights

Though classified as "underwear," every top in this category is appropriate for use as a stand-alone garment. Microweight and lightweight T-shirts are standard summertime attire for active outdoor types—when hiking, riding, climbing, taking training runs, you name it—and they're excellent for gym workouts.

When selecting tops and bottoms for use as base layers (actual *underwear*), anticipate the conditions you'll face when choosing the heft of the fabric. Here are our general guidelines:

- **Microweight:** For mild to cool conditions. (At REI, you'll find garments identified as micros within the Lightweight category.)
- **Lightweight:** Cool to moderately cold conditions.
- **Midweight:** Moderately cold to cold conditions.

- **Heavyweight:** Cold, frigid or blustery conditions.

Some people get cold easily. If so, consider choosing a heavier fabric. Just avoid overdoing it. If conditions become unexpectedly mild, a mid-weight or heavyweight first layer could feel a touch too toasty during vigorous activity.

Tip: Personally, I always carry a spare micro or lightweight top on my outings. They weight very little and dry very fast. At the end of a sweaty day I can change out of my "motion" shirt and into my "resting" shirt. This allows me to hand-rinse or air-day my motion shirt in preparation the next day. It's a nice little luxury.

Shop REI's selection of Men's Underwear and Women's Underwear.

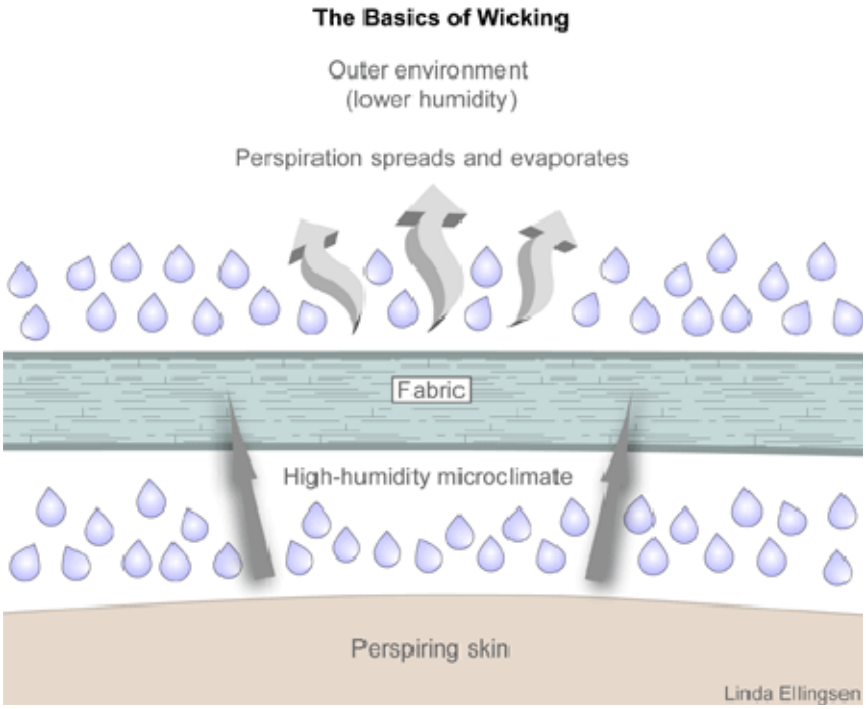
A few words on fit: The warmer the conditions, the looser you want your base layer to be. Snug-fitting base layers keep body-generated warmth close to your skin, boosting comfort in cool conditions. When temperatures heat up, it's best to let your next-to-skin layers hang loose to accommodate lots of air circulation. If a garment's advertising promotes an "athletic fit," figure its fit will be on the snug side.

What Is Wicking?

People understandably find it odd to hear "wick" used as a verb. A "wicking" T-shirt? Sounds strange at first. Here's an explanation of this phenomenon for nonscientific minds:

Candle Wicks

Think of a candle wick—usually a braided, wax-coated cord of cotton. When lit, the wax coating melts away. Melted wax becomes the fuel source for the flame, and the wick draws ("wicks") melted wax to the flame, where it vaporizes. The flame continues to burn because the wick steadily draws more liquefied fuel to it. An oil lamp works on the same principle, drawing (wicking) fuel to the flame. This act of wicking a liquid along a fibrous path is known as capillary action.



