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# **Case study**

**Theme: Silicon. Silicate minerals. Weathering**

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14

**Si**

Silicon

28.0855

▣ **Silicon** is a chemical element with symbol **Si** and atomic number 14. A hard and brittle crystalline solid with a blue-gray metallic luster, it is a tetravalent metalloid. It is a member of group 14 in the periodic table, along with carbon above it and germanium, tin, lead, and flerovium below. It is rather unreactive, though less so than germanium, and has great chemical affinity for oxygen; as such, it was first prepared and characterized in pure form only in 1823 by Jöns Jakob Berzelius.



# Production

- Ferrosilicon, an iron-silicon alloy that contains varying ratios of elemental silicon and iron, accounts for about 80% of the world's production of elemental silicon, with China, the leading supplier of elemental silicon, providing 4.6 million tonnes (or 2/3 of the world output) of silicon, most of which is in the form of ferrosilicon. It is followed by Russia (610,000 t), Norway (330,000 t), Brazil (240,000 t) and the United States (170,000 t). Ferrosilicon is primarily used by the iron and steel industry (see below) with primary use as alloying addition in iron or steel and for de-oxidation of steel in integrated steel plants.





# Health effects of silicon

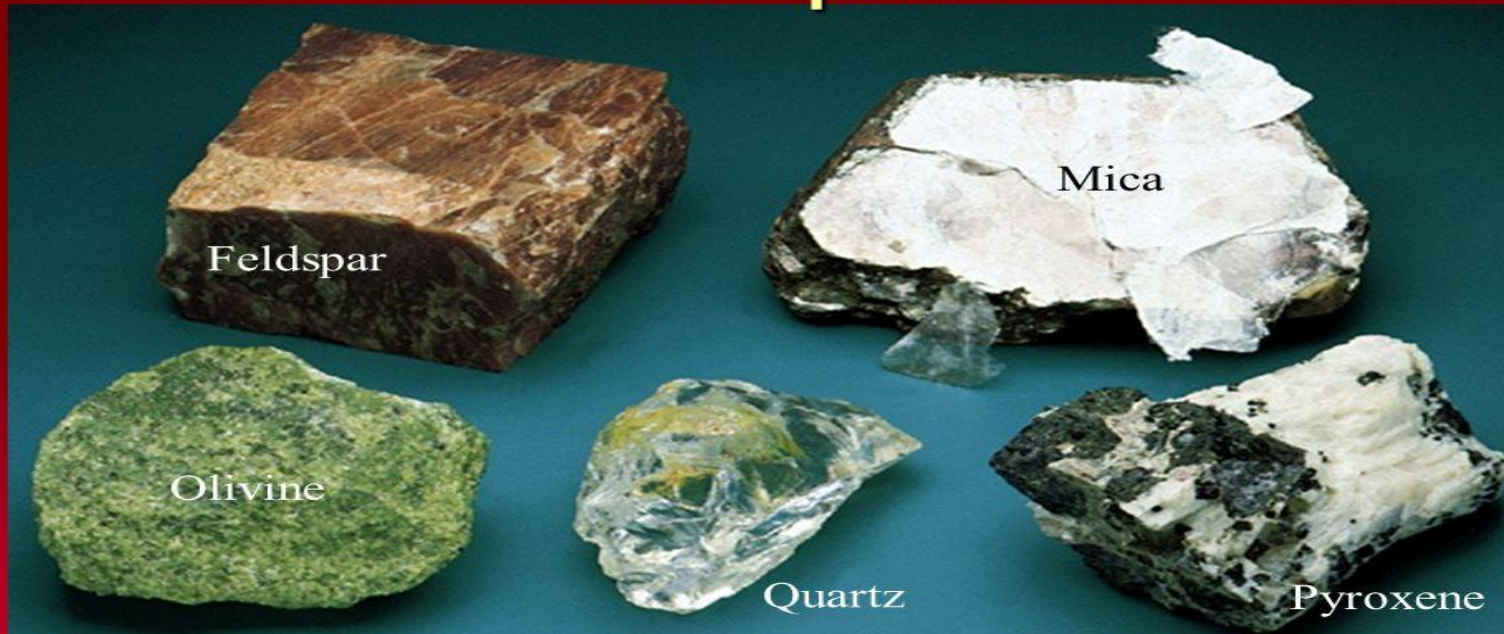
Silicon concentrates in no particular organ of the body but is found mainly in connective tissues and skin. Silicon is non-toxic as the element and in all its natural forms, namely silica and silicates, which are the most abundant.

Silicon crystalline irritates the skin and eyes on contact. Inhalation will cause irritation to the lungs and mucus membrane. Irritation to the eyes will cause watering and redness. Reddening, scaling, and itching are characteristics of skin inflammation.



- **Silicate minerals** are rock-forming minerals made up of silicate groups. They are the largest and most important class of rock-forming minerals and make up approximately 90 percent of the Earth's crust. They are classified based on the structure of their silicate groups, which contain different ratios of silicon and oxygen.

