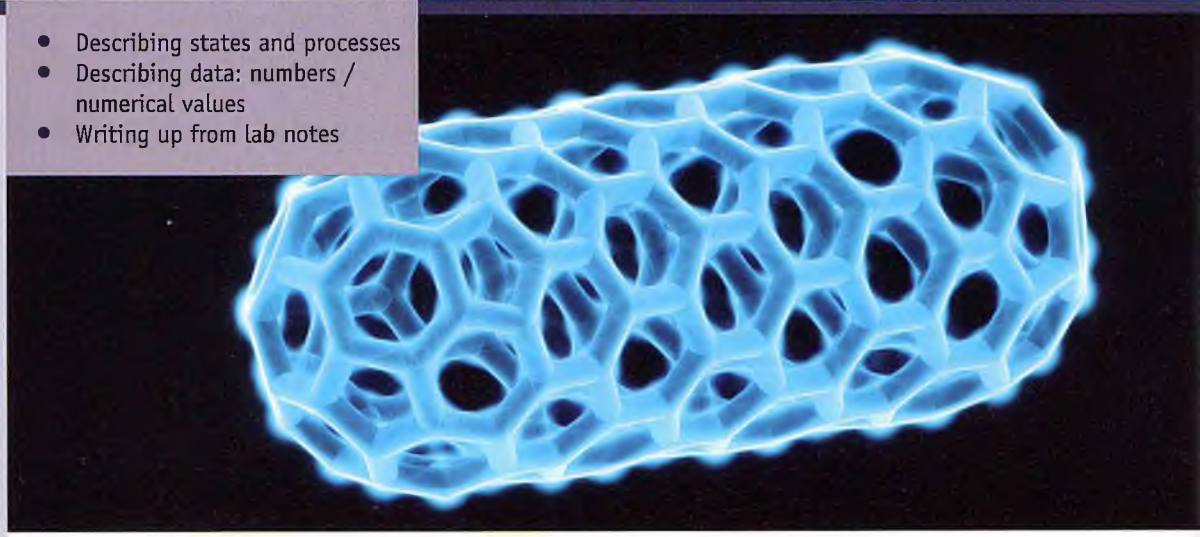
UNIT 6

Writing up research 1: materials and methods

- Describing states and processes
- Describing data: numbers / numerical values
- Writing up from lab notes



Describing states and processes

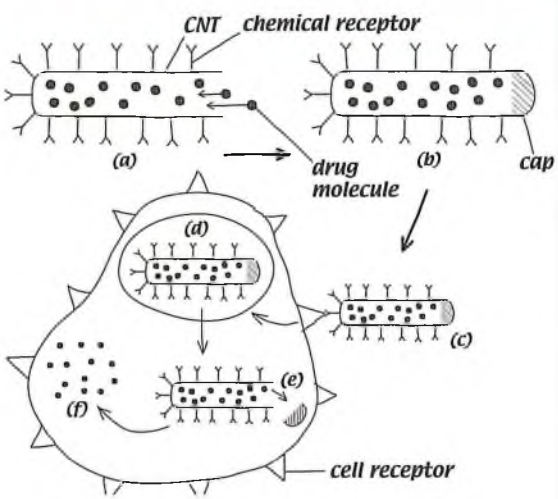
1 a Match the beginnings (1–9) to the endings (a–i) to make definitions of the words in bold.

1 A **biodegradable** substance is one which	a can be put in one place then taken away again.
2 A **nanocapsule** is a capsule which has	b into your body.
3 A **removable** object is one which	c between cells in the same organism.
4 **Endocytosis** is a process by which	d decays naturally.
5 If a cell **overexpresses** a protein, it expresses	e put inside something else.
6 If someone is given **multiple** doses of a drug, they receive	f it many times.
7 **Intercellular** communication is communication which happens	g molecules can move inside cells.
8 When a drug is **encapsulated**, it is	h a diameter smaller than 200 x 10^{-9} metres.
9 If you **ingest** a substance, you take it	i too much of it.

b Underline the key words in the sentence endings (a–i) which summarise the meaning of the prefixes in (1–9) (for example, bio- = naturally).

c In pairs, discuss the following questions.