Wicking: Synthetic Fabrics

Capillary action also occurs with synthetic performance underwear. Here's how:

1. An active person wearing a polyester T-shirt begins to sweat.
2. A high-humidity "microclimate" is created between the person's sweating skin and the shirt covering the skin.
3. Perspiration vapor and moisture condense on the garment's interior (its underside).
4. Because everything in nature moves toward equilibrium, the high-humidity air mass between skin and garment will seek a path to a lower-humidity environment. The difference (gradient) between temperature and humidity on both sides of the garment becomes the driving force that moves the warmer, wetter air beneath the garment toward the cooler, dryer air on the outside.
5. Wicking takes place when perspiration moisture travels along the surface of the fiber but is not absorbed into the fiber. (Synthetic fibers are, essentially, plastic—and virtually nonabsorbent). Moisture escapes to the outside through the interstitial spaces (the miniscule holes) between the knitted yarns.
6. Moisture is dispersed across the fabric's exterior, where it evaporates after contacting the lower-humidity environment outside the shirt.

Wicking is enhanced by:

Fabric construction:

- Fibers with an altered texture (roughened or grooved) can transport moisture more quickly.
- Fabrics such as Polartec PowerDry use a 2-sided "bi-component" construction. Such fabrics typically position thinner yarns closer to the skin (sometimes dotted with moisture-collecting "touch spots") and place larger yarns on the garment's exterior, providing more surface area for moisture dispersal and evaporation

Chemical treatments:

- Some type of chemical finish is applied to nearly every synthetic fabric in order to boost wicking performance. The finish usually convey some degree of hydrophilic (water-attracting) attributes to polyester, allowing it to more speedily draw moisture along its nonabsorbent fibers and transport it to the garment's exterior.

Note: Polyester, while synthetic, does have a very small absorption rate, roughly 0.4% of its weight. (In contrast, cotton can absorb 7% of its weight.) Polyester's absorption rate is so minimal that it is generally regarded as nonabsorbent.

Wicking: Wool

Technically, it can be argued that wool does not wick moisture. The end result, however—fibers moving perspiration away from skin and dispersing it through evaporation—is the same.

Rather than straining perspiration moisture and vapor through the tiny, tiny gaps in a nonabsorbent synthetic knit, wool's inner core (cortex) absorbs moisture—between 27% and 36% of its weight.

This absorbed moisture is then impacted by the lower humidity, air movement and (potentially) sunlight on the outside of the garment. The result: evaporation.

With so much moisture being absorbed, will a wool garment feel soggy? If it becomes saturated and is confined to a damp or high-humidity environment, it could. (Synthetics are often a better choice for excursions where persistent rain is likely.)

Yet wool has the capacity to both absorb moisture (in a vaporous state such as perspiration) while also resisting water (in a liquid state such as light rain). This is one of the almost-too-good-to-be-true marvels of wool.

Wool fibers have a scaly exterior layer called the cuticle, and that is overlaid with the epicuticle, itself coated with lanolin, a waxy, water-shedding film. It is the epicuticle and its waxy coating that makes wool resistant

to mist and light rain (hydrophobic). It is this hydrophobic layer that touches your skin, minimizing (or eliminating) any sensation of dampness.

A very sweaty person can overwhelm any fabric. During those moments a wool garment will likely feel less damp and clammy on your skin than a synthetic garment, but it may feel weightier. A synthetic garment will dry out and feel lighter more quickly.

As a total sweat machine myself, I have to laugh at enthusiastic promotional claims ("Keeps you dry!") sometimes linked to wicking garments. If a T-shirt shut down my ability to sweat, I'd be worried. What wicking fabrics do is allow you to *feel drier faster* than if you were wearing cotton or some other nontechnical fabric—and that's a huge positive that, in my mind, makes them worth the money.

Wool Texture and Temperature Regulation

Some people may be hesitant to consider wearing wool as a next-to-skin fabric.

Realize that performance underwear designed with wool uses merino wool, which consists of "ultrafine" fibers just 17.5 microns in width, fine enough that people will not experience the scratchy sensation often associated with traditional wool. The average human hair, just for comparison, measures 60 microns.

