Resourcing tomorrow

Australian Mining

Produced by the
Minerals Council of Australia

THE *Original* EDITION

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minerals.org.au

Everyday things mining makes possible

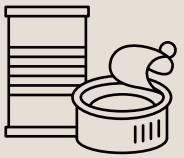
01	Electricity	16	Batteries
02	Food processing	17	Commercial printing
03	Health care	18	Dentistry
04	Smartphones	19	Funerals
05	White goods	20	Film & television
06	Electric cars	21	Meat & vegies
07	Defence	22	Home protection
08	Solar panels	23	Environmental solutions
09	Your house	24	Melbourne Cup
10	Public transport	25	Birthing suites
11	Cleaning products	26	Brewing beer
12	Sydney Harbour Bridge	27	Lenses & telescopes
13	Gaming consoles	28	Roads & rail
14	Personal hygiene	29	Wind farms
15	Currency	30	Space travel

13
Al
Aluminium

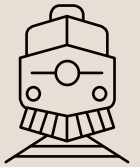
Aluminium

COMMON USES

Aircraft



Canned food



Transport

Housing

Cookware

Bicycles

DID YOU KNOW?

Wrapped in aluminium
Life Savers and Toblerone chocolate bars were among the first commercial uses of aluminium foil. Swiss chocolatier Tobler began wrapping bars in rolled foil in 1911. In the United States, aluminium replaced tin foil Life Saver wrappers in 1925.

PROPERTIES

Symbol	Al
Atomic number	13
Atomic mass	26.98 u
Melting point	660°C
Electron configuration	[Ne] $3s^2\,3p^1$

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01 Electricity

Energy generation

- 6 **C** — Carbon
- 92 **U** — Uranium

Fluorescent lighting

- 57 **La** — Lanthanum
- 39 **Y** — Yttrium
- 65 **Tb** — Terbium

Production and transmission

- 26 **Fe** — Iron
- 29 **Cu** — Copper
- 13 **Al** — Aluminium

LED lights

- 31 **Ga** — Gallium
- 58 **Ce** — Cerium
- 63 **Eu** — Europium
- 65 **Tb** — Terbium

Halogen

- 26 **Fe** — Iron
- 74 **W** — Tungsten
- 24 **Cr** — Chromium

Electricity travels at around 90 per cent of the speed of light.

Australia is an energy powerhouse

Australia exports more than three-quarters of its energy output and plays a critical role supplying the minerals needed for global decarbonisation, such as lithium, nickel and rare earth elements. At home, the royalties and company tax paid by mining helps the government afford services and infrastructure like schools, hospitals and roads.

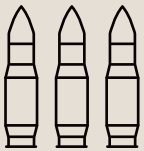
51
Sb
Antimony

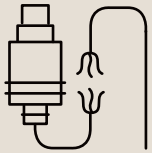
Antimony

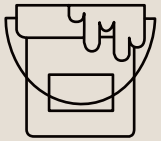
COMMON USES

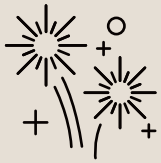

Batteries


Fire retardant


Ammunition


Cable sheathing

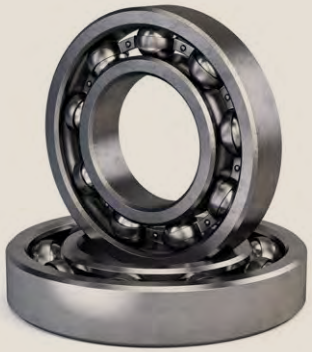

Paint


Fireworks

DID YOU KNOW?

The everlasting pill

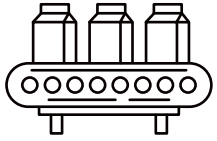
Antimony was a popular remedy in the 19th century for the chronically constipated. Ingested as a small metal ball, it became known as the everlasting pill and would be collected and reused, sometimes passed down through generations.



PROPERTIES

Symbol	Sb
Atomic number	51
Atomic mass	121.76 u
Melting point	630°C
Electron configuration	$[Kr]\,4d^{10}5s^{2}5p^{3}$

minerals.org.au



Machinery used to manufacture food

26	6	24	42	25	28
Fe	C	Cr	Mo	Mn	Ni
Iron	Carbon	Chromium	Molybdenum	Manganese	Nickel

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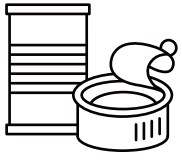


Aluminium 13 Al

Foil packets
Drink cans

Coca-Cola uses 300,000 tons of aluminium every year in the US – 17.4% of total US aluminium production

MINING MAKES THE PRESERVATION OF FOOD POSSIBLE

Tin 50 Sn — Canning (tin-coated steel)

Copper 29 Cu — Alloys reduce food contamination

Sodium 11 Na — Flavour enhancer
Preservative

02 Food processing

Chromium 24 Cr

Blender blades
Machinery plating

Sustainable aluminium

Rio Tinto and Alcoa are developing breakthrough technologies for carbon-free aluminium smelting. Aluminium produced through ELYSIS, the name given the tech partnership, has already been used by Apple for its products and Audi for the wheels on its eTron GT. The focus now is developing the technology for eventual commercial use at scale.

5
B
Boron

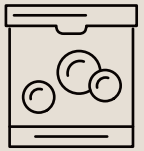
Boron

COMMON USES

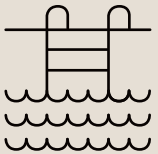
Tile glazes

Rocket propellant

Fireworks



Washing powder



Pool cleaner

Eye drops

DID YOU KNOW?

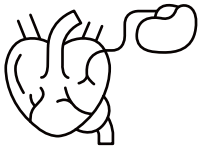
The artisan's compound

Boron compounds have been used for thousands of years. Borax, a composite of boron, sodium, oxygen and water, was mined from salt lakes in Tibet and Kashmir as early as 2000 B.C. It was used by gold and silversmiths and pottery makers.

PROPERTIES

Symbol	B
Atomic number	5
Atomic mass	10.811 u
Melting point	2076°C
Electron configuration	[He] $2s^2 2p^1$

minerals.org.au



Platinum **78 Pt**
Pacemakers
Medical apparatus

Copper **29 Cu**
Kills surface microbes and reduces infections
Electronic devices

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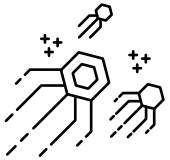
Titanium **22 Ti**
Artificial joints
Prosthetic limbs
Surgical equipment

Lithium **3 Li**
Treatment of bipolar disorder
Medical implant batteries

Metal-based compounds are crucial to the diagnosis and treatment of disease.



Uranium **92 U**
Imaging
Radiation therapy

Silver **47 Ag**
Anti-bacterial
Aids healing

Niobium **41 Nb**
Medical devices

Gadolinium **64 Gd**
MRIs and x-rays
Diagnostic tracer

Gold **79 Au**
Cancer treatment
Diagnosis

03 Health care

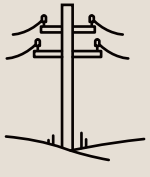
Gold nanoparticle technology

The nanotechnology boom has opened up a new frontier of early detection, diagnosis and treatment of diseases. Gold nanoparticle technology is being used to target and deliver antibodies directly into cancerous tumors. They are also being engineered to attach to cancer-related proteins to aid earlier detection.

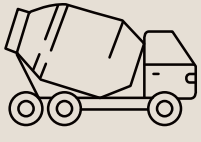
6
C
Carbon

Carbon

COMMON USES



Electricity

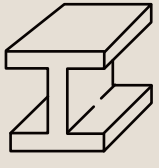


Cement

Carbon fibre

Wind turbines

Water filtration

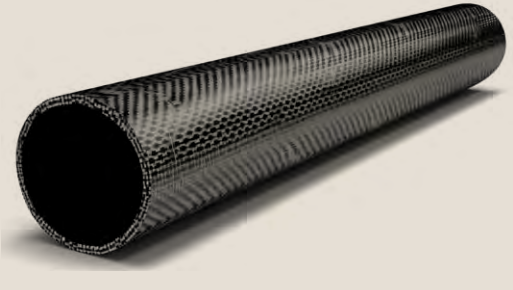


Steel

DID YOU KNOW?

Giant swamp plants

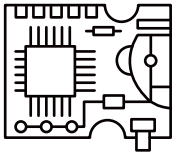
The energy we get from coal today comes from giant swamp plants that lived before the dinosaurs. Sound far-fetched? All living plants store solar energy. Coal is the product of decaying plant matter that millions of years ago locked in this energy.



PROPERTIES

Symbol	C
Atomic number	6
Atomic mass	12.011 u
Melting point	3,550°C
Electron configuration	[He] $2s^2 2p^2$

minerals.org.au



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Electronics

79	29	47	73	74
Au	**Cu**	**Ag**	**Ta**	**W**
Gold	Copper	Silver	Tantalum	Tungsten

Battery

13	3	27
Al	**Li**	**Co**
Aluminium	Lithium	Cobalt

Touch screen

14	50	19
Si	**Sn**	**K**
Silicon	Tin	Potassium

49	13	31
In	**Al**	**Ga**
Indium	Aluminium	Gallium

More than 40 mined metals and rare earths are used to produce a single smartphone.

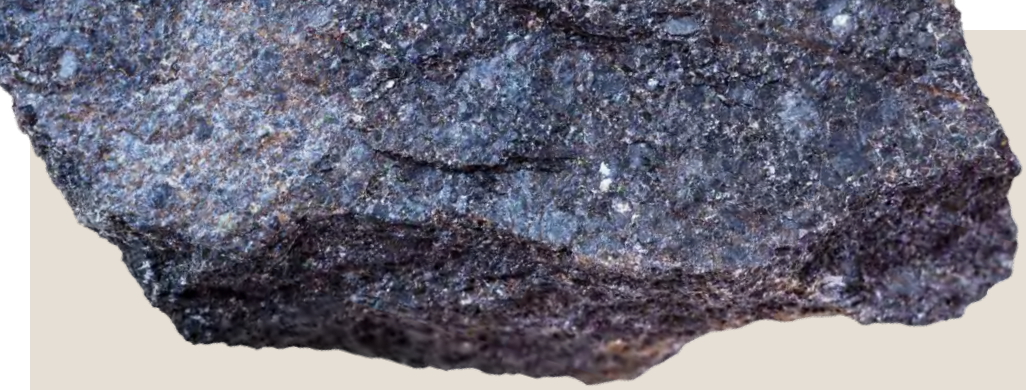
Sound

60	62	28	59
Nd	**Sm**	**Ni**	**Pr**
Neodymium	Samarium	Nickel	Praseodymium

04 Smartphones

Modern day gold mine

E-scrap is one of the fastest growing segments of the recycling industry. While the gold in a smartphone is not worth a lot on its own (a couple of dollars), it adds up when e-waste is recycled by the tonne. A tonne of smartphones contains around 10 troy ounces of gold, while 200 laptops yields around 5 troy ounces, according to Dell.

