

UNIT 1 MATERIALS

Match these substances with their corresponding descriptions:

1	aluminium	b	Light to carry and silvery to look at.
2	brass	p	Mixture of copper and zinc. (alloy)
3	bronze	o	Mixture of copper and tin.
4	carbon dioxide	f	Gas produced in the combustion of fossil fuels.
6	chromium	l	Hard, shiny metal used to coat other metals to prevent rust/corrosion
7	concrete	k	Building material made by mixing cement and gravel.
8	copper	n	Soft, reddish-brown metal, used in wires/cables
9	gold	g	Precious yellow metal used as international currency.
10	hydrogen	j	The lightest gas and the simplest element in nature.
11	Iron /ai'n/	e	With symbol Fe, it is the main component of steel
12	Lead /led/	r	Soft, grey, heavy metal used in pipes, whose symbol is Pb.
13	mercury	d	Heavy, silvery metal, usually (a) liquid at room temperature.
14	nitrogen	m	80% of the air.
15	oxygen	q	Colourless and tasteless gas supporting life.
16	Tin	i	A can is made of it and its symbol is Sn. Can-recipient/ tin-made of Sn
17	Uranium	c	Heavy, white metal whose atoms can be fissioned.
18	zinc	a	Hard, bluish-white metal used in alloys and in roofing (top of houses)
19	steel	h	Iron plus carbon

VIDEO (OU-THE ORIGIN OF THE EARTH)

SECTION 1 : elements found in all stars.

Profile of the abundance of elements found in stars:

- immense amounts of..**HYDROGEN** and **HELIUM**.
- .(**much**) **LOWER** amounts(**2%**) of the heavier elements

Peaks

CARBON
OXYGEN
MAGNESIUM
SILICON
SULPHUR/SULFUR
IRON

Process: nuclear fusion

- 2 **HYDROGEN** atoms= **HELIUM** + **ENERGY** -> origin of **SUNLIGHT**
- **HELIUM** + **HELIUM** atoms= **CARBON**
- **HELIUM** + **CARBON** atoms= **OXYGEN**
- **OXYGEN** + **HELIUM** atoms= **MAGNESIUM**

Right up to **IRON**

For each of these fusion reactions to occur, **INCREASING TEMPERATURE** and **PRESSURE** are needed

READING: PLASTICS

Plastics(1) are organic materials which can be moulded or shaped(2) as required(3). They are synthetic materials(4) and are composed of(5) long chain-like molecules(6) called polymers. Each of these polymer molecules is formed by joining together many (7) thousands of small molecules called monomers.

The monomer molecule(8) is an arrangement of atoms which can be made(9) to react with similar monomer molecules to form a chain. The reaction is known(10) as polymerization.

The monomers(11) from which plastics are made are generally produced by separation from natural gases or from oil(12). By means of pressure and heat, and often with the aid of catalysts(13), the monomer molecules react and form polymer molecules, and by careful(14) control of the polymerization, the monomer molecules may be arranged, obtaining the required properties

Shape= external appearance

Now answer the following questions using the information from the reading above.

1. Is the word *plastics* countable or uncountable? Is it used in this sentence in a general or a specific sense? **Uncountable and general**

2. *shaped* = give a synonym or explain the meaning of this verb. **Given a shape, to give a specific external appearance**

3. *required* = Give a synonym **wanted, needed, necessary**

4. What is a "synthetic material"? **a material (that is) not found in nature in pure state, man made**

5. *are composed of* = **Give a different expression consist of, are made up of,**

6. *long chain-like molecules* = Translate this into Spanish **moleculas lineales**

7. *many* is the adjective of quantity for countable or uncountable nouns? **Countable**

8. Is the word *molecule* countable or uncountable?. Is it used in a general or specific sense? **Countable - specific**

9. *made* is the Past Participle of the verb *.make.....* The past tense is ...**made**.....

10. *known* is the Past Participle of the verb *.know....* The past tense is ...**knew**.....