A property unique to wool is its ability to release small amounts of heat as it absorbs water. This effect is known by the arcane term "heat of sorption." Energy, in the form of small amounts of heat, is produced through the work of moisture-absorption by wool fibers. Thus, in damp conditions, a wearer could potentially collect a small amount of comfort from this phenomenon. This is in addition to the countless warmth-trapping air pockets created by all the crimps inherent merino wool fibers.

Could that make wool too warm in hot conditions? Not necessarily. Evaporating moisture within the cortex can cool the air between the wool fabric and your skin, promoting a stable body temperature. Also, breathable wool fibers can buffer skin from air heated by the sun the same way they can trap warmed air and keep it close to skin in cool conditions.

Admittedly, these nuances can be tough to detect in the field, and when conditions turn seriously cold, you will obviously need more than a lightweight wool tee to maintain a comfortable body temperature.

Some Subjective Opinions

A lot of my colleagues are fans of wool base layers. I use both wool and synthetics but have never used silk. Wool continues to impress me with the consistency of comfort that it provides, from very warm to quite cool conditions. I'm also a huge fan of its ability to resist odors. If I'm planning on a multiday adventure where I

may be wearing the same shirt for many of those days, I'm reaching in my drawer for wool base layers. Wool's chief downside: its high price.

I own lots of synthetics, wear them often and still like them all. I just need to launder them faithfully. I'm particularly a fan of bi-component designs. They really seem to dry in a flash.

My practical side chooses synthetics. My indulgent side prefers wool. And my don't-be-an-idiot side says never wear cotton on a serious outdoor excursion.

Insulated Outerwear: How to Choose

How do we keep warm in chilly conditions? Add a layer of insulation. Insulating jackets, vests or pullovers are designed to trap body heat, hold it close to our skin and buffer us from colder external air.

Insulation is the middle layer of a 3-layer cold-weather clothing system. Such a layering systeminvolves:

- Base layer such as a T-shirt or long underwear.
- **Insulation layer such as a fleece jacket or down vest.**
- Outer layer such as a rain jacket. Outer layers may also be insulated.

Typical insulation choices:

- Down: nature's best insulator.
- Synthetic fibers: engineered to mimic down's natural loftiness.

- Fleece: usually made from synthetic fibers, though some wool jackets/sweaters exist.

	Pros	Cons	Best for
Down	Lightest Most compressible Most warmth for weight Highly durable	Insulation reduced if wet Slow to dry More expensive	Dry conditions
Synthetic	Water resistant Fairly quick to dry Less expensive	More bulk Weightier Less breathable	Potentially wet conditions
Fleece	Soft, breathable, stretchy Dries quickly Less expensive	Modest warmth Most bulk	Vigorous activity in cool conditions

Down

Advantages: Impressive warmth for minimal weight. Goose down plumules (a mix of feathers and puffy clusters) exhibit a natural loftiness that is exceptionally efficient at trapping "dead" (noncirculating) air and retaining warmth. Can be compressed into a very small shape. Luxurious feel. Long lasting.

Disadvantages: Loses its warmth-retaining abilities if it gets wet (except for new "water-resistant down" garments). Very slow to dry. Expensive.

Overview: Down garments make an excellent choice for dry, very cold conditions and are well-suited for moderate activity in dry weather such as skiing or snowboarding in powder. Also good for dry, chilly mornings when camping, belaying or backpacking. Relying on down in wet or damp conditions is risky, though; down garments must be carefully shielded from moisture.

Not all down is created equal: Down is graded according to fill power, which indicates how many cubic inches 1 ounce of down occupies when placed inside a container. Down ranges from 450 to 900 fill power. Higher numbers indicate a higher quality of down, with more air-trapping ability. Down with higher fill-power numbers includes fewer feathers and uses bigger, more mature down plumules. Larger down clusters are more durable and can better withstand repeated compressing.

New **water-resistant down** was first introduced in sleeping bags in 2012 but is starting to appear in outerwear, too. This micro-treatment of down feathers promises to retain down's loft even in wet conditions—a big breakthrough.

Shop REI's selection of men's down jackets and women's down jackets.

Synthetic Fibers

Advantages: Water-resistant, will dry much more quickly than down and even retains some thermal resistance when damp. Less expensive, too. The most advanced synthetic fibers (e.g., PrimaLoft) have drawn close to down in breathability, weight, texture and compressibility.

