BY ROB YAGID

Heat transfer through insulation

In the article "New Insulation for Old Walls" on pp. 32-37, senior editor Justin Fink helps you to determine what types of insulation might be in your home and your options for upgrades that will increase performance. To get the most out of that article and to appreciate the performance potential of any type of insulation, it's helpful to understand the basics of heat transfer through insulation. Here's how it works.

HEAT MOVES IN THREE WAYS

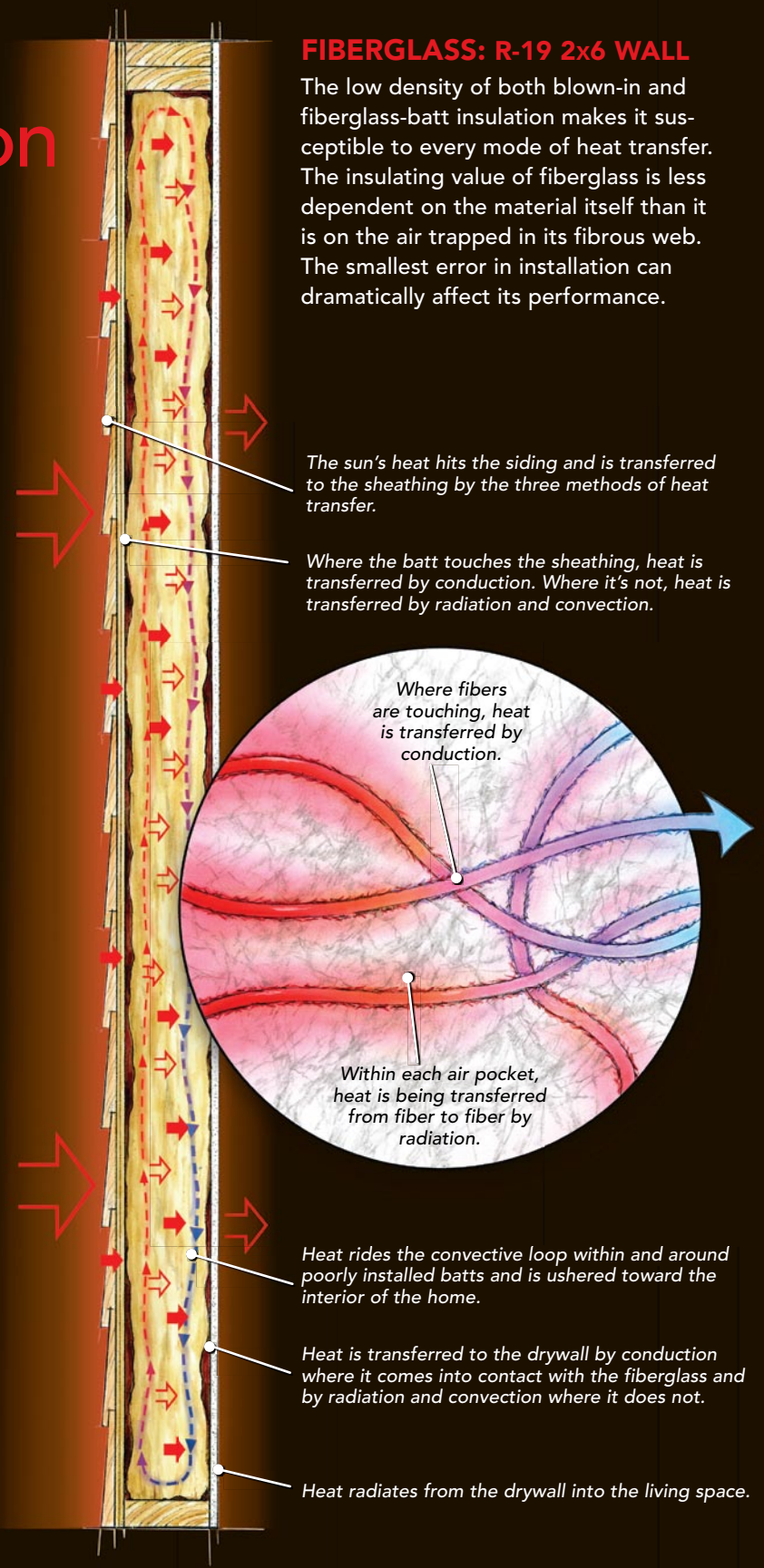
Heat moves from the warm side of insulation to the cold side through three mechanisms: radiation, conduction, and convection. All three mechanisms are almost always at work simultaneously.

Radiation conjures images of solar-heat waves passing through a wall or roof assembly into a home, much like radio waves. But that's not really how radiation heats your home. Radiation is a term used to describe the transfer of heat from one object to another through an airspace. While the siding on your house blocks a lot of the sun's radiation, radiation can take place on a much smaller scale in and around the insulation within the cavity.