11. Is the word *monomers* used in a general or a specific sense? **specific**

12. What is *oil*? **Natural substance, very expensive, used for making plastics, petrol and many others= petroleum it's a fossil fuel**

13. What is a *catalyst*? **an element that/which speeds up a reaction/makes a reaction faster**

14. *careful* is an adjective formed from which other word? **Noun – care verb-to care≠careless painful≠painless full**

DESCRIBING

Definition:	X is GENERAL CLASS:	Lead is a heavy metal A relay is a switching device
Composition:	<p>It is made (up) of <i>Steel is made of Fe + C</i> <i>Chair – made of wood and metal</i> <i>Made up of seat, back and legs</i></p> <p>It consists OF IN+ ING (procedure) <i>Steel consists OF iron and carbon</i> <i>Alloying consists OF /IN MIXING different elements...</i></p> <p>It has It is composed of It is formed by</p>	<p>Materials</p> <p>Substances</p> <p>Components Parts</p> <p>Pieces</p>
Characteristics:	<p>to be To look (<i>external appearance</i>) To seem +ADJ To become Ø Turn/convert INTO</p> <p>To have+ NOUN</p>	<p>Shape (circular, elliptical) Properties (flexible, tough) Colour (blue, greenish) Texture (hard, smooth)</p> <p>Temperature (warm, cold)</p>
Dimensions:	<p>General dimensions (thin, long, small) Measurements: X is 3m + ADJ (long) X is 3m + in + NOUN (in length) X has a + NOUN + OF 3 m (X has a length of 3m) The + NOUN + OF 3m (The length of X is 3m)</p>	
Applications:	<p>X is used for (+ING) / to (+INF) of/for/off/about/around/by/in(to)/on... + ING To + INF (in this case)</p> <p><i>Petrol is (widely/commonly/frequently/often) used to fuel vehicles</i> <i>Oil is used FOR making plastics</i> X serves to (+INF) X is used in/as a(n) (+NOUN) <i>Silicon is commonly used in Electronics / the electronic industry</i> <i>Silicon is used as a semiconductor/Petrol is used as a fuel</i></p>	

Note: The present simple tense is used most frequently when describing, because descriptions in science are usually universals. The most commonly used verbs are **TO BE** and **TO HAVE**.

GRAMMAR: ARTICLES

Indefinite article is not too troublesome (a/an) – a horse, an hour, honor, hydroelectric power plant

The use of the article depends on the **kind of statement** and on whether the noun is **countable or uncountable**.
 THE – In Spanish we use the article with all types of nouns. In English OMISSION of **'the'** is quite common.

TYPE OF NOUN	GENERAL STATEMENT	SPECIFIC STATEMENT
Countable nouns		
- Singular	A/THE	A/THE
	A generator is a device to produce electricity The atom consists of different subatomic particles A metal can be ferrous or non-ferrous	Power plants need a generator to produce electricity Bring me the calculator
- Plural	NO ARTICLE	THE (SOME)
	Ø Transformers are used to change voltage Ø Students are listening to the teacher	The monomers used in plastics come from oil The transformers in power plants are very powerful
Uncountable noun		
-Only singular	NO ARTICLE	THE (SOME)
	Ø Steel is an alloy of Ø iron and Ø carbon Ø Water is composed of Ø hydrogen and Ø oxygen	Don't drink the water in the bottle Add (some) water
<p>REMEMBER: pages, chapters, figures, etc. DO NOT use an article (e.g. = <i>The results are shown in Ø Figure 3</i>). Let's go to Ø page 7. Look at the first exercise on the page Ø 90% of students</p> <p>It is very common (recommended) to use a POSSESSIVE adjective (ITS/THEIR) instead of the DEFINITE article. eg= <i>Materials can be classified depending on (THEIR) conductivity</i></p>		

A. Add the appropriate article or possessive adjective for each of these sentences.

- Ø** corrosion is **a** very serious problem in **Ø** metallic structures.
- Ø** iron is used in **Ø** Engineering due to ...**its/Ø**.... strength.
(in the engineering industry/in industry) EngineERing
-**the**.. physical properties of **Ø** matter will be studied in **Ø** chapter 3.
*What's the matter? Corrosion can become a big problem. The/this **matter** will be studied in chapter 3*
- Ø** fission is one of **the** two types of **Ø** nuclear reactions which release. **Ø** large amounts of **Ø** energy. **The** fission of **Ø** Uranium atoms is used in **Ø** nuclear power plants to generate **Ø** electricity. (**A LARGE NUMBER OF=countable**)
- the/a** major component of **Ø** steel is **Ø** iron, **a** metal that in **Ø/its** pure state is not much harder than **Ø** copper. (*major≠minor – importance, not size/quantity*)
- ..**Ø** silicon is used as ..**a**. semiconductor in**the**. manufacture of **Ø** chips.
- ... **Ø**..... plastics may be classified into two major groups according to ...**their/ Ø**.. chemical composition.
- ... **Ø**..... mathematics is basic for ...**an**.... engineer. (*basic for engineering*)
- ... **an**.. alloy is ... **a**... metallic substance composed of two or more elements as (either) **a**.... compound or ... **a**..... solution.
- In ... **Ø**.... Kevlar, ...**an**.. artificial fiber, **Ø/the** molecules lie straight, giving it **Ø/its**. strength and **Ø/its**.. stiffness