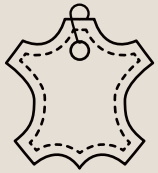


24
Cr
Chromium

Chromium

COMMON USES


Utensils


Leather tanning


Chrome plating


Wood preservation


Fireworks


Dyes & inks

DID YOU KNOW?

Chromium-tipped swords
Chrome plating might be synonymous with the modern era, but it was also used as early as the Qin Dynasty in China. Archaeologists discovered swords tipped with chromium oxide during the unearthing of the Terracotta Army in the 1970s.

PROPERTIES

Symbol	Cr
Atomic number	24
Atomic mass	51.9961 u
Melting point	1,907°C
Electron configuration	[Ar] $3d^5 4s^1$

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Steel used to build white goods

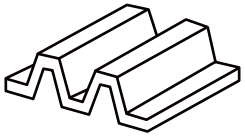
26	6	27
Fe	**C**	**Co**
Iron	Carbon	Cobalt

Titanium **22 Ti** Paint and some finishes

Copper **29 Cu** Electrical wiring Compressors

MINING MAKES THE PRODUCTS THAT MAKE EVERY DAY POSSIBLE

Aluminium **13 Al** Condenser Fan blades



Stainless steel

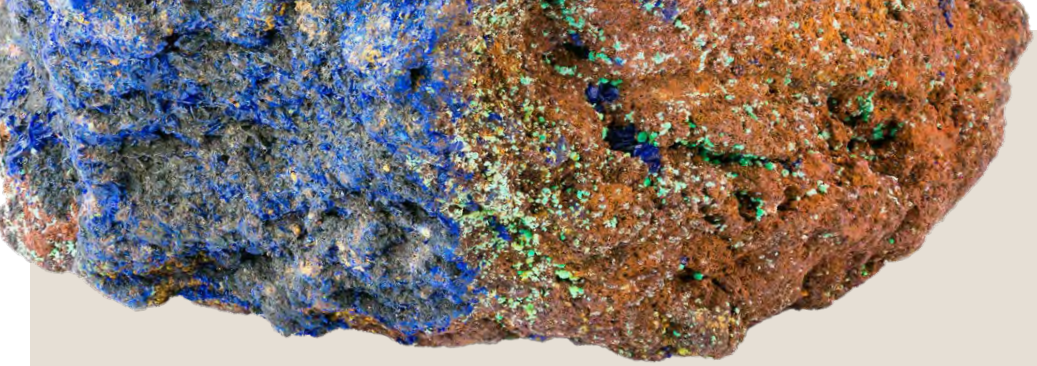
26	24	14
Fe	**Cr**	**Si**
Iron	Chromium	Silicon
6	**28**	**25**
C	**Ni**	**Mn**
Carbon	Nickel	Manganese

More than 75% of fridges sold in Australia are now stainless steel.

05 White goods

Lost Sock Index

Scientists devised a 'Sock Loss Index' to find out why socks go missing in the wash. This formula *(L(p x f)+C(t x s))–(P x A)* explains why Britons lose on average 1.3 socks a month. Unsurprisingly it's down to the complexity and care taken while doing laundry. The research was clever marketing by a white goods company.

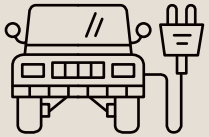


27
Co
Cobalt

Cobalt

COMMON USES


Batteries


Electric cars


Ceramics


Wind turbines


Medical tracer


Jet engines

DID YOU KNOW?

From pigment to superalloy

Cobalt has provided the striking blue pigment used by potters and artisans to colour their wares for centuries. Today the indispensable metal is also used to make rechargable batteries, such as those in EVs and smartphones, and as a critical superalloy in aerospace and defence industries.

PROPERTIES

Symbol	Co
Atomic number	27
Atomic mass	58.93 u
Melting point	1,495°C
Electron configuration	[Ar] $3d^7 4s^2$

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Car body and chassis
(strengthened steel and aluminium alloys)

26	25	23	42	13	12
Fe	Mn	V	Mo	Al	Mg
Iron	Manganese	Vanadium	Molybdenum	Aluminium	Magnesium

MINING MAKES THE CARS OF TODAY AND TOMORROW POSSIBLE

In 1899, 90% of New York City's taxi cabs were electric vehicles.

Cerium
58
Ce

LCD screens
Windscreens

Magnets in EV motors

66	60
Dy	Nd
Dysprosium	Neodymium

EV batteries

3	27	28	6
Li	Co	Ni	C
Lithium	Cobalt	Nickel	Carbon

Copper
29
Cu

Connectors
Brakes
Bearings

06 Electric cars

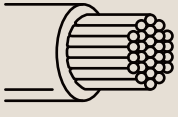
Electric cars aren't new

London inventor Thomas Parker designed and built the first practical electric car in 1884. In the 19th and early 20th centuries, electric cars fueled by high-capacity rechargeable batteries were the most popular cars on the road. It wasn't until a more advanced combustion engine and the expansion of highways that sales dropped off.

29
Cu
Copper

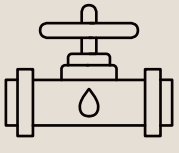
Copper

COMMON USES

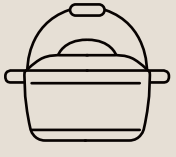


Electrical wiring

Circuit board

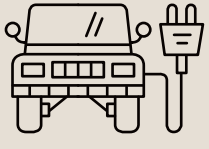


Plumbing



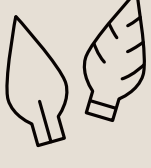
Homewares

Instruments



Electric cars

DID YOU KNOW?



Humankind's oldest metal

Copper is considered to be humankind's oldest metal. It is thought that Neolithic communities used copper as an alternative to stone tools during 8000 B.C. Ancient Egyptians believed copper was sacred and gave its wearer magical powers.

PROPERTIES

Symbol	Cu
Atomic number	29
Atomic mass	63.546 u
Melting point	1,083°C
Electron configuration	[Ar] $3d^{10}4s^{1}$

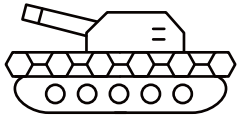
Silver 47 **Ag**
Navigation
Radio equipment

Neodymium 60 **Nd**
Communications
Missiles

Samarium 62 **Sm**
Jet aircraft
Missiles

Rhenium 75 **Re**
Exhausts
Turbine fans

Antimony 51 **Sb**
Ammunition



Australia's F-35A Lightning II fighter jets can travel at 1.6 times the speed of sound – or almost 2000 km/h.

Manganese 25 **Mn**
Batteries
Ship building
Jet engines

Germanium 32 **Ge**
Fibre optics
Infrared optics
Electronics

MINING MAKES PROTECTING OUR NATION POSSIBLE

Vanadium 23 **V**
Armor plating

Yttrium 39 **Y**
Targeting systems
Radar

07 Defence

Augmented reality helmets

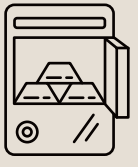
Australia's F-35A Lightning II fighter pilots wear custom-made augmented reality helmets worth upwards of US$400,000 each. Made of Kevlar and carbon fiber, the helmets are packed with electronics that project data inside the visor. Vision from sensors located around the aircraft allow pilots to effectively see 'through' the jet.

79
Au
Gold

Gold

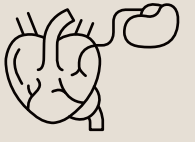
COMMON USES

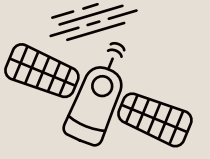

Awards


Investment

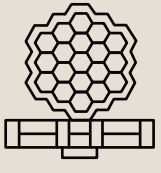

Electronics


Jewellery


Advanced health


Aerospace

DID YOU KNOW?



James Webb Telescope
NASA's James Webb Space Telescope is equipped with 18 gold-coated hexagon mirrors that reflect infrared light to observe the earliest formation of stars and search for potentially habitable exoplanets. It is so sensitive to infrared light it can detect the heat signature of a bumblebee at the distance of the moon.

PROPERTIES

Symbol	Au
Atomic number	79
Atomic mass	196.97 u
Melting point	1,064°C
Electron configuration	$4f^{14}\ 5d^{10}\ 6s^{1}$

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Resourcing Tomorrow
Australian Mining

Solar panels

14 Si	48 Cd	52 Te	4 Be	42 Mo	47 Ag	49 In
Silicon	Cadmium	Tellurium	Beryllium	Molybdenum	Silver	Indium

Semi-conductor

- 32 Ge — Germanium
- 31 Ga — Gallium

Frame

- 13 Al — Aluminium
- 22 Ti — Titanium
- 30 Zn — Zinc
- 12 Mg — Magnesium

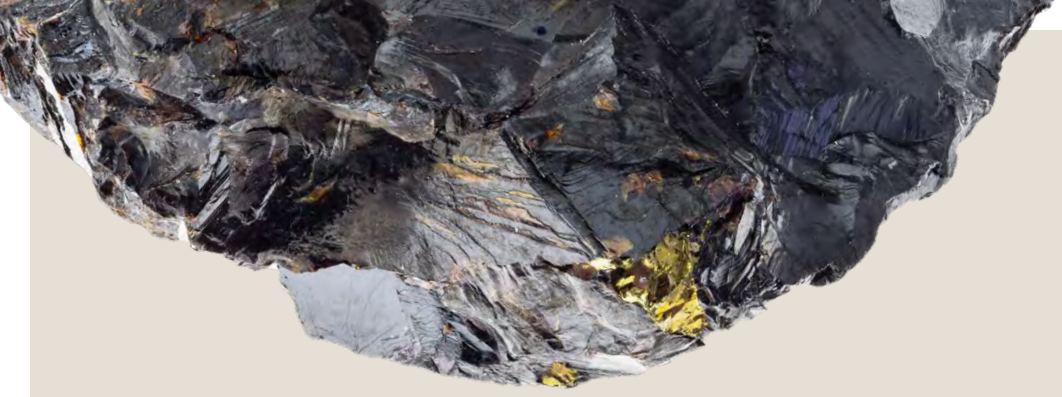
08 Solar panels

Rooftop solar accounted for 25.8% of Australia's total renewable energy generation in 2022.
Clean Energy Council

Copper: 29 Cu — Wiring

Solar-powered mine sites

Australia's mining industry is playing a key role in the deployment of solar power. Not only is the sector providing the silica sands to manufacture solar panels, mines are installing large solar farms near their operations to reduce reliance on fossil fuels as part of their commitments to achieving net zero carbon emissions.



