SUGARNUTRITION
RESOURCE CENTRE

Where does sugar come from?

Where does sugar come from?

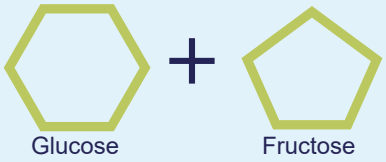
GROW | MILL | REFINE

WHAT IS SUGAR?

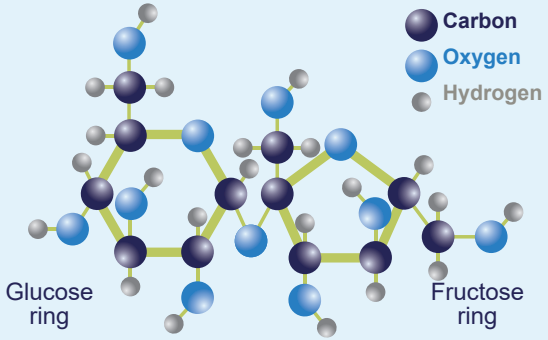
When we talk ‘sugar’ most people are referring to the sugar you find in the sugar bowl – table sugar.

Table sugar is made up of sucrose, a disaccharide of one glucose unit and one fructose unit. Sucrose has the chemical formula $C_{12}H_{22}O_{11}$.

Monosaccharides:



Sucrose (table sugar)
Disaccharide:



Sugar (Sucrose) molecule

HOW IS IT MADE?

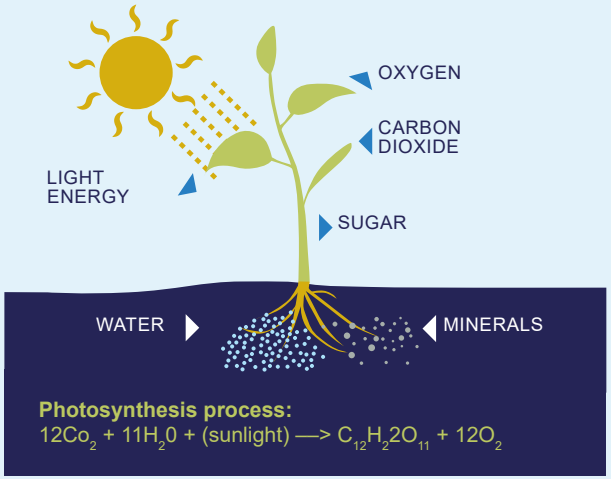
In Australia, sugar is made from the sugar cane plant. In other parts of the world sugar may be derived from cane, beet, palm trees and maple trees.

Sugar cane is a tropical grass which can grow to around 3-4 m tall, similar to bamboo. To grow well, sugar cane needs warm sunny weather (free from frost), well-drained and fertile soil, and lots of water (around 1,500 mm of rainfall a year or access to irrigation).

Sugar is made in the leaves of the plant by photosynthesis. Energy from the sun transforms carbon dioxide ($C0_2$) and water (H_20) into oxygen (0_2) and glucose with the aid of sunlight.

The plant absorbs water through its roots and 0_2 through pores in its leaves. The chlorophyll in the plant’s leaves helps to trap energy from the sun needed to kick-start this process.

Excess energy that the plant doesn’t need is stored as sugar in its fibrous stalks as a sweet juice. It is this juice that is harvested to produce raw sugar when the plant is ‘ripe’ or ‘mature’.



WHERE DOES IT GROW IN AUSTRALIA?

Sugar cane can be seen growing along the 2,100 km stretch of coastline between Mossman in north Queensland to Grafton in northern New South Wales.

SUGARNUTRITION RESOURCE CENTRE

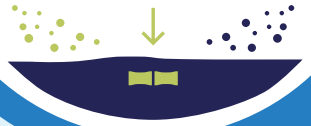
GROW | MILL | REFINE

The growing process:

PLANTING

Most sugar cane is grown on family owned and operated farms. Sugar cane is grown by replanting 40 cm lengths of mature cane which are called ‘setts’.

Setts are planted by machines which drop them into furrows, add fertiliser and cover them with soil. The crop that arises from this process is called a ‘plant’ crop.



GROWING

Within two to four weeks of planting new shoots will start to break through the soil. These shoots come from buds on the joints of the setts planted. Each sett can shoot around 12 stalks which forms what is called a ‘stool’.