B. Read this description of MERCURY and decide which, if any, article to use.

___ Ø ___ mercury is ___ **the** ___ chemical element whose symbol is Hg. It is ___ **a** ___ silvery-white, heavy, liquid metal. Compared with other metals, it is ___ **a** ___ poor conductor of ___ Ø ___ heat and ___ **a** ___ fair conductor of ___ Ø ___ electricity. ___ Ø ___ mercury is ___ **the** ___ only common metal that is ___ Ø/a ___ liquid at ___ Ø ___ ordinary temperatures. It easily forms ___ Ø ___ alloys with many other metals. When it combines with certain metals (such as ___ Ø ___ silver, ___ Ø ___ zinc or ___ Ø ___ tin) ___ **the** ___ resulting alloy is called ___ **an/ Ø** ___ amalgam. Both ___ **the** ___ element and ___ Ø ___ most of ___ **its** ___ compounds are poisonous. ___ Ø ___ mercury and ___ **its** ___ compounds are used in ___ Ø ___ electrolytic cells, ___ Ø ___ dentistry, ___ Ø ___ thermometers, (___ Ø ___ switches), ___ Ø ___ mercury-vapor lamps, ___ Ø ___ paint, ___ Ø ___ batteries, ___ Ø ___ explosive detonators, and in ___ Ø ___ medicine.

LISTENING 1 UNIT 1 – CHARACTERISTICS OF METALS

We are so familiar with metals that it might be quite a surprise to be asked the question What is a metal?.

- 1- Which metal is mentioned first? **magnesium**
- 2- Which is its main characteristic? **It burns easily**
- 3- Which other metal is it compared to? **iron**
- 4- Which is the main difference between these two metals? **iron will not burn**
- 5- The most important properties that distinguish metals from non-metals are:
 - **they reflect light and thus are shiny=glossy** (~~bright-brilliant~~ **+** *bright colours=live colours – brilliant=splendid, intelligent*)
 - **They are good conductors of heat and electricity**
 - **They combine with fluorine and chlorine**
 - **Most react with acids and with oxygen**
- 6- Which is the property of gold, lead and sodium? **very soft materials**
- 7- They are much softer than which non-metals? **silicon and graphite**
- 8- Which is another typical property of most metals? **Many metals corrode easily**
- 9- However, which metals do not? **Gold, chromium and platinum**
- 10- Which metals are very active? **sodium, calcium and potassium**
- 11- Which elements do they combine easily with? **oxygen, chlorine and fluorine**
- 12- Which metals do not form compounds easily? **Gold, silver and mercury**
- 13- Metals far outnumber non-metals. How many elements are non-metals? **20**

SECTION 2: samples of METEORITES

The Ballwell meteorite fell in 1965.

BROWN METALLIC skin due to **ATMOSPHERIC HEATING**.....

it consists of : **SILICATES**..... (..**GREEN**....olivine)

some..**METAL** ((brown discoloration due to oxidation of) **IRON**)

tiny spherical chondrules

Section of a chondritic meteorite:

chondrules

SILICATES (OLIVINE)

DARK patches(**IRON METAL**)

Iron meteorites:

Blades **OF IRON-NICKEL ALLOY (IRON WITH A LITTLE NICKEL)**

inclusions of **IRON SULFIDE**

Meteorites contain three principal phases:

1- **OLIVINE (MAGNESIUM SILICATES)**

2- **IRON OFTEN WITH A LITTLE NICKEL**

3- **IRON SULFIDE**

Chondritic meteorites appear to have changed chemically the least since their condensation from the primitive solar nebula. They contain (little) **HYDROGEN** and **HELIUM** but otherwise their element abundances should be similar to the heavy elements in the solar spectrum.

SECTION 3: The composition of the earth

Inner core: **IRON**.....+ **NICKEL**.....

Outer core: **IRON**..... + **SULPHUR/SULFUR**.....