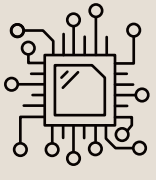
49
In
Indium

Indium

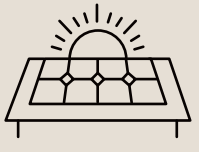
COMMON USES

Touchscreens

Protective eyewear

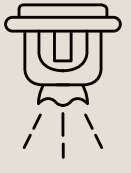


Microchips



Solar panels

LCD televisions

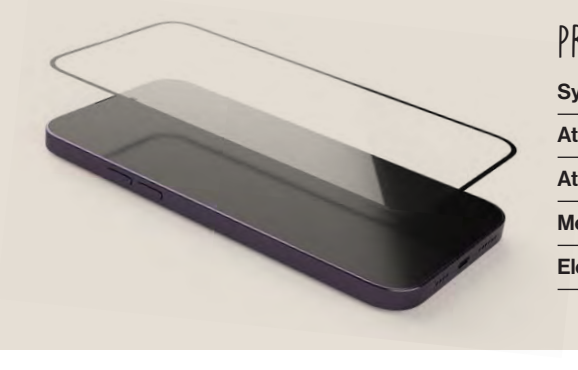


Fire sprinklers

DID YOU KNOW?

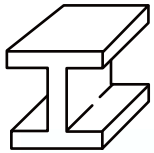
Cut with a knife

After a century of near obscurity, Indium is having its moment. Indium tin oxide is the material used for touch and flat screen tech and solar panels. Soft enough to cut with a knife, indium is also notable for the high pitched 'cry' it gives off when bent.



PROPERTIES

Symbol	In
Atomic number	49
Atomic mass	114.818 u
Melting point	156.6°C
Electron configuration	[Kr] $4d^{10}5s^{2}5p^{1}$



Steel

26	24	25	42	23	28
Fe	**Cr**	**Mn**	**Mo**	**V**	**Ni**
Iron	Chromium	Manganese	Molybdenum	Vanadium	Nickel

Carbon 6 **C**

Mortar
Concrete

House paint

Titanium 22 **Ti**

Zinc 30 **Zn**

Copper 29 **Cu**

Plumbing
Electrical wiring
Air conditioning

Aluminium 13 **Al**

Cladding
Window frames
Fixtures

Australia's property market reached $10.1 trillion in 2023, according to CoreLogic.

09 Your house

Solder

82	50
Pb	**Sn**
Lead	Tin

House blocks are shrinking

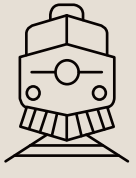
While house blocks might be shrinking, Australians still have an appetite for relatively large houses compared to the rest of the world. The average house block decreased by 13 per cent (64 square metres) over the last decade while the average house shrunk by just three square metres, according to the ABS.

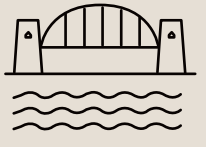
26
Fe
Iron

Iron

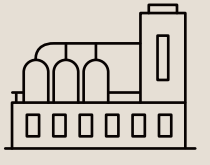
COMMON USES

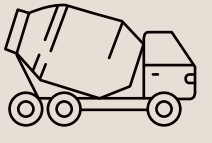

White goods


Public transport


Roads & bridges


Cities


Manufacturing


Cars & trucks

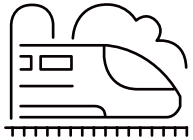
DID YOU KNOW?

Armored snails

A deep-sea snail has evolved a suit of armor made from iron sulfide – the only animal on earth that uses iron in this way. The scaly-foot gastropod was discovered in 2001 and lives in the hydrothermal vent fields of the Indian Ocean.

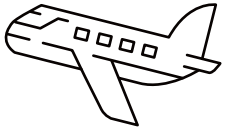
PROPERTIES

Symbol	Fe
Atomic number	26
Atomic mass	55.845 u
Melting point	1,538°C
Electron configuration	[Ar] $3d^6 4s^2$



Trains, trams, buses and taxis

26	13	25	42	12	23
Fe	Al	Mn	Mo	Mg	V
Iron	Aluminium	Manganese	Molybdenum	Magnesium	Vanadium



Aircraft

Aluminium	13 Al	Scandium	21 Sc
Niobium	41 Nb	Neodymium	60 Nd
Titanium	22 Ti	Zinc	30 Zn

Air conditioning

26	14	29	13
Fe	Si	Cu	Al
Iron	Silicon	Copper	Aluminium

GPS and electronics

29	29	50
Cu	Au	Sn
Copper	Gold	Tin

10 Public transport

Melbourne has the world's largest tram network with 250 km of track.

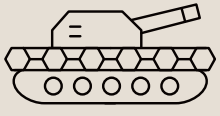
Public transport usage

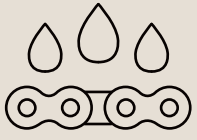
Over 12 million Australians use public transport in an average three-month period, according to Roy Morgan in 2023. That includes 3.4 million Sydneysiders, equal to 76 per cent of the city's population, and over 3 million Melburnians (71 per cent of the population). Although the pandemic put a dent in the numbers, usage is on the rise again.

3
Li
Lithium

Lithium

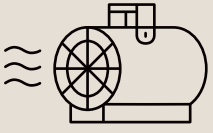
COMMON USES

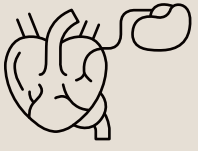

Armour plate


Lubricant

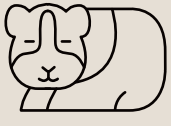

Batteries


Mental health


Industrial drying


Pacemaker

DID YOU KNOW?

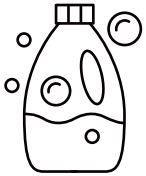


Medicinal power of lithium
An Australian POW discovered the medicinal power of lithium in 1949. Dr John Cade survived three and a half years at Changi before returning to his work in Australia where he successfully treated patients after noting the calming effects on guinea pigs.

PROPERTIES

Symbol	Li
Atomic number	3
Atomic mass	6.941 u
Melting point	180.5°C
Electron configuration	$1s^2 2s^1$

minerals.org.au



Resourcing Tomorrow
Australian Mining

Sodium 11 **Na**
Detergents
Oven cleaner
Drain opener

Boron 5 **B**
Cleansers
Water softener
Detergents

Zinc 30 **Zn**
Plastic bottles
Soaps

MINING MAKES THE UNAVOIDABLE POSSIBLE

Phosphorus 15 **P**
Laundry powders
Dish detergent

Chlorine 17 **Cl**
Bleach
Pool cleaner

Silicon 14 **Si**
Steam cleaning
Furniture polish

Carbon 5 **C**
Plastic bottles
Stain remover

Salt has been used as a natural scourer since medieval times.

11 Cleaning products

Iodine 53 **I**
Disinfectants
Sanitisers

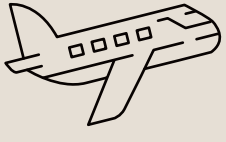
Tomato sauce and elbow grease

Tomato sauce and elbow grease can make blackened pots and pans and tarnished brass objects shine like new. The acetic acid in tomato sauce breaks down the copper oxide that builds over time. Apply a layer of tomato sauce to the discoloured surface, leave for half an hour and then scrub to a shine.

12
Mg
Magnesium

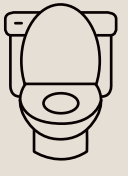
Magnesium

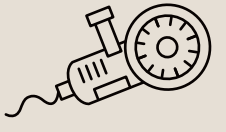
COMMON USES

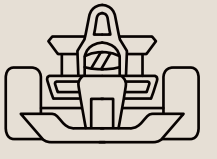

Aircraft


Fireworks

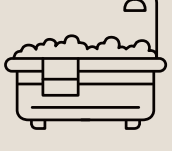

Cameras


Laxatives


Power tools

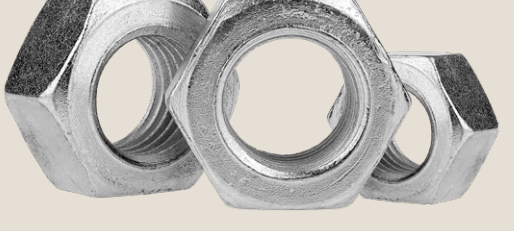

Racecars

DID YOU KNOW?



Salve for weary bones

Epsom Salts originated from natural springs discovered in 1618 by cow-herd Henry Wicker in Epsom, England. The water's healing properties led physician and botanist Nehemiah Grew to extract the magnesium sulfate for medicinal purposes in 1695.



PROPERTIES

Symbol	Mg
Atomic number	12
Atomic mass	24.305 u
Melting point	650°C
Electron configuration	[Ne] $3s^2$

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Australian Mining

Electrified rail

29	6
Cu	C
Copper	Carbon

Steel beams and supports

6	26	14	25
C	Fe	Si	Mn
Carbon	Iron	Silicon	Manganese

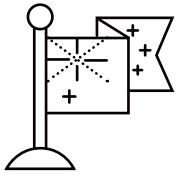
Fireworks

Antimony	Zinc	Titanium	Barium	Strontium	Copper
51	30	22	56	38	29
Sb	Zn	Ti	Ba	Sr	Cu
Glitter	Smoke	Whites	Greens	Reds	Blues

Before he made throwing a shrimp on the barbie famous, Paul Hogan worked as a rigger building the bridge.

Flag pole

13	30
Al	Zn
Aluminium	Zinc



12 Sydney Harbour Bridge

Building the bridge

The Sydney Harbour Bridge took eight years, 1400 men, 53,000 tonnes of steel and 6 million hand-driven rivets to build. Labor Premier Jack Lang opened the bridge on 19 March 1932. The ceremony was briefly interrupted when ex-servicemen Francis de Groot charged on horseback and cut the ribbon with his sword.

25
Mn
Manganese

Manganese

COMMON USES

Magnets

Deoxidiser

Fertiliser

Animal feed

Steel

Colourant

DID YOU KNOW?

