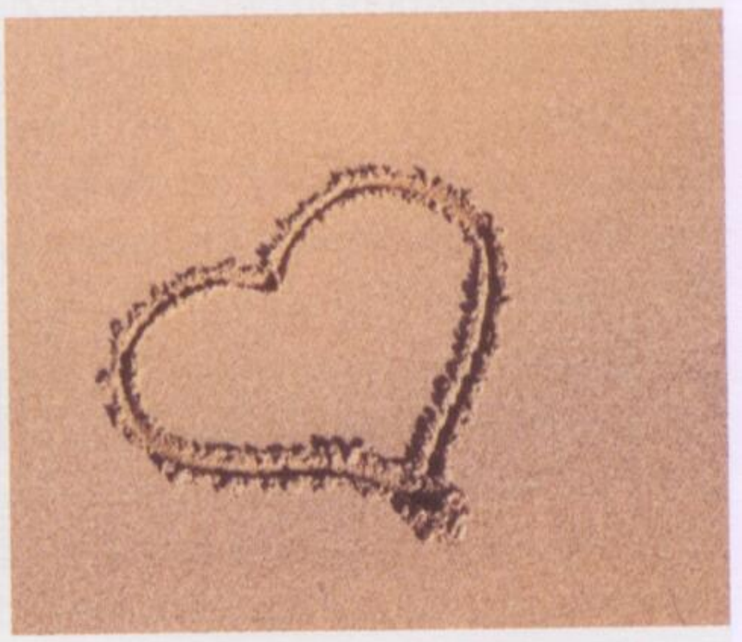
Where Silicon is Found

Silicon is found in rocks, clays, and soils as well as in the brown amorphous powder we commonly call *beach sand*. Although it is such an abundant element, making up 27.6% of the Earth's crust, rarely does it occur in its pure state. Instead, it forms compounds, the most common of which are silica and silicates, the former being a combination of silicon and oxygen, while the latter are combinations of silicon, oxygen, and other elements (aluminum, magnesium, sodium, iron, etc.). Silicon compounds are found in the atmosphere, in all natural waters, and in some plants and animals (humans included). The most common of them is silicon dioxide (SiO_2), which takes the form of ordinary sand, quartz, rock crystal, agate, amethyst, flint, jasper, and opal.



Sand is an easy to find silicon deposit

Production & Purification

In order to obtain its pure form, silicon must be chemically extracted from its naturally occurring compounds, the most prevalent of which is silica (silicon dioxide). There are various techniques available for silica's purification, some of which are able to make silicon that is 99.99% pure. The principal means, nevertheless, is via a twostep **reduction** process: with the use of powerful electrode arc furnaces, silicon dioxide and carbon are heated at temperatures approaching 2,000 degrees Celsius; subsequently, the molten material is treated with oxygen to reduce the amount of impurities. Finally, silicon is poured off into pots, cooled, and dumped in the storage pile. Some silicon applications, however, require higher purity silicon. To meet this demand, special purification methods have been devised that further refine the extracted silicon. Further purification essentially involves turning the synthesized silicon into a silicon compound that can be easily distilled, and then breaking it up to yield an ultra-pure silicon product.

Uses & Applications

As silicon appears in so many different forms, it has become a vital component of modern-day industry. It can be found in products ranging from concrete and other building materials to computer chips, its use being determined by its purity level. For instance, silicon of lesser purity is used in metalworking as a reducing agent (i.e., something that helps separate metals from their ores) and as an alloying element (i.e., used to form alloys with other metals) in aluminum, steel, brass, and bronze. High purity silicon, on the other hand, obtained via the Siemens process, is used in semiconductors.

Electronics

One of silicon's most important uses is in electronic devices, such as computer chips, transistors, liquid crystal displays, solar cells as well as integrated circuits, microprocessors, semiconductors, etc. The fact that *Silicon Valley* has been named after the element underscores the role that silicon plays in modern day technology. Though actually not the most optimal electronic material, silicon is preferred over other materials (e.g., germanium, gallium arsenide, etc.), some of which are with better electronic properties, mainly because of its abundance and cheap price and secondly because of its unique ability to control the electric current that passes through it. The latter characteristic makes silicon play a role of the utmost importance in electronic devices, where such current control is a necessity for their proper performance.

Semiconductors

Silicon's atomic structure makes it the most important natural semiconductor in contemporary technology. Its crystalline form has been said to be 'the foundation of the semiconductor age'. For starters, let's revise what semiconductors are. Unit 10 provides more detailed information about the topic, so here a very