Mantle : **MAGNESIUM RICH SILICATES (MAGNESIUM, SILICON, OXYGEN)**

VOCABULARY: ADJECTIVES

When describing, one of the most usual word classes employed in descriptions is adjectives.

Look at the following characteristics and classify them using the categories given below.

huge	cool	rectangular	straight	icy	ferrous	sticky
rough	tiny	light	bright	minute	short	faded
boiling	molten	hard	smooth	wooden	synthetic	broad
cylindrical	metallic	dark	large	plastic	organic	rounded
square	soft	warm	burning	opaque	reddish	
	sharp					

TEMPERATURE
Hot ≠ cold
Boiling ≠ freezing
Warm ≠ Cool
Burning
COMPOSITION
Ferrous ≠ non-ferrous
Metallic
Synthetic ≠ natural
Wooden
Woollen
Plastic
organic ≠ inorganic
golden

TEXTURE
Rough ≠ smooth
hard ≠ Soft
Sticky
coarse ≠ fine
Molten = liquid

SIZE
Huge = enormous
Tiny = minute /ai/
Short ≠ long
Broad ≠ narrow, tight
(wide ≠) narrow
Large = big ≠ small

SHAPE
Sharp ≠ blunt
Cylindrical
Square
rectangular
Straight ≠ curved
rounded

COLOUR
Faded ≠ bright
Light ≠ dark
Opaque ≠ transparent
reddish
Shiny (glossy) ≠ matte
golden
silvery

Boiling point – a liquid becomes gas
melting point – a solid becomes liquid

LISTENING

METALS AND NON METALS

Complete the text with the word(s) or expressions you hear.

The most commonly used metal in industry is **IRON**. Its symbol is **Fe**, its atomic weight **55.19** and its specific weight is **7.86 GR/CM³**. Its melting point is **1,528°C**; this is a metal which is magnetized quite strongly but above **768°C** it cannot be magnetized.

Another metal of a great importance in engineering is **ALUMINIUM**, with an atomic weight of **26.97**, a specific weight of **2.7 GR/CM³** and its melting point is **658°C**

Among metals, **LEAD** is the metal which possesses the highest density, with an atomic weight of **207.22** and a specific weight of **11.34 GR/CM³**; contrarily to other metals, however, its melting point is relatively low as it melts at **327°C**.

However not all metals have the same characteristics; as an example we have **MERCURY** which is **A LIQUID** at room temperature; thus, the temperature at which this metal changes from liquid to solid is **-38.9°C** and its boiling point is **357.2°C**.

Non-metals, on the other hand, vary greatly with regard to their characteristics. For example, **CHLORINE** has a specific weight of **0.0032 GR/CM³** and its boiling point is **-33.7°C**. However, **SILICON**, whose specific weight is **2.33**, melts at **1,310°C** and boils at **2,355°C**.

WORD FORMATION

When describing it is very common to use adjectives. That is why it is important to know how to form adjectives from other word classes. Here are examples of some of the most important SUFFIXES.

ADJECTIVES FROM NOUNS		<u>ENGLISH ORIGIN OR ROOT</u>	
LATIN ORIGIN OR ROOT			
-IC	Atomic	-FUL	beautiful
-AL/ AR	usual / linear	-LESS	harmless
-OUS	poisonous / lustrous dangerous	-(L)Y	Sunny, friendly
		-ISH	yellowish
ADJECTIVES FROM VERBS			
-ING	Shining, concentrating, interesting, boring, surrounding		
-ED	Concentrated, interested, bored, surrounded		
ADJECTIVES FROM VERBS OR NOUNS (usually from a Latin origin)			
	-IBLE / -ABLE	terrible / drinkable	
	-ENT / -ANT	different / important	
	-IVE	massive	

EXERCISES

1. Write down examples for each of the suffixes given.

- | | |
|---|--|
| -IC metallic, alcoholic, electric, magnetic | FUL harmful, wonderful, painful, helpful |
| -AL/-AR physical, technical, electrical, | LESS harmless, painless,
hopeful, useful |
| Particular, circular | helpless, shameless, homeless, hopeless, useless |
| -OUS dangerous=hazardous,
precious, gorgeous | -(L)Y windy, chilly |
| -IBLE / -ABLE impossible, comfortable, unable, capable, available,
(re)liable, (un)countable | |
| -ENT / -ANT redundant, | |
| -IVE active, passive, impressive | |

2. Form adjectives as shown above from the following words.

PeriodIC Impressive/ING SymmetrIC

DangerOUS Eat EDIBLE HazardOUS = dangerOUS

HarmFUL/LESS PainFUL/LESS HomeLESS

3. Now, read this text and underline all those adjectives or adverbs which use one of these suffixes in their formation.

TIN

Tin (1) is a pure element belonging to the carbon group (2). It is a soft, silvery-white metal with a bluish aspect (3), known (4) to the ancients as bronze, an alloy with copper. Tin is widely used for plating steel cans (5) used as food containers, in metals used for bearings and in solder.