Restoring balance

Manganese is important for good health and exists in some of the foods we eat. Too much environmental manganese can have a negative impact however, causing body tremors, aggression and delusions known as 'manganese madness'.

PROPERTIES

Symbol	Mn
Atomic number	25
Atomic mass	54.94 u
Melting point	1,246°C
Electron configuration	[Ar] $3d^5 4s^2$

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Computer processors

14 Si	15 P	51 Sb	5 B	73 Ta
Silicon	Phosphorous	Antimony	Boron	Tantalum

LCD screens

Silicon	14 Si	Tin	50 Sn
Europium	63 Eu	Yttrium	39 Y
Indium	49 In	Terbium	65 Tb

Circuit boards

79 Au	29 Cu	4 Be
Gold	Copper	Beryllium
32 Ge	47 Ag	74 W
Germanium	Silver	Tungsten

Batteries

3 Li	28 Ni
Lithium	Nickel

13 Gaming consoles

By 2030, IoT-connected devices globally will almost double to 29 billion units, according to Statista.

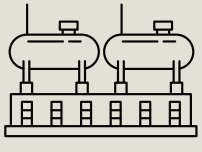
Australia gave the world WiFi

WiFi was developed by the CSIRO in the 1990s by scientists working to interpret radio signals. The issue of reverberation, where radio waves bounce off surfaces in confined spaces, was resolved by a team led by astrophysicist Dr John O'Sullivan. Today there are an estimated 19.5 billion WiFi-enabled devices worldwide.

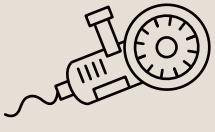
42
Mo
Molybdenum

Molybdenum

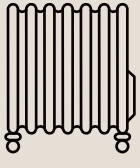
COMMON USES



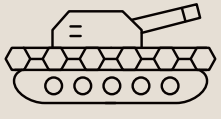
Petrol refining



Saw blades



Heaters



Armor plating

Skyscrapers

Nuclear reactors

DID YOU KNOW?

Fighting crime

Molybdenum gives steel strength, but did you also know it is an important crime fighter? Some fingerprint powders contain molybdenum. Combined with other chemicals, the powder works by adhering to the oil and moisture of a latent print.

PROPERTIES

Symbol	Mo
Atomic number	42
Atomic mass	95.95 u
Melting point	2,623°C
Electron configuration	[Kr] $4d^5 5s^1$

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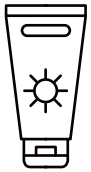
Toothpaste

- 9 **F** — Flourine
- 20 **Ca** — Calcium
- 13 **Al** — Aluminium
- 11 **Na** — Sodium

Deodorant

- 13 **Al** — Aluminium
- 40 **Zr** — Zirconium

Resourcing Tomorrow
Australian Mining



Titanium — 22 **Ti**
Whitening agent in powders and cosmetics

Potassium — 19 **K**
Fragrances
Tanning lotions

Zinc — 30 **Zn**
Sunscreens
Soaps

Iron — 26 **Fe**
Cosmetic pigment
Metal polish

Copper — 29 **Cu**
Electric shavers and toothbrushes

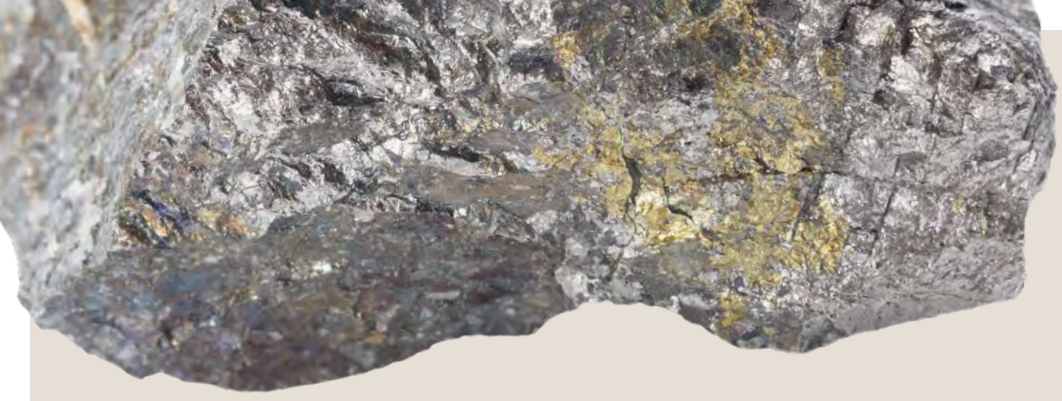
Magnesium — 12 **Mg**
Anti-caking (talc)
Used in foundations powders and creams

14 Personal hygiene

Australians spend almost $22 billion a year on cosmetics and personal care items.

Ancient cosmetics

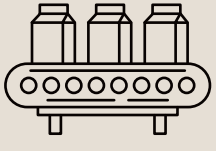
Humans have been enhancing their appearance for thousands of years. In Ancient Egypt, women and men lined their eyes using kohl, a lead sulphide. In Greece, women sought out lead carbonate to make their complexion pale. By 3000 B.C, men and women in China stained their fingernails. Well manicured nails reflected status.



28
Ni
Nickel

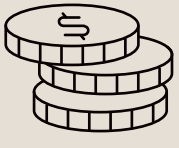
Nickel

COMMON USES



Food processing

Guitar strings



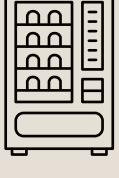
Coins

Marine engineering

Electronics

Kitchen sink

DID YOU KNOW?



A nickel for a coke

A bottle of Coca-Cola could be bought for a nickel in the United States between 1885 until well into the 1950s. The company was committed to the fixed five cent price, largely because its vending machines only accepted nickels.

PROPERTIES

Symbol	Ni
Atomic number	28
Atomic mass	58.6934 u
Melting point	1,453°C
Electron configuration	[Ar] $3d^8 4s^2$

Coin press robotics

26	6	29	30
Fe	C	Cu	Zn
Iron	Carbon	Copper	Zinc

Australia's 5, 10, 20 and 50 cent coins

29	28
Cu	Ni
Copper	Nickel

Investment

Gold	79 Au
Platinum	78 Pt
Silver	47 Ag

Australia's $1 and $2 coins

29	13	28
Cu	Al	Ni
Copper	Aluminium	Nickel

Collector coins

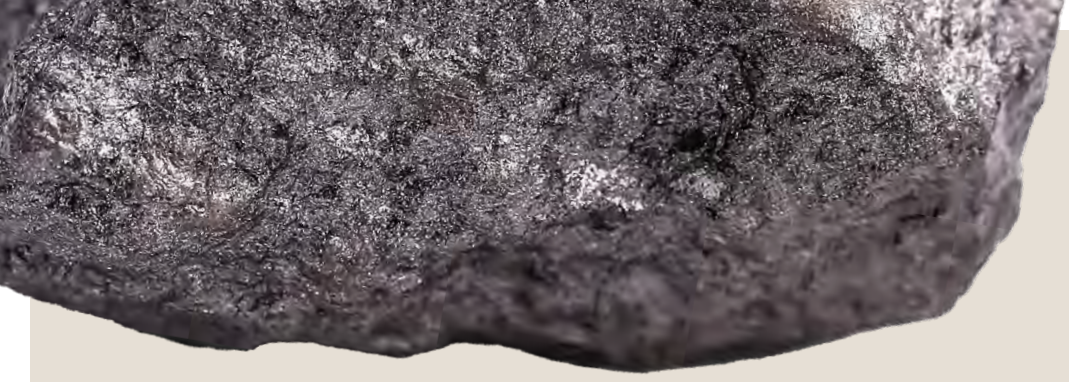
79	78	47
Au	Pt	Ag
Gold	Platinum	Silver

15 Currency

The Royal Australian Mint can produce up to two million coins per day.

Making money

Robots Titan and Robbie work alongside three autonomous vehicles – Penny, Pence and Florin – and a human staff of around 170 people to produce the nation's coins at the Royal Australian Mint in Canberra. Outside maintenance and quality checks, no human hands touch the product in the coin hall.

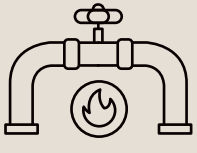


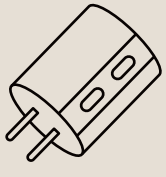
41
Nb
Niobium

Niobium

COMMON USES


Nuclear energy


Gas pipelines


Capacitors


Particle accelerators


Spacecraft


MRI scanners

DID YOU KNOW?

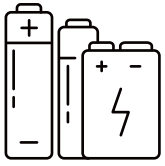
From the Gods

Niobium got its name from Niobe, the Greek goddess of tears. Niobe was also the daughter to King Tantalus, who inspired the name for another element, tantalum. In nature, niobium and tantalum are almost always found side by side.

PROPERTIES

Symbol	Nb
Atomic number	41
Atomic mass	92.91 u
Melting point	2,477°C
Electron configuration	[Kr] $4d^4 5s^1$

minerals.org.au



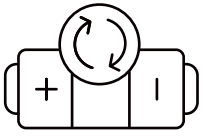
Resourcing Tomorrow
Australian Mining

Alkaline batteries (i.e. toys and electronics)

30	25	19
Zn	**Mn**	**K**
Zinc	Manganese	Potassium

Silver-oxide batteries (i.e. watches)

47	30	19
Ag	**Zn**	**K**
Silver	Zinc	Potassium



EV batteries

14	50
Si	**Sn**
Silicon	Tin

63
Eu
Europium

Li-ion batteries (i.e. mobile phones)

3	27	6
Li	**Co**	**C**
Lithium	Cobalt	Carbon

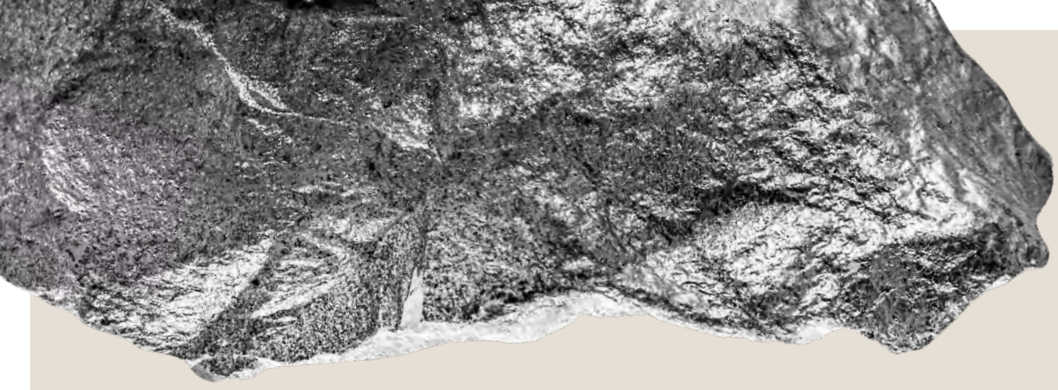
Around 95% of the cobalt, lithium and graphite in batteries can be reused.