1 What is nanotechnology?
2 What commercial applications could research in nanotechnology have?



2 a One application of nanotechnology is in pharmaceutical research. Kimiko, a PhD student, has drawn a sketch of a targeted drug delivery for the materials and methods section of her paper. What do you think is happening at each stage (a–f)?

b ▶ 6.1 **Kimiko asks Tom, a colleague, to look at her first draft. Listen to part of their conversation and mark the following statements true (T) or false (F).**

1 Tom asks Kimiko to make changes to her diagram. _____
2 According to Tom, some readers may only know a little about Kimiko's research subject. _____
3 Some people call nanotubes 'magic bullets' because they can be dangerous. _____
4 Kimiko's main interest is in the best method for coating a nanotube with chemical receptors. _____
5 The nanotube can be ingested in different ways. _____
6 Kimiko uses only one method to open the nanotubes after ingestion. _____

3 a ▶ 6.2 **Tom asked Kimiko to explain what happens during the process. Complete the following extracts from their conversation using the words in the box. Then listen and check your answers.**

attach by coat dissolves encapsulated in internalised to with

1 To do this, first we _____ the surface of the tube _____ a chemical receptor.
2 If we want to target a tumour which overexpresses folic acid, then we _____ folate receptors _____ the surface of the nanotube.
3 And then we encapsulate the drug _____ the tube.
4 Once the drug is _____ , we use a cap to close the open end so the drug can't escape.
5 After that, the capsule is _____ _____ the cell.
6 I use biodegradable caps. The cap _____ and then ...

b **The sentences below describe processes in different experiments. Match the verb in bold in each sentence (1–5) to the correct definition (a–e).**

1 A microtome was used to **slice** 4 µm sections of the paraffin-embedded tissue.	a to change from a gas to a liquid or solid state
2 As the gas cools, the water vapour **condenses** and is caught in the conical flask.	b to change the colour of something using a chemical
3 Devices in the two chimneys would **filter** out radioactive dust.	c to cut something into thin, flat pieces
4 Haemotoxylin-Eosin **stains** the cell nucleus blue and the cytoplasm pink.	d to remove or take something away
5 Plutonium 239 was **extracted** from the sample using nitric acid.	e to remove solids from liquids or gases

c **Use the glossary (pages 117–125) to check the meaning of the words in the box. Then write the verbs in the correct form to complete the sentences.**

dilute fuse together grind into purify rinse with

1 50 µl test plasma samples were _____ 1:10 with sterile water.
2 The remaining material was _____ powder for examination.
3 Steam distillation could be used to _____ the nitrobenzene because of its high boiling point.
4 The product was _____ distilled water four times using an Amicon filter.
5 When two deuterons _____ at low energy, the neutron is liberated with an energy of 2.45 MeV.

4 a **Look at the extracts below from the conversation between Kimiko and Tom. Which can be used to ask politely for help and advice (A)? Which can be used to offer help and advice (O)?**

1 But first of all you need to explain briefly what is happening.
2 Do you have a moment?
3 I wondered if you could look through it for me?
4 Sure, Kimiko. What can I do for you?
5 Why don't you talk me through it and make some notes as you go?

b **Draw a diagram of a process you are working on or one you know well. Then role play a conversation in which you ask a colleague to check your diagram and your explanation of the process, using the phrases in Exercise 4a to help you.**

5 a ▶ 6.3 **Tom has checked Kimiko's second draft of the materials and methods section of her paper and underlined some changes he thinks she should make. Read the following extract and discuss in pairs how you could improve Kimiko's text. Then listen and make a note of the changes Tom suggests.**

The magic bullet process uses carbon nanotubes to send a drug to a specific target. Firstly, I functionalise the surface of the nanotube by coating it with chemical receptors. For example, for target a tumour which overexpresses folic acid, folate receptors are attached to its surface. Secondly, I encapsulated the drug molecules within the nanotube. Third, the tube is capped and the nanotubes are ingested. For example, the patient can swallow them or inhale them or have the capsules injected into them. Once inside the body, the nanotube locates to the target site. Fifth, the target cell internalises the nanotube by receptor-mediated endocytosis. After that, the cap is either removed or biodegraded and the drug molecules are released into the cell.

b **Use your notes from Exercise 5a to improve Kimiko's text. Then compare your paragraph with the Answer key on page 110.**

6 a **We use the passive when the person or thing which performs the action is not the main point of interest in the process we are describing in the materials and methods section. Re-write sentences 1–5 using the passive voice so that they focus on the underlined word.**

1 I rinsed the tissue surface with ice-cold isotonic saline solution.
2 After incubation at 37 °C for 60 minutes, the scientist diluted the suspension to 100 ml with water.
3 A mesh filters out particles as small as 10 μm.
4 The experiment measures the audiometric thresholds at six frequencies from 250 Hz to 8 kHz.
5 I used densitometry to analyse the autoradiograph.

b **Which of the sentences (1–5) in Exercise 6a describe a process in general? Which report a particular procedure carried out in one particular experiment or set of experiments?**

c **Look back at the sentences in Exercises 3a–3c. Which verbs are in the passive? Which sentences could be made more formal by using the passive? Which verbs don't need to be changed into the passive?**