Disadvantages: Down still trumps synthetics in minimizing bulk and weight, though an innovator such as PrimaLoft continues to narrow the gap. Less durable than down, especially if repeatedly compressed.

Overview: A very good insulation choice if wet conditions are expected. It performs quite nicely in dry conditions, too, of course. Personally, I wore a lightweight jacket lined with PrimaLoft during a midsummer climb of 14,411-foot Mt. Rainier and found it to be quite comfortable in what I estimate were 40F (or less) temperatures on the summit. Coworkers tell me they also like synthetic insulation during cool mornings when hiking, camping or sea kayaking. Despite

advances, synthetic insulation still can't match high-end down for warmth in extreme cold. Nearly all synthetic insulation is made of polyester.

Like down, not all polyester is identical. The science of synthetic insulation fabrics continues to evolve. At the moment, the **PrimaLoft** family of insulations (explained in more detail later in this article) is widely considered the most highly evolved "species" of the synthetic world, often besting other synthetics in weight and low bulk, though the differences are not always hugely apparent. Clothing manufacturers routinely create their own proprietary variation of polyester: **Coreloft** and **ThermaTek** from Arc'Teryx, for example,**Heatseeker** (The North Face); **Thermal R** (Marmot); **Thermogreen**(Patagonia); and so on. Most of these examples also have a green/eco version, meaning they were manufactured from recycled materials.

Shop REI's selection of men's synthetic jackets and women's synthetic jackets.

Fleece

Advantages: Very good breathability, making it a good choice when insulation is needed during vigorous, highly aerobic activity. (Down and synthetic jackets/vests are best worn for moderate to sedentary activities.) Dries quickly when wet, usually faster than a puffy-style synthetic garment.

Disadvantages: Not for serious or prolonged cold. While most synthetic fleeces dry quickly, a few are prone to retaining water (and it's not always easy to predict which fleece items are the exception to the dries-quickly rule). Fleece is also bulky and heavy when compared to down and synthetics. Wind can also permeate fleece pretty easily (which leads to chills) unless it contains a wind-blocking membrane (which inhibits stretch) or is worn under a jacket.

Overview: Fleece comes in various weights (light, mid and heavy). Heavier garments, logically, are better suited to colder conditions. **Polartec** is one of the best-known brand names in fleece.

Its Classic fleece categories—100 (lightweight), 200 (mid) and 300 (heavy)—remain popular and are in widespread use. Its **Thermal Pro** and **Thermal Pro High Loft** products offer next-generation benefits in terms of lower weight and reduced bulk. Some fleece-like pullovers are specially engineered to provide extra stretch, wind-resistance, water-resistance or some combination of all of these. Ultimately, though, even the heaviest fleece is not as warm as a jacket insulated with down or a synthetic such as PrimaLoft.

A recent trend: Fleece middle layers made out of actual fleece—natural, 100% wool, that is. Already a huge hit with active outdoor types in socks and base layers for its adaptability to cool or warm conditions and its odor-free nature, mid layers made from soft, finely textured merino wool are worth a look. Just be aware that heavier cuts of wool tend to dry slowly. One suggested use is as a downhill skiing layer in dry conditions.

Shop REI's selection of men's fleece jackets and women's fleece jackets.

Buying and Wearing Tips

Anticipate the weather. Will you be going out in wet conditions? If you bring a down jacket or vest, be sure to also bring along a weather shield (usually a waterproof-breathable shell) so your down fill stays dry. Alternatively, a synthetic insulation layer offers a little more peace of mind. Regarding temperature, if you're having a tough time deciding between a lighter or heavier garment, usually it's best to opt for the warmer option. This offers greater versatility despite a minor increase in weight and bulk.

Understand the energy output your activity requires. Skiing or climbing in dry, alpine conditions? A puffy down jacket should work beautifully. Hiking in variable conditions? Go with fleece and, for very cool nights at high elevation, consider also toting a synthetic jacket.

Jacket or vest? It's a matter of personal preference. Vests are often preferred by high-energy, high-metabolism types who understand their tolerance for cold and need a just-enough insulation buffer for their core. Get chilled easily? Carry a jacket. A few items, such as the REI Spruce Run Jacket, offers zip-off sleeves, though such sleeves (due to the zippers) are a little bulkier.