16 Batteries

Lead	82
	Pb
	Lead acid car batteries

Battery-powered telephony

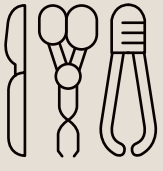
French scientist Georges Leclanché invented a battery consisting of a zinc anode encompassed by a magnesium dioxide cathode which was used to power early telephones. The dry cell battery was good only for intermittent use. Long conversations would run the battery down and the conversation would become inaudible.



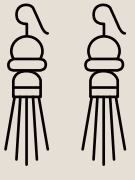
78
Pt
Platinum

Platinum

COMMON USES



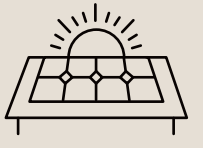
Surgical tools



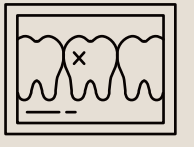
Jewellery

Catalytic converters

Polish

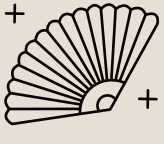


Solar panels



Dentistry

DID YOU KNOW?



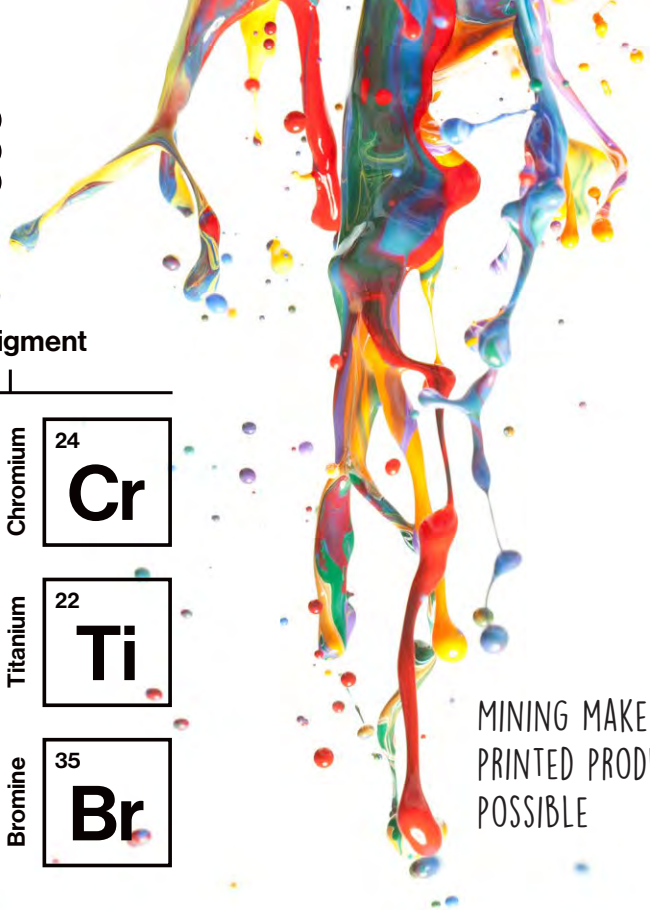
By another name

Platinum is among the most prized metals in the world, both rarer and more expensive than gold. It does not oxidize and is a good electrical conductor. When the Spaniards first found the grey-white metal in Colombia in the 18th century they named it ‘platina’, which means ‘little silver’.

PROPERTIES

Symbol	Pt
Atomic number	78
Atomic mass	195.084 u
Melting point	1,768°C
Electron configuration	$[Xe]4f^{14}5d^{9}6s^{1}$

17 Commercial printing



MINING MAKES PRINTED PRODUCTS POSSIBLE

Ink pigment

Carbon — 6 C	Chromium — 24 Cr
Iron — 26 Fe	Titanium — 22 Ti
Cadmium — 48 Cd	Bromine — 35 Br

Paper and cardboard

11 Na	12 Mg	20 Ca
Sodium	Magnesium	Calcium

3D printing

24 Cr	14 Si	28 Ni	47 Ag
Chromium	Silicon	Nickel	Silver
6 C	7 N	25 Mn	22 Ti
Carbon	Nitrogen	Manganese	Titanium

Osmium — 76 Os — Pen tips

Times New Roman uses 27 per cent less ink than Arial.

Australia's first printing press

The first printing press arrived in 1788, but it wasn't until convict George Hughes taught himself to use it that the ink started flowing. NSW Governor John Hunter commissioned Hughes to print government orders and regulations. Hughes produced more than 200 documents as the government printer, a job he held until 1800.

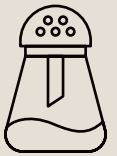
19
K
Potassium

Potassium

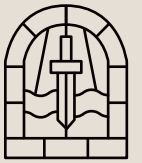
COMMON USES

Fertiliser

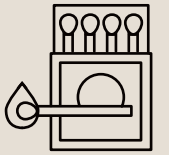
Detergents



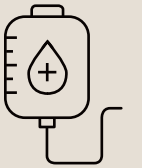
Salt substitute



Glass



Match heads



Saline drip

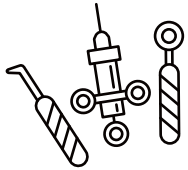
DID YOU KNOW?

Loaded with potassium

Potassium is vital to good health and at the same time, radioactive. Loaded with potassium, bananas are among the most radioactive foods. Background radiation has been with us since the earth formed. Small amounts are not harmful to humans.

PROPERTIES

Symbol	K
Atomic number	19
Atomic mass	39.0983 u
Melting point	63.25°C
Electron configuration	[Ar] $4s^1$



Crowns and bridges

- Gold: 79 **Au**
- Palladium: 46 **Pd**
- Silver: 47 **Ag**
- Platinum: 78 **Pt**

Dental amalgam (fillings)

- Silver: 47 **Ag**
- Copper: 29 **Cu**
- Tin: 50 **Sn**
- Mercury: 80 **Hg**

- Aluminium: 13 **Al** — Porcelain veneers; Synthetic resin filling

Dental drills and instruments
(also stainless steel)

- 74 **W** Tungsten
- 6 **C** Carbon
- 27 **Co** Cobalt
- 28 **Ni** Nickel
- 45 **Rh** Rhodium
- 22 **Ti** Titanium

Dental implants

- Titanium: 22 **Ti**
- Zirconium: 40 **Zr**

- Uranium: 92 **U** — X-rays

18 Dentistry

Historians believe the Etruscans were the real founders of gold teeth, not the ancient Egyptians.

Tooth extraction with a shave?

Barbers were just as likely to pull a rotten tooth as offer a shave or a hair cut during the Middle Ages. Tooth extractions were performed by 'barber surgeons' as part of routine hygienic services. The red and white barbers' pole even represented bloodletting – the white stripe represented the bandage used to stem the blood.

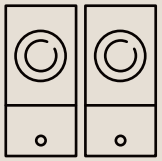
21, 39, 57-71

Ree

Rare earth elements

Rare earth elements

COMMON USES

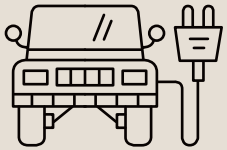


Speakers

Wind turbines

Telescopes

MRI scanners



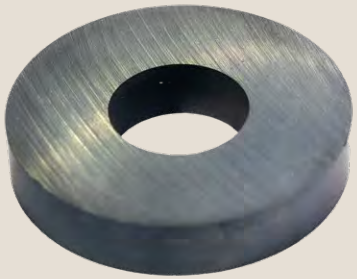
Electric vehicles

Magnets

DID YOU KNOW?

Magnetic metals

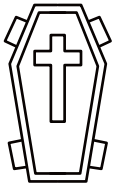
Rare earth magnets make the strongest permanent magnets available, power the motors of electric vehicles and turn the blades of energy-generating wind turbines. They also make our favourite gadgets faster, smaller and lighter.



THERE ARE 17 RARE EARTH ELEMENTS

Cerium
Dysprosium
Erbium
Europium
Gadolinium
Holmium
Lanthanum
Lutetium
Neodymium
Praseodymium
Promethium
Samarium
Scandium
Terbium
Thulium
Ytterbium
Yttrium

minerals.org.au



Resourcing Tomorrow
Australian Mining

Coffins and urns

29	47	79	22	30
Cu	Ag	Au	Ti	Zn
Copper	Silver	Gold	Titanium	Zinc

High temperature refractory cremator bricks

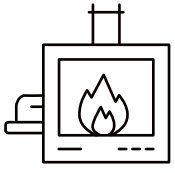
13	12	14
Al	Mg	Si
Aluminium	Magnesium	Silicon

20	24
Ca	Cr
Calcium	Chromium

Cryogenic procedures

49	7
In	N
Indium	Nitrogen

Stainless steel (cremators)



26	24	14
Fe	Cr	Si
Iron	Chromium	Silicon

6	28	25
C	Ni	Mn
Carbon	Nickel	Manganese

19 Funerals

Over 115,000 Australians received hip or knee joint replacements in 2022.

Recycling post-mortem

Titanium, gold, silver and platinum are some of the metals from dental work and artificial joints not destroyed during a cremation. Crematoriums can choose to recycle these metals, shipping them free of charge to a company in the Netherlands. Local crematoriums then receive a percentage of the revenue, which they usually donate to charity.

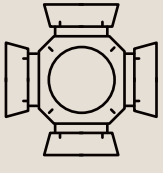
21
Sc
Scandium

Scandium

COMMON USES

Bicycle frames

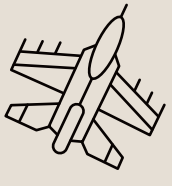
Aerospace



Studio lights

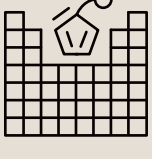
Televisions

Fluorescent lamps



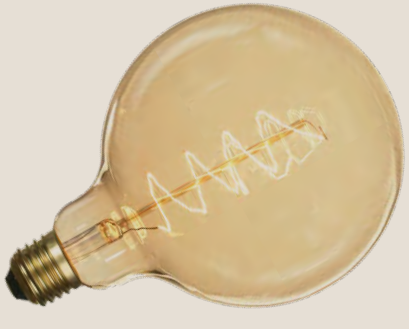
Defence industries

DID YOU KNOW?