7 **Write a paragraph for the materials and methods section of a paper which describes the process you discussed in Exercise 4b. Use Tom's advice to Kimiko to write the paragraph in an appropriate style.**

Describing data: numbers / numerical values

8 a ▶ 6.4 **You are going to hear eight short extracts in which scientists discuss their work. Read the questions below, using the glossary (pages 117–125) to check the meaning of the underlined words. Then listen to each extract and choose the correct number (a, b or c).**

1 What was the dosage of fluoride per kilogram of body weight?
a 0.166 b 0.16 c 0.616

2 What was the sensitivity of the assay?
a 0.02 b 2.0 c 0.2

3 What is the output impedance at the 5V end?
a 0.02 b 0.20 c 0.92

4 What amperage of flex is used?
a 0.6 b 6 c 6.8

5 What is the temperature below which the superconductor conducts electricity with no resistance?
a $^{9}/_{10}$ b 19 c 90

6 What is the enthalpy change when 2 moles of water are formed at a pressure of one atmosphere and a temperature of 298 kelvin?
a −517.6 b −5716 c −571.6

7 What is the lowest frequency at which young mice squeak (make a noise) when isolated from their mother?
a 450 b 45 c 405

8 What speed laser pulses were used?
a 15 b 50 c −50

b ▶ 6.5 **Listen and complete the values (a–l) with the number or numbers you hear.**

a ___ $/_4$	e 5 x 10——	i ___7
b ___%	f −___5	j 17 $^5/$___
c 1___6	g ___^{6}	k 0___
d 2, 9___, 7___	h 1___,893	l 5,___,019

c ▶ 6.6 **In pairs, answer the following questions. Then listen and check your answers.**

1 How do we say these values?
a ¾ b $^5/_8$ c $^4/_9$ d 10^7 e 10^{-9}

2 How do we say these symbols?
a % b x (in e.g. 5 x 10^9) c −

3 What is the difference between **1.356** and **1,356**? How do we say them?

The International System of Units (SI) is the most common measurement system around the world, particularly in the fields of science, commerce and trade. It is a modern form of the metric system and as such is devised around the number 10. The system consists of 7 base units and a set of prefixes. There are a number of other common SI-derived units.

9 a Match the SI unit in column A to its abbreviation in column B and the quantity it measures in column C.

A UNIT	B ABBREVIATION	C QUANTITY
1 metre	K	temperature
2 kilogram	cd	electric current
3 second	mol	frequency
4 ampere	kg	thermodynamic temperature
5 kelvin	s	time
6 candela	m	amount of substance
7 mole	A	mass
8 hertz	Ω	length
9 joule	°C	energy
10 ohm	Hz	resistance
11 degree Celsius	J	luminous intensity

b In pairs, discuss the following questions.

1 What units of measurement do you commonly use in your everyday life?
2 What units do you use in your work?
3 Which SI prefixes do you know? How do they change the quantity?

c Look at the table below which shows the symbols for some of the SI prefixes and the factor they represent. Then complete the right-hand column using the prefixes in the box.

centi- giga- kilo- mega- micro- milli- nano- pico- tera-

	symbol	factor	prefix
1	k	10^{3}	_____
2	M	10^{6}	_____
3	G	10^{9}	_____
4	T	10^{12}	_____
5	c	10^{-2}	_____
6	m	10^{-3}	_____
7	μ	10^{-6}	_____
8	n	10^{-9}	_____
9	p	10^{-12}	_____

d ▶ 6.4 Listen again to the eight scientists from Exercise 8a. What unit of measurement does each one use? Write the abbreviation.

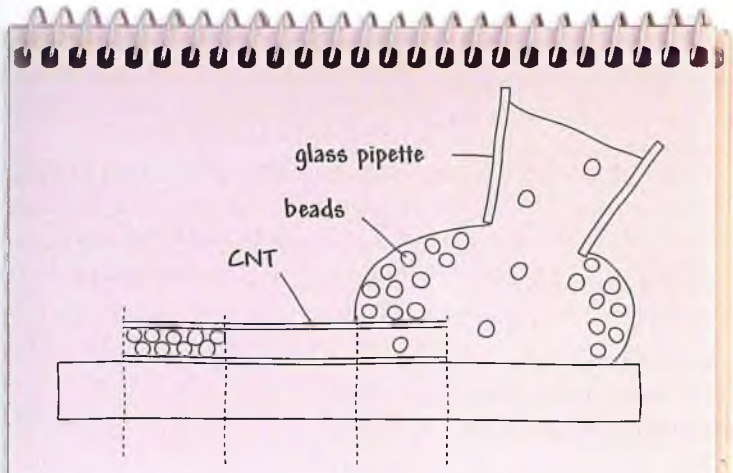
1 0.166 _____ 3 0.02 _____ 5 19 _____ 7 45 _____
2 0.2 _____ 4 6- _____ 6 −571.6 _____ 8 50- _____

10 Find data for some research that you are familiar with. In pairs, take turns to discuss the key findings in the data.

Writing up from lab notes

11 a Kimiko has been investigating methods of encapsulating molecules in functionalised carbon nanotubes (or CNTs). Look at the extract from her lab notebook below and then match the definitions (1–8) to the words or phrases in bold (a–h) in the notebook.