Conduction is the transfer of heat between two objects that are touching. High-density insulation materials have a lot of solid matter in contact. Conductive materials—mineral wool or fiberglass—transfer heat more easily and rely on trapped air (which has a low conductivity) for insulating performance. That's why these types of insulation don't make quality dense-insulation products, as do less conductive materials, such as spray foam or even cellulose.

Although air trapped inside insulation helps its performance, moving air (convection) kills it (inset drawing, right). Convection can occur when cold air around or inside the insulation displaces hot air, causing it to rise. This puts into motion a cyclical flow of air known as a convective loop. As warm air is pushed up toward the cold side of insulation, cold air flows down toward the warm side of the insulation and helps to transfer heat out of the home in the winter and into it during the summer.

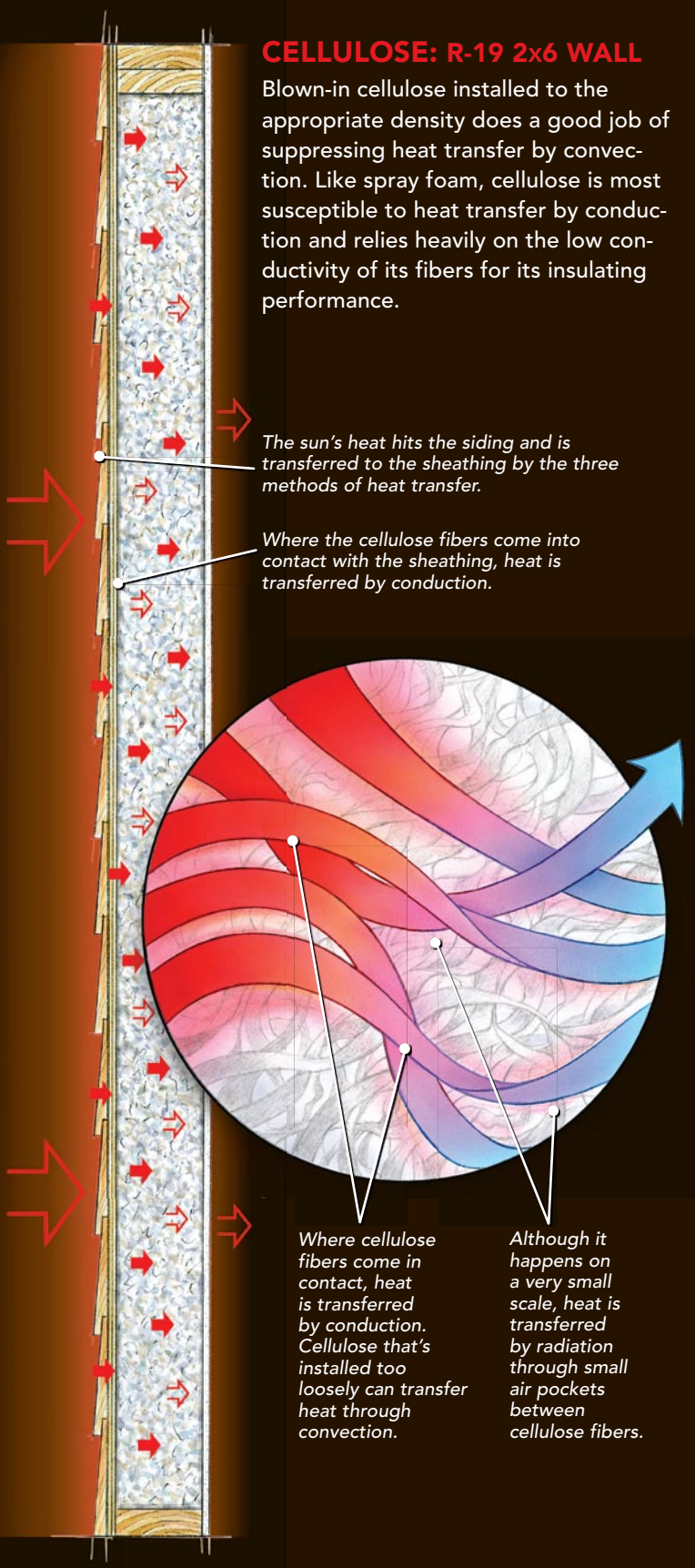
Rob Yagid, associate editor



Drawings: Don Mannes

CELLULOSE: R-19 2x6 WALL

Blown-in cellulose installed to the appropriate density does a good job of suppressing heat transfer by convection. Like spray foam, cellulose is most susceptible to heat transfer by conduction and relies heavily on the low conductivity of its fibers for its insulating performance.



SPRAY FOAM: R-33 2x6 WALL

Because spray foam creates an airtight cavity, convection is less of an issue than conduction. There aren't large voids of air in the insulation, so radiation is virtually eliminated. Spray foam relies on the low conductivity of the gas or air trapped within its cellular structure, and the low conductivity of its plastic content.