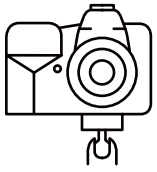
Elemental predictions

Dmitri Mendeleev, the father of the periodic table, predicted the existence of an element with an atomic mass between 40 and 48 in 1869. Lars Fredrik Nilson detected such an element in 1879 which he named scandium, from the Latin Scandia meaning 'Scandinavia'.



PROPERTIES

Symbol	Sc
Atomic number	21
Atomic mass	44.955912u
Melting point	1,541°C
Electron configuration	[Ar] $4s^2 3d^1$



DSLR cameras

14 **Si**	50 **Sn**	73 **Ta**	74 **W**	13 **Al**	30 **Zn**
Silicon	Tin	Tantalum	Tungsten	Aluminium	Zinc

MINING MAKES BINGE-WORTHY TELEVISION POSSIBLE

Sound bars and speakers

22 **Ti**	Titanium
13 **Al**	Aluminium

Television (electronics)

Copper	29 **Cu**	Chromium	24 **Cr**	Silicon	14 **Si**
Gold	79 **Au**	Tin	50 **Sn**	Zinc	30 **Zn**

Oscar statuette

Tin	50 **Sn**	Antimony	51 **Sb**

The top grossing Australian box office movie is the 1986 film, Crocodile Dundee.

20 Film & television

Kelly Gang film the world's first

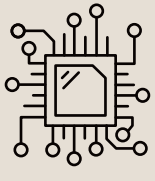
The world's first multi-reel, feature length film, *The Story of the Kelly Gang*, was screened at Melbourne's Athenaeum Theatre in 1906. The production took six months, was shot around Melbourne and cost £1000. It ran for five weeks, with actors providing voices to the screening and youngsters creating sound effects backstage.

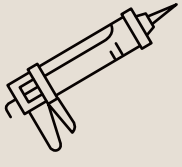
14
Si
Silicon

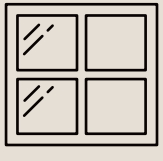
Silicon

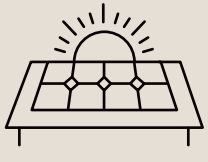
COMMON USES

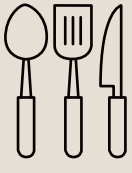

Pottery


Semiconductors


Sealants


Glass

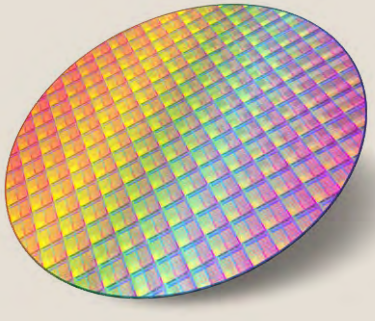

Solar panels


Cooking utensils

DID YOU KNOW?

The rise of Silicon Valley

The name 'Silicon Valley' was popularised by tech reporter Don Hoefler in 1971 in a series of columns about the area's burgeoning semiconductor industry. The silicon chip remains a building block of modern day computers and electronics.



PROPERTIES

Symbol	Si
Atomic number	14
Atomic mass	28.0855 u
Melting point	1,414°C
Electron configuration	[Ne] $3s^2 3p^2$

minerals.org.au

Resourcing Tomorrow
Australian Mining

21 Meat & vegies

Farm fertilisers

15 P	7 N	19 K	16 S	26 Fe
Phosphorous	Nitrogen	Potassium	Sulfur	Iron

Vegetable storage and distribution

26 Fe	24 Cr	25 Mn
Iron	Chromium	Manganese
6 C	28 Ni	
Carbon	Nickel	

Stock feed nutrients

Copper	29 Cu	Cobalt	27 Co
Selenium	34 Se	Magnesium	12 Mg
Manganese	25 Mn	Zinc	30 Zn

Tractors and harvesters

26 Fe	13 Al
Iron	Aluminium

Around 20-40% of 'ugly' fruit and veg is rejected before it reaches the supermarket.

Made fresh in Australia

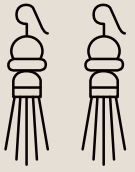
Australia has more than 87,000 farm businesses that produce almost 93 per cent of the nation's food supply, according to the National Farmers Federation. In fact, every Australian farmer produces enough food to feed 600 people – 150 at home and 450 overseas – which also makes us a leading food export nation.

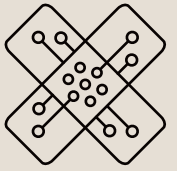
47
Ag
Silver

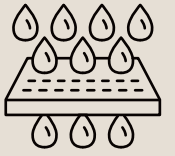
Silver

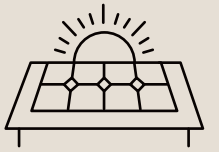
COMMON USES

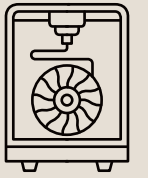

Mirrors


Jewellery


Wound care


Water purification


Solar panels


3D printing

DID YOU KNOW?

Beating bacteria

Silver has been used for centuries in medicine because of its antibacterial properties. It remains a wound management agent today, especially for burns patients. Unlike manufactured antibiotics, bacteria do not develop an immunity to silver.

PROPERTIES

Symbol	Ag
Atomic number	47
Atomic mass	107.8682 u
Melting point	961.8°C
Electron configuration	[Kr] $4d^{10}5s^{1}$

minerals.org.au

Resourcing Tomorrow
Australian Mining

Thermal imaging home security cameras

14 Si Silicon	49 In Indium
32 Ge Germanium	51 Sb Antimony

Fire sprinklers

83 Bi Bismuth	82 Pb Lead	50 Sn Tin	48 Cd Cadmium

Smoke detectors

Americium	95 Am
Silver	47 Ag
Gold	79 Au
Lithium	3 Li

Home safe

26 Fe Iron	6 C Carbon

Australians sent and received more than 2.5 billion parcels in FY2023.
Australia Post

22 Home protection

Fire extinguisher

13 Al Aluminium	15 P Phosphorous

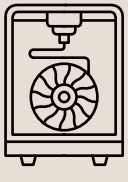
Home security is changing

Australia's online shopping habit is seeing us send and receive parcels en masse – more than 2.5 billion parcels during FY2023, according to Australia Post. New ways of monitoring parcel delivery, from digital doorbells to smart locks to password protected lock boxes, are adding another dimension to home security demands.

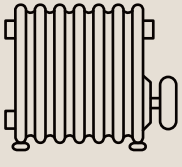
73
Ta
Tantalum

Tantalum

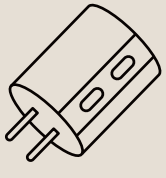
COMMON USES



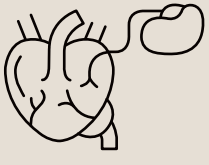
3D printing



Heat exchangers



Capacitors

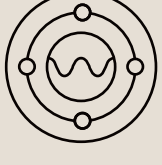


Surgical implants

Jet engines

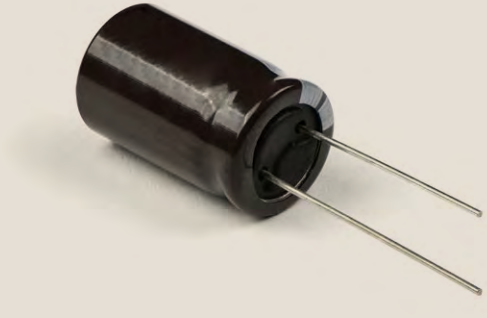
Defence industries

DID YOU KNOW?



Less abundant than gold

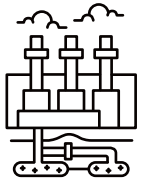
Tantalum is remarkable for being the rarest stable element in the solar system. Just one atom of tantalum exists for every 181 billion atoms of other elements, which makes tantalum far less abundant than any of the traditional precious metals, including gold.



PROPERTIES

Symbol	Ta
Atomic number	73
Atomic mass	180.94788 u
Melting point	3,017°C
Electron configuration	[Xe] $4f^{14}5d^{3}6s^{2}$

minerals.org.au



Calcium 20 **Ca**

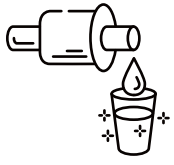
Soil quality
Fertilisers

MINING MAKES SCIENCE TO SAVE THE PLANET POSSIBLE

Carbon 6 **C**

Air filtration
Humidifiers

Resourcing Tomorrow
Australian Mining



Carbon capture and storage

- Iron 26 **Fe**
- Carbon 6 **C**
- Aluminium 13 **Al**
- Zinc 30 **Zn**

Catalytic converters
(reduce vehicle and other emissions)

- Platinum 78 **Pt**
- Rhodium 45 **Rh**
- Palladium 46 **Pd**
- Gold 79 **Au**
- Carbon 6 **C**
- Zinc 58 **Ce**
- Iron 26 **Fe**
- Manganese 25 **Mn**
- Nickel 28 **Ni**

Water desalination
(nanofibre membrane technology)

- Carbon 6 **C**
- Aluminium 13 **Al**

Nanoscale metal blends are used to break down contaminants in groundwater.

23 Environmental solutions

Potassium 19 **K**

Plant health
Soil quality

Metal-organic frameworks

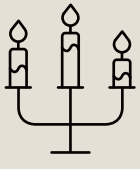
Researchers from CSIRO, Monash University and the University of Texas have developed a desalination membrane that separates salt and lithium from seawater. Metal-organic frameworks (MOFs) are a next generation material that filters chemical compounds, making seawater safe to drink and recovering lithium for use in batteries.

50
Sn
Tin

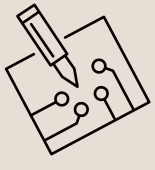
Tin

COMMON USES

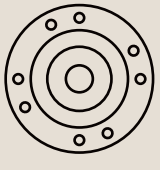

Magnets


Pewter


Tin cans


Solder


Touchscreens


Metal bearings

DID YOU KNOW?

Nod to the Academy

The Academy Award's Oscar statuette is made primarily of tin. The figure, a stylised knight holding a crusader's sword and standing on a film reel, is made of Britannia metal (93 tin, 5% antimony, 2% copper) and plated with 24 carat gold.