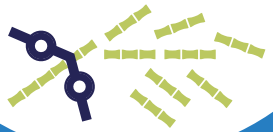
In north Queensland, it takes nine to 16 months for a crop to grow. In northern NSW, due to the cooler weather, it takes a little longer – usually 18-24 months.

Sugarcane will also grow a ratoon crop from regrowth or stubble. During harvesting the roots and lower section of the plant are left in the ground. These then re-shoot and produce a second, third, fourth or even fifth-crop depending on the health of the roots.

HARVESTING

Harvesting takes place annually between June and December. Harvesters cut the cane stalks off at the base and chops it into 30 cm lengths called ‘billets’. The billets are collected by a second vehicle which drives beside the harvester.

In most areas, the unwanted leaves are chopped up and blown out of the harvester to cover the ground as a thick layer of mulch ready to nourish the next crop.



TRANSPORT

Once cut, the sugar cane is transported to the mills within 16 hours, either by road or by rail in mill bins which go directly to the allocated mill.‘

YIELD

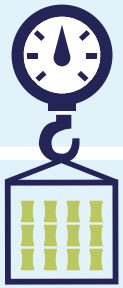
One hectare of land will typically produce around 93 tonnes of cane. This much cane will then produce 12 tonnes of raw sugar. Up to 35 million tonnes of cane is produced each year in Australia, equalling around 4.6 million tonnes of raw sugar.

SEE INFO SHEET: MILL for the next step of the process

Where does sugar come from?

GROW | **MILL** | REFINE

The milling process can be broken down into the following steps:



1 WEIGH

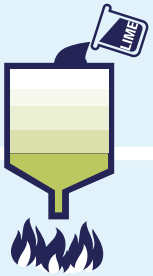
Sugar cane billets arrive at the mill where each load is weighed by automatic weigh stations.

2 SHRED

The billets are tipped onto a cane carrier and taken to the shredder. The shredder chops and shreds the cane, rupturing the juice cells.

3 CRUSH

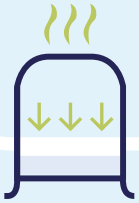
The cane is then crushed by a series of rollers. The rollers are arranged into a triangle formation. This process produces sugar juice and bagasse (the dry, pulpy residue left after the juice is extracted).



4 CLARIFY

(a) Lime is added to the extracted juice which is then heated to remove impurities. The lime neutralises acids and precipitates impurities in large vessels called clarifiers. The clear sugar juice is run off the top of each clarifier.

(b) The muddy juice at the bottom of the clarifiers is extracted, mixed with bagasse, and sent back to the farms as fertiliser.



5 CONCENTRATE

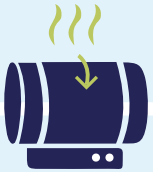
The clear juice is concentrated by boiling under a vacuum into a syrup.

6 CRYSTALISE

The syrup is further concentrated and seeded with small sugar crystals. The sugar crystals then grow to the required size. Once they reach the correct size, the crystals and remaining syrup are discharged from the pan.

7 CENTRIFUGE

The syrup and crystals are separated by spinning at high speeds in centrifugals. The dark syrup is 'thrown off' and passes through perforations in the machine. The spin off syrup is boiled down again (often multiple times) to get the maximum number of crystals. The final syrup is molasses.



8 DRY

The crystals are dried by tumbling them through a stream of hot air in a rotating drum.

9 STORAGE

The raw sugar which is not food-grade is then stored or transported from the mill.

MILLING

- There are 24 working sugar mills in Australia. 21 of these are in Queensland and three are in northern New South Wales.
- Because sugar cane needs to be transported to the mills within a short time frame after it is harvested, the mills are located in the sugar growing areas.
- Sugar mills crush the cane to extract and separate the sucrose from the water, impurities and plant fibres contained in the billets.
- Mills typically run from June – December each year. This can change depending on the weather.
- The sugar produced from a sugar mill is not food grade. The raw sugar from a mill must go through a refining process until it is suitable for human consumption.
- The by-products from the milling process can be made into many other products, some which are listed on the right. Sugar cane is also the only crop in the world that can provide its own processing energy. The bagasse produced after the crushing stage is used to make electricity. During the crush season mills actually put electricity back into the grid, rather than taking it.

SEE INFO SHEET: REFINE for the next step of the process

Where does sugar come from?

GROW | MILL | REFINE

The purpose of sugar refining is to convert non-food-grade raw sugar into food-grade consumer products and a manufacturing raw material.

