Introductory Discussion:
Design Ideas to Cover

Note: Try to elicit these ideas from students rather than just presenting them with these components of passive solar design. This conversation should take place before they are given their design challenge.

The **key aspects** of passive solar design are: geographical location and orientation, insulation, windows, thermal mass, surface colors, ventilation and circulation, overhangs and shading, amount of space, overall orientation

The really cool part about it is that it can be done in nearly limitless ways, so engineers can be as creative in the building design as they want.

Whether we are discussing passive solar heating or cooling, the buildings' **geographical location and orientation** play important roles. For example, to take advantage of passive solar heating and cooling, a building in the US must be designed so its windows and main living spaces are located on the south side of the house. That way, the windows face the sun and can heat up the spaces people occupy more often. Windows located on the north side do not let in any direct sunlight and allow more heat to escape than a solid wall. This is one reason that building orientation is important. Geographical location must be considered because different places have different climates. In some regions, clouds block the sun more often than not, so they would not be good locations to rely on the sun for heating. If a region's prevailing wind comes from the west, windows placed on the west and east sides would allow for the greatest airflow. When considering all the passive solar techniques, it is important to use the correct ones based on the climate.

Without a properly **insulated** building, no matter how good its heaters and air conditioners are, the hot or cold air will escape to the outside. This wastes a lot of energy because appliances work to heat or cool the building AND the outside air! It is extremely important in passive solar design not to waste the heated or cooled air because passive solar heating does not produce as much heat as conventional methods. While a number of materials exist to create well-insulated walls, ranging from spray-on foam to hay bales, it is important to remember to insulate the other parts of your house — all the places that separate the inside from the outside. These places include the roof/ceiling, and windows and doors. For example, windows let considerably more heat escape to the outside than the walls of your home.

Windows are another important component of passive solar designs. You don't want to have too many windows for a good passive solar design. On the other hand, while a windowless

building would have the best insulation, would you want to live in it? Rather than eliminate windows altogether, you can install high-quality, double-pane windows and place them in strategic locations. Double pane windows are much better insulators than single pane ones. (In fact, engineers have designed many types of high-tech windows that are helpful for good passive solar design.) For heating purposes, windows are best placed primarily on the equator-facing wall so that they can let sunlight in. Windows, placed in the right locations, can bring in the most sunlight without losing too much heat.

Once the sunlight comes into a room, two other aspects of passive solar design become important: **thermal mass** and **surface color**. You probably already know that darker colors absorb more sunlight than lighter colors, so, for passive solar heating, we would want darker colors on the outside and inside of a building. A good thermal mass is a material that can absorb lots of heat and release it slowly when the surrounding temperature starts to go down. A few materials with a high thermal mass are concrete, bricks and water. When used properly, these materials absorb the heat from the sunlight coming through windows and then release that heat throughout the night. Using windows, darker colors, and thermal masses, we can create a passive solar heating design that warms up a house during the day and keeps it warm throughout the night. The trick comes in finding the right amount of each item to be used and integrating it into a house.

Proper **ventilation** is achieved by strategically placing windows so that as much air as possible can be **circulated** when open. One way to prevent heat from entering a building is to design the building with thermal mass on the outside so that it absorbs the heat before entering the building. Another method is to plant large **shade** trees so they shade the building from direct sunlight during the summer months.

Another point to consider is the amount of **space** being heated. Larger volumes of space need more heat to make the same gain in temperature as a smaller volume. So a smart passive solar design would limit the space that needs heating to as little as necessary.

The final component to remember in passive solar design is the overall **orientation** of your design elements. Do you know which way the sun comes up and goes down and shines all day long? You must know from which direction the sun shines so you can place your walls and windows intended to capture the sunlight facing in that direction. Also, if you know the regular direction of cold wind, it is smart to position and design the house to block or divert that wind, to minimize it cooling your house (which makes heating it more difficult).