Tin is non-toxic, ductile (6), malleable and adapted to all kinds of cold-working such as rolling, spinning and extrusion. The colour of pure tin is retained during exposure (7) because a thin invisible, protective layer (8) of tin oxide is formed by reaction with the oxygen of the air. The low melting point (9) of tin and its firm adhesion to clean surfaces facilitate its use as an oxidation-resistant coating material (10).

As (11) tin is fairly weak (12), it is not used in structures unless alloyed with other metals; yet (13) it has become a very common metal in alloys for industry.

Source: Britannica Encyclopaedia.

QUESTIONS

- 1- What is the symbol for tin? **Sn**
- 2- Translate the sentence BELONGING TO THE CARBON GROUP
Pertenciente al grupo del carbono
- 3- BLUISH ASPECT in Spanish is
Aspecto azulado
- 4- KNOWN: this is a shortened relative clause. Give the complete relative clause
That/which is known
- 5- Translate the sentence TINCANS **widely/commonly/often/frequently used**
El estaño se utiliza/usa mucho para platear/chapar/cromar latas de acero
- 6- Explain this property in English
That can be stretched into coils/wires
- 7- EXPOSURE: translate into Spanish. What is the word formation of this word?
Exposicion. To expose + ure, verb+ure=noun
Maintenance = verb+ance=noun, to maintain + ance
- 8- Translate into Spanish BECAUSELAYER (coat, film)
Porque una capa protectora fina e invisible
- 9- Explain in English LOW MELTING POINT
The temperature at which a/this substance melts is relatively low
- 10- Translate AN OXIDATION-RESISTANT COATING MATERIAL
Un material de recubrimiento resistente a la oxidación
- 11- AS: give a synonym
Because, since
- 12- Translate into Spanish FAIRLY WEAK
Bastante débil
- 13- Translate YET into Spanish
aun asi (however)
not yet (end of clause/sentence) – aún/todavía no = still not
yet (beginning of clause/sentence) = aún así = however

EXERCISES

1. Write down examples for each of the suffixes given.

-IC	metallic, _____	-FUL	helpful
-AL/-AR	spiritual	LESS	helpless
-OUS	gorgeous, _	-(L)Y	(un)friendly
	-IBLE / -ABLE		horrible
	-ENT / -ANT	_____	
	-IVE	_____	

2. Form adjectives as shown above from the following words.

Periodic	Impressive/ing	Symmetric	edible-food
Dangerous	Eat-edible	Hazardous	combustible-fuel fossil fuels
Harmful/less	Painful/less	Homeless	

Complete the following text by adding the appropriate suffix to form the corresponding adjectives

STAINLESS STEELS

Stain**LESS**_ steels contain chromium, nickel and other alloy**ING/ED**-elements that keep them rust resist**ANT**_ in spite of the action of moisture or corros**IVE-DING**_____ acids and gases. Some steels have unus**UAL**__ strength. Because of their shin**Y-ING** surfaces architects wide**LY** use them for decorat**IVE-ING**___ purposes.

EXPRESSING MEASUREMENT

The most important measurement expressions are the following:

X is 3 m+ADJ (ex: The bar is 3m LONG)

X is 3m + IN+NOUN (ex:the bar is 3m IN LENGTH)

X has a +NOUN + Of 3m (ex: the bar has A LENGTH OF 3m)

The NOUN + OF X is 3m (ex: THE LENGTH OF THE BAR IS 3M)

Measurement nouns are difficult to spell. Circle the correct spelling:

STRONG	strength				
LONG	longth	length	lengeth	lenght	longht
HIGH	haight	hight	heighth	hieght	height
WIDE	wideth	wiedth	width	widht	wiedht
DEEP	depeth	depht	depth	depth	deepht
To WEIGH	wieg	weight	weighth	waight	wight
BROAD	broadth	*broadness	breadth	broadht	breahht
THICK	thickness	thought	thought	thicknes	thickht
THIN	thinness	thineth	thinnes	thineht	thinness

**This word exists in the dictionary, but it's not used in TECHNICAL LANGUAGE, just in literature.*

DESCRIBING THE SPECIFICATIONS OF A NEW MACHINE

Today I am here to tell you about the new machine which will be used in our factory from now on. I will mention its main characteristics or features and its dimensions.