## Silicate Mineral Examples



# Silicate minerals

## ▣ Quartz $\text{SiO}_2$

- ▣ Quartz is one of the most common mineral in Earth's crust!
- ▣ Silica (Si) and Oxygen (O) are the only elements within pure quartz. If a cooling magma has silica leftover after feldspars form, quartz is likely to form.
- ▣ Quartz can be found in all sorts of rocks. Igneous rocks sometimes contain large quartz crystals. Metamorphic rocks such as gneiss also have large quartz crystals. Sedimentary rocks such as sandstone are often made of tons of little pieces of quartz crystals. In fact, most sand is made of quartz because it is hard and does not weather away easily. Some pieces of quartz are white like milk but most are clear like glass, sometimes with a little pink or gray tinge of color.

## *Olivine* $(\text{Mg, Fe})_2\text{SiO}_4$

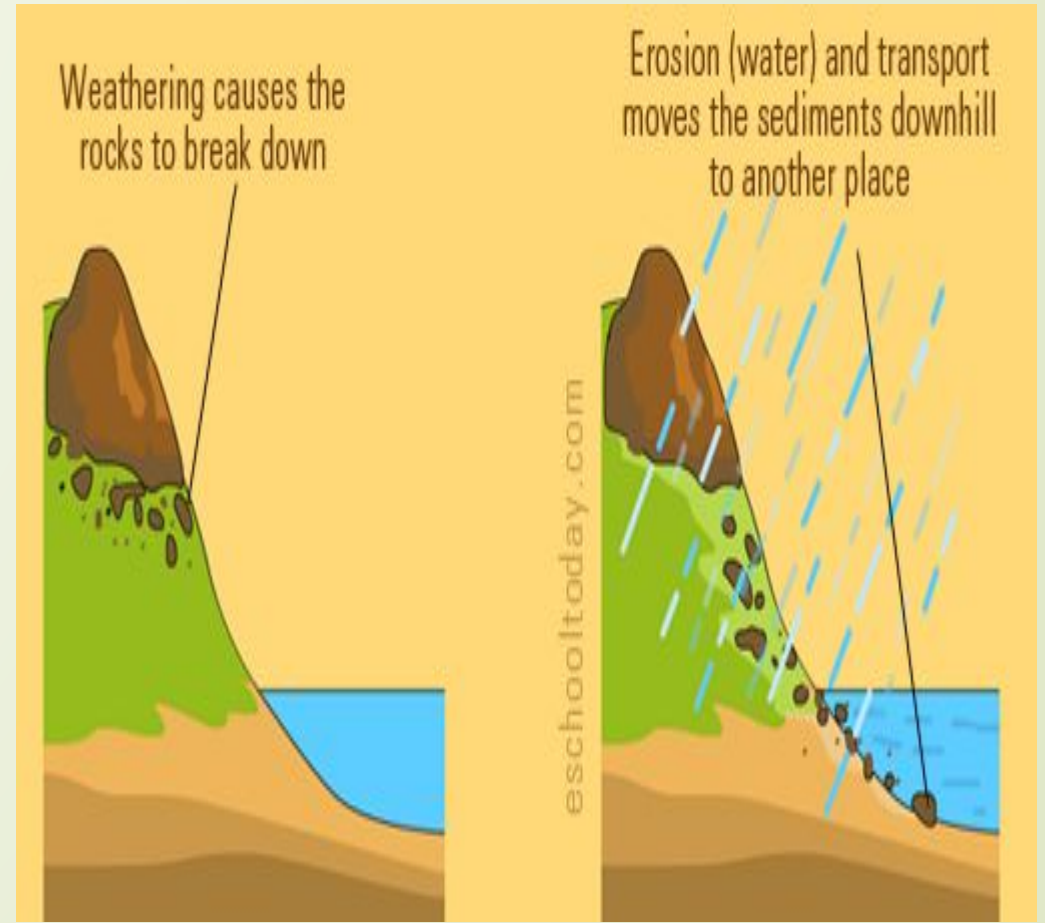
Olivine looks like little green crystals. It is typically found in some igneous and metamorphic rocks. Often the crystals are so small that you need to use your hand lens or magnifying glass to see them clearly.

- Shape: Orthorhombic (usually a many-sided prism that has an overall sphere shape)
- Luster: Greasy
- Color: Green (but sometimes yellow or brown)
- Streak: White
- Hardness: 6.5-7 on Mohs Hardness Scale
- Fracture: Conchoidal, brittle



# Weathering

- **Weathering** is the breaking down of rocks, soil and minerals as well as wood and artificial materials through contact with the Earth's atmosphere, waters and biological organisms. Weathering occurs *in situ* (on site), that is, in the same place, with little or no movement, and thus should not be confused with erosion, which involves the movement of rocks and minerals by agents such as water, ice, snow, wind, waves and gravity and then being transported and deposited in other locations.





