

CARD SET 2

YTTRIUM ($^{88}_{39}\text{Y}$)



Bastnäsite-(Y) ((Y,Ce)CO₃F)

[By-product]

Source: Wikimedia.org

Property:

Yttria (Y₂O₃) stabilized-zirconia (YSZ) hard ceramic used as a strong base material

TUNGSTEN (Wolfram) ($^{183}_{74}\text{W}$)



Wolframite ((Fe,Mn)WO₄)

Source: Colecciones del Museo Histórico Minero D. Felipe de Borbón y Grecia. ETSIME-UPM.

Property:

Hardness and strength combined with toughness and plasticity

VANADIUM ($^{50}_{23}\text{V}$)



Vanadinite (Pb₅(VO₄)₃Cl)

Source: Colecciones del Museo Histórico Minero D. Felipe de Borbón y Grecia. ETSIME-UPM.

Property:

Low-neutron-absorption abilities without deforming under high temperatures

TITANIUM ($^{47}_{22}\text{Ti}$)



Rutile (TiO₂) and Ilmenite (Fe²⁺Ti⁴⁺O₃)

Source: Colecciones del Museo Histórico Minero D. Felipe de Borbón y Grecia. ETSIME-UPM.

Property:

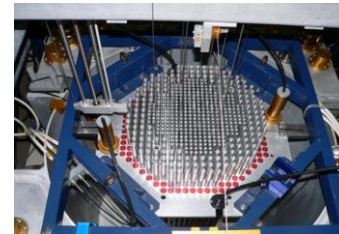
Nontoxic and biologically compatible



Base material in dental ceramic restorations



Button bits (mining and tunneling cutting tools)



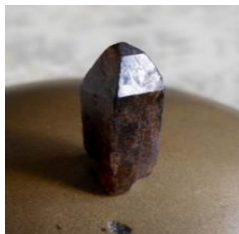
Nuclear reactors



Titanium prosthesis and hip replacement implant



ERBIUM ($^{167}_{68}\text{Er}$)



Xenotime (YPO_4)
[By-product]

Source: Mindat.org

Property:

Er^{3+} ions have pink colour

EUROPIUM ($^{151}_{63}\text{Eu}$)



Loparite-(Ce)
 $((\text{Ce}, \text{Na}, \text{Ca})(\text{Ti}, \text{Nb})\text{O}_3)$
[By-product]

Source: Mindat.org

Property:

Eu_2O_3 phosphorescence

YTTERBIUM ($^{173}_{70}\text{Yb}$)



Gadolinite
 $(\text{Ce}, \text{La}, \text{Nd}, \text{Y})_2\text{FeBe}_2\text{Si}_2\text{O}_{10}$

Source: Mindat.org

Property:

Yb-169 emits gamma rays

NEODYMIUM ($^{144}_{60}\text{Nd}$)



Monazite-(Nd) $(\text{Nd}, \text{La}, \text{Ce})\text{PO}_4$
[By-product of Bastnäsite]

Source: Mindat.org

Property:

Nd-doped crystals
 $(\text{Nd}:\text{YVO}_4)$ serve as a gain
media for infrared
wavelengths



Pigment in glass



Helical fluorescent light
bulbs



Radiography of small
objects



Lasers



COBALT ($^{58}_{27}\text{Co}$)



Skutterudite (CoAs_3)

Source: Colecciones del Museo Histórico Minero D. Felipe de Borbón y Grecia. ETSIME-UPM.

Property:
 LiCoO_2 cathodes.

INDIUM ($^{114}_{49}\text{In}$)



Sphalerite ($(\text{Zn}, \text{Fe})\text{S}$)
[Trace element in sphalerite (20-200 ppm of In)]

Source: Colecciones del Museo Histórico Minero D. Felipe de Borbón y Grecia. ETSIME-UPM.

Property:
Light absorber material which maximizes light transmission.

CARBON (Graphite) ($^{12}_6\text{C}$)



Natural Graphite (C)

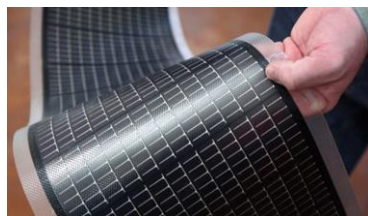
Source: Colecciones del Museo Histórico Minero D. Felipe de Borbón y Grecia. ETSIME-UPM.

Property:
High temperature stability and chemical inertness

UPS! You **lose your turn.**
If you have found two matching cards in this turn you cannot keep them,
Sorry...



Stable capacity
batteries



Touch screens,
flatscreen TVs and solar
panels



Foundry refractory
materials (steel making
and hot metal-forming)



UPS! You **lose your turn.**
If you have found two matching cards in this turn you cannot keep them,
Sorry...

Turn over 1 **secret extra card** but do not show it to the rest of the players. If that card matches the other one, you can keep it, if not put it back face down again, not letting anyone knowing which card it is.

Roll the dice to see how many **extra cards** you can turn over:

nº 1: 1 card from the group of your choice.

nº 2: 2 cards, 1 from the blue group and 1 from the orange.

nº 3: 3 cards, 2 from the blue group and 1 from the orange.

nº 4: 1 card from the group of your choice.

nº 5: 2 cards, 1 from the blue group and 1 from the orange.

nº 6: 3 cards, 1 from the blue group and 2 from the orange.

Roll the dice to see how many **extra cards** you can turn over:

nº 1: 1 card from the group of your choice.

nº 2: 2 cards, 1 from the blue group and 1 from the orange.

nº 3: 3 cards, 2 from the blue group and 1 from the orange.

nº 4: 1 card from the group of your choice.

nº 5: 2 cards, 1 from the blue group and 1 from the orange.

nº 6: 3 cards, 1 from the blue group and 2 from the orange.

Steal a pair of cards from the team of your choice.

You have 1 **extra turn.**

Raise one more card from the same group this turn.

Then you have a new chance.

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Raise one more card from the same group this turn.

Then you have a new chance.