1 UNLOAD & STORE

Sugar arrives at the refinery and is transported to a bulk raw sugar store. These stores can often hold tens of thousands of tonnes of sugar in large piles. Traps doors in the floor release the sugar at a controlled rate onto conveyor belts which take the sugar to the main refinery areas.

2 AFFINATION

Raw sugar is mixed with hot, concentrated syrup. This process is called affination and softens the hard, molasses coating on the outside of raw sugar crystals.

When the mixed syrup and crystals are spun at high speeds in a centrifuge they separate. Hot water is sprayed during this process to help force the syrup and impurities through the holes in the basket. The remaining sugar crystals are 'affined raw sugar crystals'. This process removes around 50% of the colour from raw sugar.

3 MELTING

The affined raw sugar is dissolved in hot/ recycled water at 80 degrees to form 'sugar liquor' or 'melter liquor'.

The sugar content of this liquor is 65-68%. The sugar liquor is passed through a coarse screen to remove large particulate matter.

4 PURIFICATION

There are several purification processes used in refining, the two main ones are carbonatation and phosphatation:

a) Carbonatation

Lime is added to the liquor and carbon dioxide is bubbled through the mixture. The lime and carbon dioxide react to form a chalk of calcium carbonate. Colour impurities cling to the chalk which then acts as a filter aid as the liquor is passed through further filters.

b) Phosphatation

Lime and phosphoric acid are added to the liquor, and fine bubbles of air are introduced along with a flocculent before the mixture is fed into a large clarifier. The lime and acid react to form a calcium carbonate "scum", which the flocculent binds together as it attaches itself to the air bubbles and is floated off of the top. The scum removes colour impurities and small particulate matter as it forms and floats.

5 DECOLOURISATION

The filtered sugar is passed through either activated carbon or ion exchange resin, which acts as a scavenger, removing organic and other residual material, further filtering and decolourising the liquor.

6 EVAPORATION

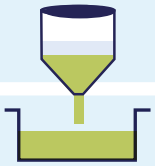
Excess water is removed from the liquor by passing it through a triple effect evaporator. This concentrates the liquor for 65% sugar content to 75-78% sugar content in an energy efficient way.

7 STERILISATION

At this stage the liquor is very clear. It is passed through UV light steriliser to make the sugar solution sterile.

8 CRYSTALLISATION

The liquor is moved to 'vacuum pans' where it is seeded to grow the right sized sugar crystals. Flash evaporation and boiling the liquor in a vacuum pan allows the solution to boil at a lower temperature, reducing colour formation and produces sugar crystals of desired size.

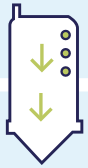


9 REFINED FUGALS

The solution moves to its final centrifuge. The refined fugals remove the syrup and wash the white sugar crystals. The syrup is either returned to the pans to grow more or concentrated so it can be used to produce soft brown sugar, coffee crystals, golden syrup or treacle.

10 DRYING

The excess moisture in the white sugar is removed by a stream of warm dry air in a rotary drier.



11 CONDITIONING

The sugar from the driers is conditioned to improve its storage capabilities. This is done in a conditioning silo where the sugar is kept in continual movement and dehumidified air is passed through it.

12 STORAGE OR PACKING

The final product is then stored, transported or packaged into retail products.

DID YOU KNOW?

It is thought that sugar was first used in the Melanesian Islands around 5,000 years ago. Sugar cane was brought to Australia in 1788 on the ships of the First Fleet, however the first successful sugar cane farm was not established until 1862 near Brisbane. Some other little known facts about sugar include:

- Sugar cane farms are often located close to natural resources including rainforests and the Great Barrier Reef. As a result growers continue to work to use the latest technology to improve their efficiency sustainability and productivity. More information can be found at www.sugarresearch.com.au
- There are many 'types' of sugar made from sugar cane. These include brown sugar, table sugar, castor sugar, icing sugar and coffee sugar. They vary mainly on the size of the sugar crystal and the amount of molasses in the final product. The molasses gives the product the golden brown colour.
- Table sugar has a medium GI of 65. In comparison, coconut sugar (from the coconut blossom) has a low GI of 54, rice malt syrup a high GI of 98 and agave sugar has a low GI of 10-19. However, nutritionally, in the quantities recommended to be consumed there is very little nutritional difference between these products.
- Around 80% of the raw sugar grown and milled in Australia is exported. It is considered the second largest export crop in Australia.
- Whilst New Zealand does not grow its own sugar cane, it does have the ability to refine bulk raw sugar.

SUGARNUTRITION
RESOURCE CENTRE

More information available at www.sugarnutritionresource.org