

Gold (Au) Student Datasheet

Atomic structure · yellow color · FCC crystal · karat purity · uses · mining geography

79

Au

Gold · 196.96657

QUICK FACTS

Atomic number	79	Group / Period / Block	11 / 6 / d
Classification	Transition metal	Electron configuration	[Xe] 4f ¹⁴ 5d ¹⁰ 6s ¹
Shells	2 · 8 · 18 · 32 · 18 · 1	Outermost shell	6s ¹
Electronegativity	2.54 (Pauling)	1st ionization energy	9.225554 eV

WHY GOLD IS YELLOW

Gold is heavy enough that relativistic effects noticeably change its electronic energy levels. The altered 5d-6s energy spacing moves strong absorption into the blue part of visible light, so reflected light is enriched toward yellow and red.

Key idea: the color is a visible consequence of heavy-atom quantum chemistry.

STRUCTURE + ISOTOPE

Natural isotope	¹⁹⁷ Au · ≈100%
Protons / neutrons	79 / 118
Crystal	FCC / cubic close-packed
Space group	Fm-3m (No. 225)
Lattice parameter	a ≈ 407.82 pm

KARAT PURITY AT A GLANCE

24K 100% gold	22K 91.7% gold	18K 75% gold	14K 58.3% gold	9K 37.5% gold
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Ideal fraction = karat ÷ 24. Hallmark rules and tolerances vary by jurisdiction.

Gold: connect atomic structure to real materials

PHYSICAL + CHEMICAL PROPERTIES

Density	≈ 19.3 g/cm³
Melting point	1337.33 K
Boiling point	3109 K (RSC)
Common oxidation states	+1, +3
Electron affinity	2.309 eV
Appearance	metallic yellow

WHY GOLD RESISTS TARNISH

Gold is a noble metal and does not readily react with oxygen, water or many ordinary substances. That helps electrical contacts stay chemically stable and lets gold surfaces retain their appearance.

Exception: gold can dissolve in aqua regia and form compounds under suitable chemical conditions.

2025 GOLD GEOGRAPHY

Leading mine production **China 380 t · Russia 310 t · Australia 280 t · Canada 200 t · United States 160 t**

Selected large reserves **Russia 12,000 t · South Africa 5,000 t · Indonesia 3,600 t · China 3,200 t · Canada 3,200 t**

Source: USGS Mineral Commodity Summaries 2026. Production and reserves are year-dependent, not permanent element properties.

REAL-WORLD USES

- Jewellery + decorative arts
- Electrical contacts + connectors
- Infrared-reflective coatings
- Bullion + monetary history
- Dental + specialized alloys
- Nanoparticles + catalysis research

REVISION QUESTIONS

1. Why is gold yellow rather than silver-colored?
2. Why does gold resist tarnish?
3. What does $[\text{Xe}] 4f^{14} 5d^{10} 6s^1$ mean?
4. Why is 18K gold 75% gold?
5. Why are gold coatings useful in electronics?
6. How many neutrons are in ^{197}Au ?

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