- CHARACTERISTICS OF THE ALLOY:

Stands very high and very low temperatures

melting point= 3527°C, below -58°C)

- DIMENSIONS:

- **2.35m high, width =37 cm**

- **1.55m length of its base – 1.05cm top**

- **782 kg**

-

- PERFORMANCE:

- **1700 hours**

- **350 rpu (revolutions per unit)**

EXERCISE

EXERCISE: MEASUREMENTS

- 1- The film/layer/coat coating the piece must be very **THIN**..... It should be 0.05 mm **THICK**.....
- 2- The light travels along THE LENGTH..... of the optical fibre
- 3- The channel is too **NARROW** to allow ships to navigate in it. It only measures 3 m **WIDE**.....
- 4- In this part of the swimming pool you can dive in because it is 5 ft **DEEP**..... to the bottom
- 5- The engineers have built a new tower which is 50 m **HIGH**.....
- 6- To make chips, a single crystal in the shape of a long bar of about 10 cm **WIDE**..... (diameter) is cut into circular slices 1/2 mm **LONG**.....
- 7- The beams needed for the structure must be 3 m **LONG**..... and 25 cm **THICK**.....
- 8- To take the recordings, the thermometer was placed at a of 1.5 m above ground level.
- 9- The steel bar can resist up to 305 kg before breaking
- 10- The piece of the machine is too long to fit in the slot, so we must make it
- 11- 3-D objects have three main dimensions:,, and
- 12- The of the tunnel decreases as it goes through the mountain, leaving only one lane.
- 13- The reaction produces a layer on top of the solution, with ranging from 0.2 to 0.6 mm

14- Pitting is a corrosion process that creates holes of about 0.03 mm on the surface of the metal

15- (¿Qué anchura tiene la base de la columna?. Well, it is 1/2 m

WRITING

Describe in 75 words any material/element... used in engineering. Try to answer these questions:

-What is it?

-What are its components?

-What does it look like?

-What are its features?

-What is it used for?

Chalk is a sedimentary rock, which comes from tiny particles left by micro-organisms deep in the sea. It is basically composed of calcium, but can also contain other substances like magnesium or sulphur.

Originally white, it can be dyed in different colours. It is soft, porous and rather brittle.

Along history it has been widely used in teaching, as a material for writing on blackboards, as well as for any type of signs or marks that need to be easily erased.

VIDEO: OPTICAL FIBRE (TECH 2)

if you pick up _____ and look through it, you'll see that the inside walls form a perfect mirror. _____.
_____. Play with _____: it is easy to forget that _____. The reason is that the light keeps on being internally reflected until it finally shines out at the other end.

But while the theory works, _____. For one thing, _____, if you look at an ordinary window pane, you'll see that edge-on, _____. This is _____.

_____ to make _____ which is deposited _____, a glass _____ that a wall of it _____ would be almost _____. If the oceans were made of this glass _____ you'd be able to see _____.

But even fibres made _____ are still not perfect. This glass rod behaves just like a giant _____; feed light at one end and it reappears at the other. Dimming the room light you can see that the rod itself is glowing, _____; when we touch the glass we destroy refraction between glass and air; _____ and more light is lost.

To prevent light losses, such as these, optical fibre (O.F.) is manufactured with _____ of a type that is _____ than the central core; because the refractive index of the outer glass is _____, the light is always reflected internally. Finally, to protect the glass _____ and an outer core of _____. The individual fibres are then stranded together to form a multicore cable.

Even using _____, some light is still lost from the fibre. One reason is that the light inside the glass scatters, the rays change paths, hitting _____ than the critical angle; they pass straight through. This effect is called "Rayleigh scatter".

We can demonstrate this effect with _____. This drum contains a kilometre of optical fibre. _____ the transmitter light and the coil glows _____ from the scattered light. _____. The light that travels all the way through the glass and appears at the other end is _____. _____ wavelength than the blue, so _____ the wavelength, _____.