PROPERTIES

Symbol	Sn
Atomic number	50
Atomic mass	118.71 u
Melting point	231.9°C
Electron configuration	[Kr] $4d^{10}5s^{2}5p^{2}$

minerals.org.au

18 carat gold
Metal alloys include:

29	47	30	28
Cu	Ag	Zn	Ni
Copper	Silver	Zinc	Nickel

Iron: 26 Fe — Horse shoes

Resourcing Tomorrow
Australian Mining

Race horse nutrition

Copper	29 Cu	Cobalt	27 Co
Selenium	34 Se	Zinc	30 Zn
Calcium	20 Ca	Sodium	11 Na

Melbourne Cup
(18 carat gold)

Gold: 79 Au

Michelle Payne was the first female jockey to win the Cup in 2015.

Stainless steel
(Bits and buckles, stirrups and other equipment)

14 Si	24 Cr	26 Fe
Silicon	Chromium	Iron
25 Mn	28 Ni	6 C
Manganese	Nickel	Carbon

24 Melbourne Cup

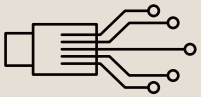
Mining Aussie gold for the Cup

Crafting the Melbourne Cup begins eight months in advance of the race that stops the nation. Agnico Eagle's Fosterville mine (VIC), Newmont's Cadia mine (NSW) and Evolution's Mt Carlton mine (QLD) have produced the gold for the Cup in recent years. From there, it takes ABC Bullion around 250 hours to craft the Cup from 44 hand-spun pieces of 18-carat gold.

22
Ti
Titanium

Titanium

COMMON USES



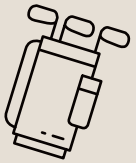
Fibre optics

Sunscreen

Aircraft engines

Medical implants

Car paint



Sporting goods

DID YOU KNOW?

To infinity and beyond!
Titanium mineral production comes from mineral sands. Named after the Greek Titans, titanium is twice as strong as steel but 45 per cent lighter. Resistant to corrosion, titanium in widely used in the aeronautics and aerospace industries.

PROPERTIES

Symbol	Ti
Atomic number	22
Atomic mass	47.867 u
Melting point	1,668°C
Electron configuration	[Ar] $3d^2 4s^2$

minerals.org.au

Resourcing Tomorrow
Australian Mining

Foetal monitor

- 29 **Cu** Copper
- 79 **Au** Gold
- 13 **Al** Aluminium

Baby powder

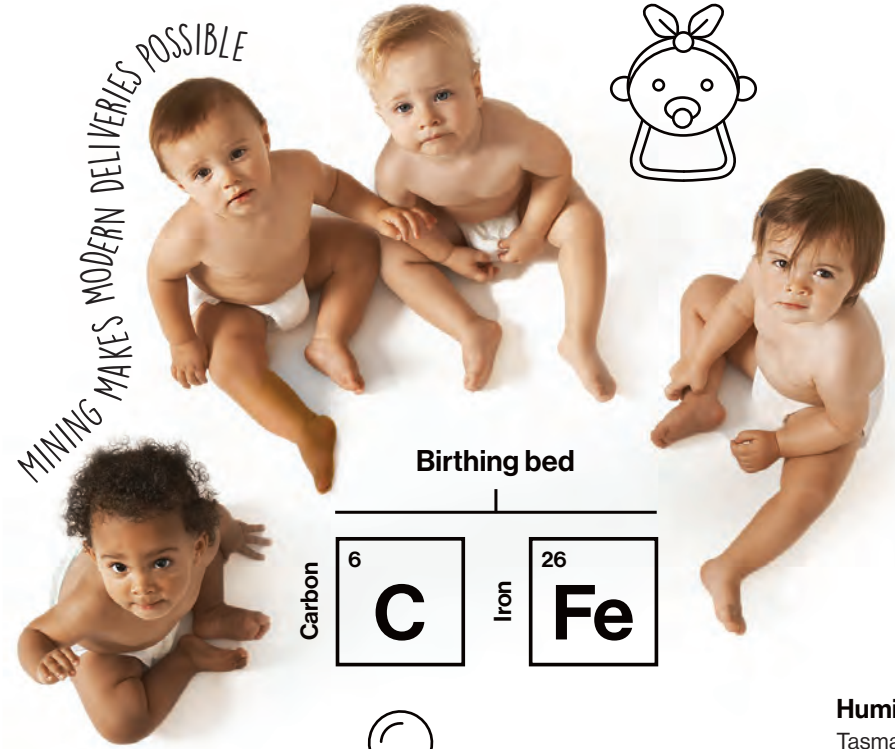
- 12 **Mg** Magnesium
- 14 **Si** Silicon

Ultrasound machine

- Zirconium 40 **Zr**
- Titanium 22 **Ti**
- Copper 29 **Cu**
- Lead 82 **Pb**
- Aluminium 13 **Al**

Baby station
Nurses trolley

MINING MAKES MODERN DELIVERIES POSSIBLE



Birthing bed

- Carbon 6 **C**
- Iron 26 **Fe**

Forceps, clamps
and other surgical instruments

- Iron 26 **Fe**
- Chromium 24 **Cr**
- Silicon 14 **Si**
- Carbon 6 **C**
- Nickel 28 **Ni**
- Manganese 25 **Mn**

25 Birthing suites

A baby is born every 105 seconds in Australia, according to the ABS.

Humidicrib a local invention

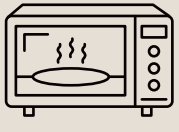
Tasmanian brothers Edward and Don Both invented the humidicrib in the late 1930s. Poliomyelitis was at epidemic levels and the portable device was an inexpensive alternative to the 'iron lung'. Today the humidicrib is used in hospitals across the globe and has helped save the lives of millions of premature babies.

74
W
Tungsten

Tungsten

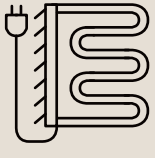
COMMON USES

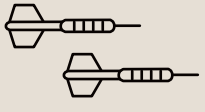

Light bulbs


Microwaves


Fishing sinkers


Televisions


Heating elements


Darts

DID YOU KNOW?

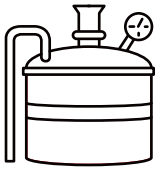
In sheep's clothing

Tungsten is the metal of choice for gold counterfeiters. It has earned the dubious reputation because it shares a similar density to gold. Ingots filled with tungsten spooked markets and sparked conspiracy theories when discovered in 2012.

PROPERTIES

Symbol	W
Atomic number	74
Atomic mass	183.84 u
Melting point	3,422°C
Electron configuration	[Xe] $6s^2 4f^{14} 5d^4$

minerals.org.au



Resourcing Tomorrow
Australian Mining

Brass fittings and valves

- 29 **Cu** — Copper
- 30 **Zn** — Zinc

Brewing kettle

- 29 **Cu** — Copper
- 13 **Al** — Aluminium

Stainless steel equipment, pipes, storage

- 26 **Fe** — Iron
- 24 **Cr** — Chromium
- 14 **Si** — Silicon
- 6 **C** — Carbon
- 28 **Ni** — Nickel
- 25 **Mn** — Manganese

MINING MAKES BREWING AND BOTTLING POSSIBLE

Amber bottles

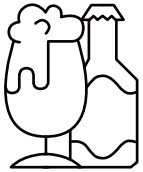
- 16 **S** — Sulfur
- 6 **C** — Carbon
- 26 **Fe** — Iron

Green bottles

- 26 **Fe** — Iron
- 24 **Cr** — Chromium
- 14 **Si** — Silicon

Beer cans

- 13 **Al** — Aluminium
- 50 **Sn** — Tin



26 Brewing beer

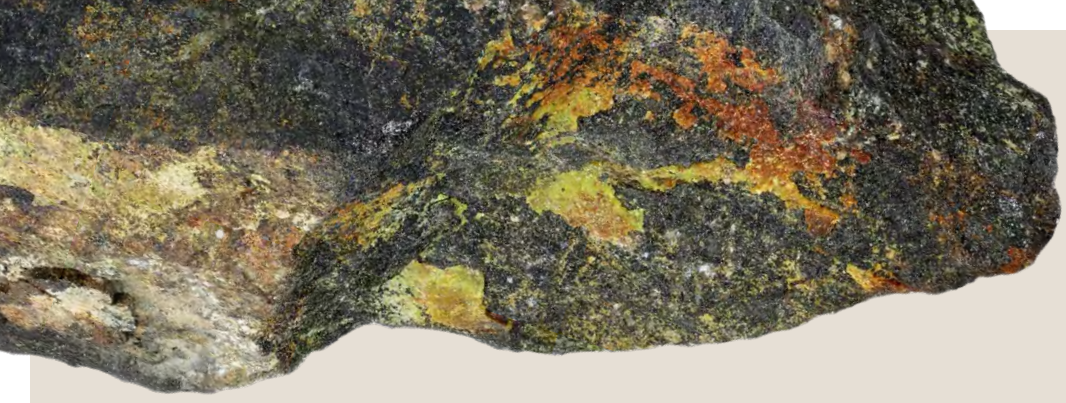
'Cenosillicaphobia' is fear of an empty beer glass.

Aluminium

- 13 **Al** — Bottle tops

A short history of bottling

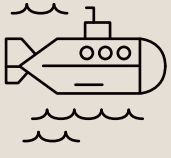
Commercial bottling is believed to have started in the latter part of the 17th century, but it wasn't until after World War I that demand for bottled beer soared. Early manufacturers struggled making glass bottles strong enough to withstand the carbonation. Producers eventually worked out that longneck beer bottles were the solution.



92
U
Uranium

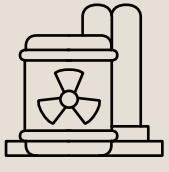
Uranium

COMMON USES

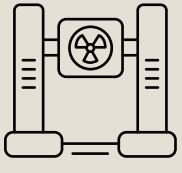


Submarines

Medical research

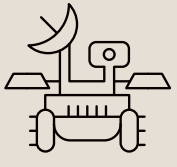


Nuclear energy



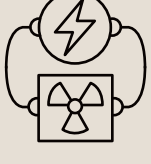
Industrial x-rays

Cancer diagnosis



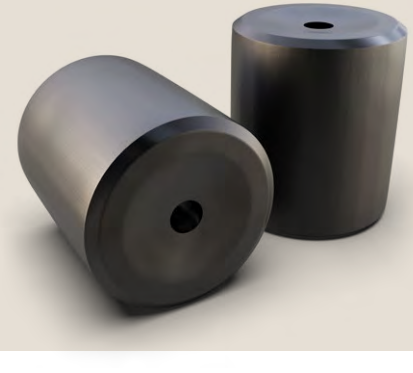
Aerospace

DID YOU KNOW?