Understand your individual variables. Your metabolism may cause you to feel chilly easily. Women often get cold more easily than men; same deal with older outdoor people regardless of gender. Ditto with slender people. In all cases, make sure you choose a garment engineered to keep someone with your characteristics warm

Manage your layers. If you feel too warm during an activity, do not hesitate to open a zipper or strip off a layer. Or reverse those actions when conditions turn cool. Add a cap and gloves when temperatures turn cold.

Technical Talk

The remainder of this article features topics that may interest only tech-minded readers, but we think it's worthwhile information to include.

A Closer Look at PrimaLoft

PrimaLoft has emerged as one of the premier synthetic insulations in the outdoor marketplace. Vanessa Mason is the company's global director of business development and the holder of a master's degree in chemical engineering with a specialty in polymer sciences and materials. She addressed a few questions about PrimaLoft's approach to synthetic insulation with REI.com:

Q: PrimaLoft keeps edging closer to down in weight, compressibility and texture. How is that accomplished?

A: It's our fiber technology. It's the size of the fibers, the design or the structure of the fibers, and the types of proprietary treatments we put on our fibers.

Q: PrimaLoft has a good reputation among retailers and in the outdoor media. Yet some shoppers have second thoughts about PrimaLoft because of its relatively thin appearance compared to puffy down jackets. Should they be concerned?

A: That's something people in this industry are educated about—thickness does not necessarily equate to warmth. But it's difficult for some consumers to see that picture. Why does PrimaLoft work? Because it has an extreme microfiber structure. Think of a funnel. With PrimaLoft, you can fit greater number of smaller fibers in that funnel than you can with larger fibers (typical of older synthetic insulations). We just trap more air spaces, so we don't need as much volume to trap as much air.

Q: Is PrimaLoft close to being the equivalent of down?

A: You can get anywhere from 450-fill-power down to 900-fill-power down. Look at pinnacle (superior) down products—900 at the top of the pyramid, 450 and 500 along the bottom. Then look at the pinnacle synthetics, and PrimaLoft One is the best synthetic insulation you can buy. The pinnacle synthetic only crosses over to the down chart near the bottom end of the down

pyramid. We usually equate PrimaLoft One as the equivalent of down in the 500 to 550 range. You could not replace a 900-filll-power down garment with PrimaLoft One and expect to get the same performance in dry conditions. However, wet down doesn't even come close to the bottom end of the synthetic pyramid in regard to thermal performance. As soon as you get down wet, you lose a lot of its thermal properties.

Understanding Heat Transfer

Everything in nature moves toward equilibrium. Cold air cools a warm object, and the process works simultaneously in reverse.

Insulation experts like to point out that people don't get cold, they lose heat. Our individual metabolisms create body heat. We lose that heat 4 ways:

1. **Conduction:** Occurs through the surfaces we touch, particularly the ground below us. Ever sit on a snow drift or a block of ice? That chill you felt on your back side was heat loss caused by conduction.
2. **Convection:** Air circulation carries away body heat. Think about standing outside on a 20F day while wearing fleece. Now think about the same day with a 20 mph wind. The cold air will blow through the fleece and displace the warm air, causing your body temperature to drop unless you add a shell. The shell by itself does not add any insulation, but does cut the wind. That cuts heat loss due to convection. Convection requires moving air. Air temperature alone does not cause convection; that would be conduction. The cold air temperature will cause your body temperature to drop unless you bundle up.
3. **Radiation:** Our bodies are heat-generating machines. When our activity level slows, so does our heat-making ability. Radiation is why your face feels warmer than your back when looking at the sun. The air temperature is the same, but the radiant heat from the sun warms you. The opposite is also true when looking at space at night. This is why it is warmer to sleep under a leafy tree. Radiation is a complicated subject; even for engineering students find it to be a difficult concept.
4. **Evaporation:** When we sweat, the moisture's evaporation cools our skin. This is good when we're warm, but less than ideal when active in cold conditions. Of course, humans are exhaling moisture and evaporating moisture from our skin all the time, not just when sweating. It's just more noticeable during activity.