Rocks gradually wear away. This is called weathering. There are three types of weathering:

1. **physical weathering**
2. **chemical weathering**
3. **biological weathering**

### 1) Physical weathering

- Physical weathering is caused by physical changes such as changes in temperature, freezing and thawing, and the effects of wind, rain and waves.

#### Wind, rain and waves

- Wind, rain and waves can all cause weathering. The wind can blow tiny grains of sand against a rock. These wear the rock away and weather it. Rain and waves can also wear away rock over long periods of time.

### 3) Biological weathering

Animals and plants can wear away rocks. This is called biological weathering. For example, burrowing animals such as rabbits can burrow into a crack in a rock, making it bigger and splitting the rock.

### 2) Chemical weathering

The weathering of rocks by chemicals is called chemical weathering. Rainwater is naturally slightly acidic because carbon dioxide from the air dissolves in it. Minerals in rocks may react with the rainwater, causing the rock to be weathered.

#### Acid rain

When fossil fuels such as coal, oil and natural gas are burned, carbon dioxide and sulphur dioxide escape into the air. These dissolve in the water in the clouds and make the rainwater more acidic than normal. When this happens, we call the rain '**acid rain**'.



# Weathering

- The breaking down of rock into smaller and smaller pieces.



# Weathering and Erosion

Painted Desert, Arizona



eschooltoday.com

Water collects in rock crack



1

Water freezes and expands, forcing crack to widen



2

Ice thaws, contracts and water gets deeper into cracks again



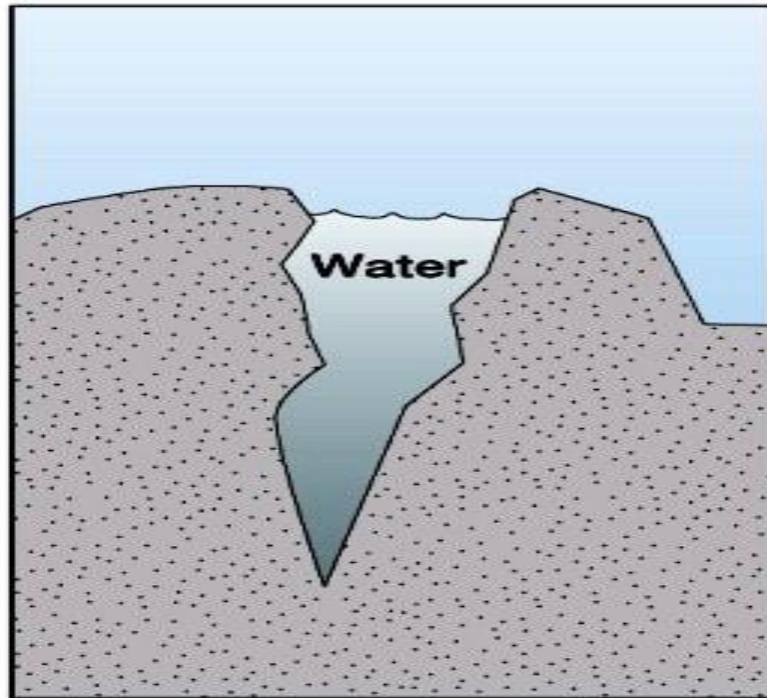
3

Repeated expansion and contraction causes further cracks till rock splits

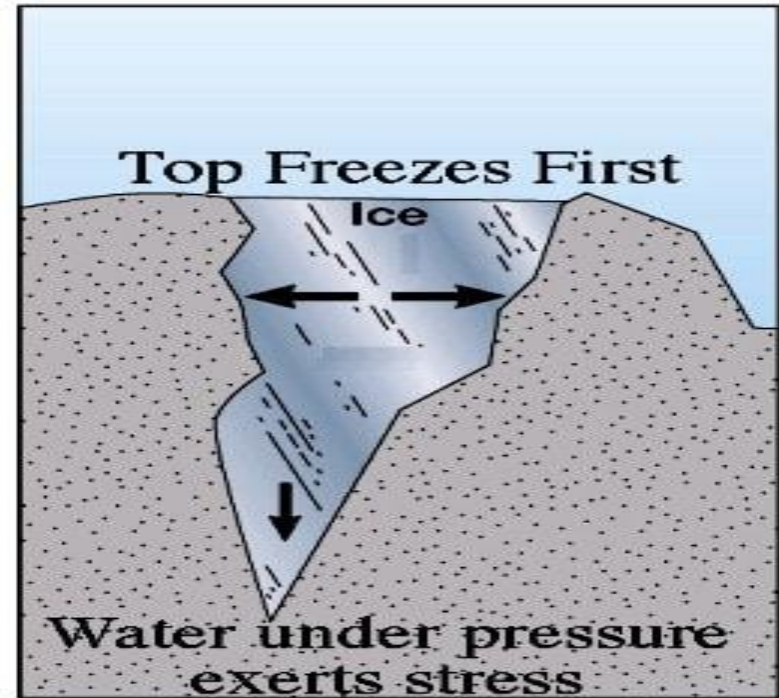


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(a)



(b)



THANK YOU  
FOR YOUR ATTENTION