The infinite power source

As a power source, uranium is practically infinite. Enriched uranium can produce 3.7 million times the energy of coal. It can also be reused multiple times. A golfball-sized amount of nuclear material provides a lifetime of energy for one person.



PROPERTIES

Symbol	U
Atomic number	92
Atomic mass	238.02891 u
Melting point	1,132°C
Electron configuration	[Rn] $5f^3 6d^1 7s^2$

minerals.org.au

Optical glass
(in camera lenses, telescopes, microscopes and binoculars)

14	5	11	19	73
Si	B	Na	K	Ta
Silicon	Boron	Sodium	Potassium	Tantalum

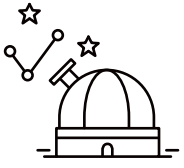
Resourcing Tomorrow
Australian Mining

Mirrors

14	5	13
Si	B	Al
Silicon	Boron	Aluminium

Hardware components

26	6	30
Fe	C	Zn
Iron	Carbon	Zinc



Australia's Parkes Observatory radio telescope, 'The Dish', was used by NASA during the Apollo 11 Moon landing.

Digital camera batteries

28	3
Ni	Li
Nickel	Lithium

27 Lenses & telescopes

The James Webb Space Telescope

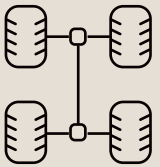
The James Webb Space Telescope has reached its cosmic base 1.5 million kilometres from Earth after being launched in 2021. Equipped with 18 gold-coated hexagon mirrors, the Webb telescope can observe the earliest formation of stars and is so sensitive it can detect the heat signature of a bumblebee at the distance of the moon.

23
V
Vanadium

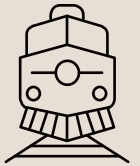
Vanadium

COMMON USES

Battery storage

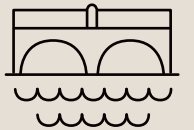


Car chassis



Railway tracks

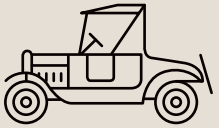
Wind turbines



Bridges

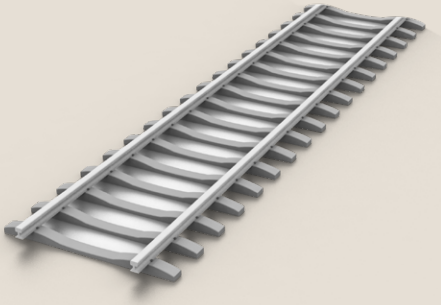
Jet engines

DID YOU KNOW?



Driving early transportation

One of the first uses of vanadium was in the steel chassis of the 1908 Model T Ford. 'Tin Lizzie' represented the first affordable family car thanks to fabrication efficiencies and was declared Car of the Century at a glitzy ceremony in Las Vegas in 1999.



PROPERTIES

Symbol	V
Atomic number	23
Atomic mass	50.9415 u
Melting point	1,910°C
Electron configuration	[Ar] $3d^3 4s^2$

minerals.org.au

Resourcing Tomorrow
Australian Mining

28 Roads & rail

Railway tracks

26 Fe	6 C	25 Mn
Iron	Carbon	Manganese

Traffic lights

14 Si	29 Cu	13 Al
Silicon	Copper	Aluminium

Road markings

22 Ti	24 Cr
Titanium	Chromium

Guard rails

13 Al	12 Mg	30 Zn
Aluminium	Magnesium	Zinc

Road signs

13 Al	30 Zn
Aluminium	Zinc

Bridges

26 Fe	42 Mo
Iron	Molybdenum

There are 874,500 km of road in Australia.

Silicon 14 Si
Cats eyes

Road and rail in Australia

Australia has one of the world's most extensive road networks per capita – twice the length of Canada's. Around 17 per cent of the 874,500 km road network is urban, the rest non-urban, according to the Department of Infrastructure and Regional Development. Australia also has 33,000 km of heavy rail and 291 km of light rail.

30
Zn
Zinc

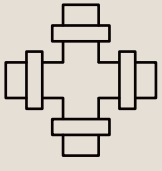
Zinc

COMMON USES

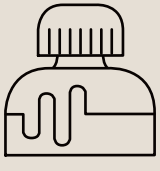

Rust prevention


Soap


Plastics


Metal alloys


Sunscreen


Ink

DID YOU KNOW?

The original aphrodisiac

Oysters contain more zinc than any other food, which is one of the reasons they are believed to be an aphrodisiac. Zinc is crucial to hormone production. Casanova believed in the power of the mollusc – the 18th century lover would breakfast on 50 oysters.

PROPERTIES

Symbol	Zn
Atomic number	30
Atomic mass	65.38 u
Melting point	419.5°C
Electron configuration	[Ar] $3d^{10}4s^{2}$

minerals.org.au

Resourcing Tomorrow

Australian Mining

MINING MAKES WIND POWER GENERATION POSSIBLE

Generator magnet

26	60	5	66
Fe	Nd	B	Dy
Iron	Neodymium	Boron	Dysprosium

Steel used to build turbines

26	6
Fe	C
Iron	Carbon

Battery energy storage

3	28	25
Li	Ni	Mn
Lithium	Nickel	Manganese

27	6	23
Co	C	V
Cobalt	Carbon	Vanadium

Corrosion protection

30	42
Zn	Mo
Zinc	Molybdenum

Controls

29	14
Cu	Si
Copper	Silicon

Aluminium

13
Al

Blades

29 Wind farms

400 tonnes of metallurgical coal is required to build a 5MW wind turbine.

International Energy Agency

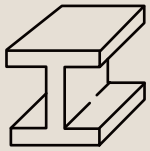
Wind power across Australia

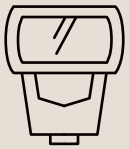
Wind farms accounted for 36 per cent of renewable energy generation in 2022, according to the *Clean Energy Council*, and 13 per cent of total generation capacity. Victoria led the way with 34 per cent of total capacity across Australia, followed by South Australia (22 per cent) and NSW (21 per cent).

40
Zr
Zirconium

Zirconium

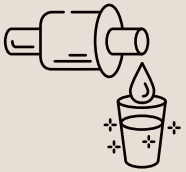
COMMON USES

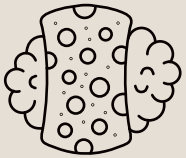

Steel alloys


Flash bulbs


Surgical tools


Nuclear energy


Catalytic converters


Abrasives

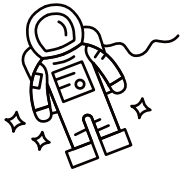
DID YOU KNOW?

Cubic zirconias
Soviet scientists discovered they could create cubic zirconias (zirconium combined with dioxide) in a laboratory in the 1970s. They faceted the stone, named the crystals 'Djevalite' and began marketing them as simulated diamonds in 1976.

PROPERTIES

Symbol	Zr
Atomic number	40
Atomic mass	91.224 u
Melting point	1,855°C
Electron configuration	[Kr] $4d^2 5s^2$

minerals.org.au

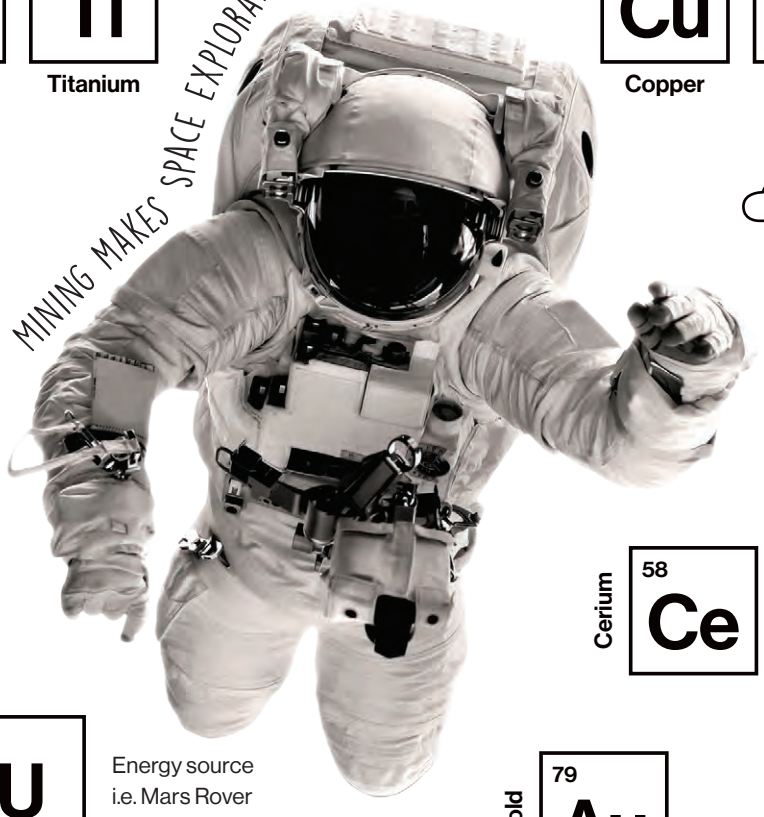


Resourcing Tomorrow

Australian Mining

30 Space travel

MINING MAKES SPACE EXPLORATION POSSIBLE



Shuttle body

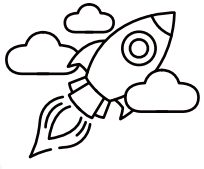
- 13 **Al** – Aluminium
- 22 **Ti** – Titanium

Rocket engines

- 29 **Cu** – Copper
- 41 **Nb** – Niobium

Thermal protection

- 14 **Si** – Silicon
- 6 **C** – Carbon
- 74 **W** – Tungsten
- 73 **Ta** – Tantalum



Control system

- 14 **Si** – Silicon
- 32 **Ge** – Germanium

The International Space Station orbits Earth every 92 minutes. That's 15-16 sunrises and sunsets a day.

Cerium 58 **Ce** – Optics

Uranium 92 **U** – Energy source i.e. Mars Rover

Gold 79 **Au** – Astronaut visors, Radiation reflector

Golden Records of life on earth

NASA launched the Voyager Golden Records – two gold-plated copper phonograph records containing sounds and images from Earth – into space in 1977. Intended for future spacefarers or intelligent lifeforms, the records contain greetings in 55 languages and sounds ranging from rain and thunder to birds, frogs, laughter and children.


Minerals Council of Australia
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ELECTRIC VEHICLE BATTERY