1 a picture _____
2 a small piece of glass you put something on to look at it under the microscope _____
3 a small round piece of plastic, wood, glass, etc. _____
4 a small round-shaped amount of liquid _____
5 always the same _____
6 the distance between the opposite sides of something _____
7 to make something hang or float in something _____
8 an upward movement of a liquid _____



- Make CNTs.
- Check size and wall (a) **thickness** using EM (b) **images** – should be (c) **consistent**.
- (d) **Suspend** tubes **in** solution.
- Put (e) **drop** of solution on (f) **slide** – solution evaporates, leaving the tubes on the slide.
- Put drop of liquid containing (g) **beads** at one end of the tube.
- Liquid moves into the tube by (h) **capillary action**.

b In pairs, look at Kimiko's notes again and answer the following questions.

1 What does Kimiko use the images from the electron microscope (EM) for?
2 How does Kimiko get the CNTs onto the slide?
3 How does she get the liquid containing the beads into the tube?

12 a Look at another extract from Kimiko's notebook on page 52, which describes two of her experiments. Then tell a partner what the symbols and abbreviations in the box mean.

@	~	→	D	diam.	EM	L	w/	w/v

b **Look at the notes again. In pairs, what differences can you see between Kimiko's experiments of 29th October and 18th November? Can you suggest a possible way of completing the spaces (1–6)?**

29th October

Tube size:
L: 10–90 μm
D: from EM – average ~ 450 nm [300–800 nm]
wall thickness: 20 nm

Tube suspension:
Float in solvent
pipette microdrop onto slides
(sticky residue remains – ?solvent blocks tube?)

Soln of beads:
Fluorescent polystyrene beads – D~50 nm
Float in deionised H_2O (1% w/v)
Mix w/ ethylene glycol 1:1

Dip:
Put microdrop full of beads @ end w/ plastic micropipette
Dip 6 μm tube in soln
→ No uptake – tubes blocked?

Next:
Suspend tubes in different solution – ethanol? propanol?

18th November

A Tube size:
L: 20–(1) ___ μm
D: from EM – average ~ 500 nm
[300– (2)___ nm]
(?? Deformed so real diam. smaller?)
wall thickness: (3) ___ nm

Tube suspension:
Float in (4) _____
Use dielectrophoresis to put on slides
2-propanol – dries away

B Soln of beads:
Fluorescent polystyrene beads – D~50 nm
Float in deionised H_2O (1% w/v)
Mix w/ ethylene glycol (5) 1:___

Dip:
Put microdrop full of beads @ end w/
(6) _____ micropipette
Dip 6 μm tube in soln
→ Good uptake

Next:
2 μm or 12 μm dipped – what difference?

c ▶ 6.7 **Kimiko is explaining to Arnie, her PhD supervisor, what she did differently in her 18th November experiment. Listen and complete the notes (1–6) in her notebook.**

13 **a** **Below are two extracts from the final draft of Kimiko's materials and methods section, based on the lab notes for the 18th November experiment. Complete each extract using the words in the boxes.**

A

actual	aid	and	approximately	average	due	estimated	evaporated	length
placed	ranged	suspended	to					

The experiment investigated filling carbon nanotubes with a suspension containing fluorescent beads. The tubes (1) _____ in (2) _____ from 20 (3) _____ 50 μm and had an (4) _____ diameter of (5) _____ 500 nm and a wall thickness of 15 nm. The tube diameters were (6) _____ from electron microscope images and ranged between 300 (7) _____ 700 nm. The (8) _____ tube diameters may have been smaller (9) _____ to tube deformation.

The CNTs were then (10) _____ in a 2-propanol solution and (11) _____ on glass cover slips with the (12) _____ of dielectrophoresis. The 2-propanol then (13) _____ .

B

blending consisted covered filled laden ratio with

A suspension was prepared by (14) _____ ethylene glycol (15) _____ a suspension of fluorescent polystyrene beads (1% weight/volume) in deionised water. The bead diameters ranged from 40 to 60 nm and the suspension (16) _____ of a 1 to 3 volume (17) _____ of particle suspension and ethylene glycol.

A liquid microdroplet, (18) _____ with fluorescent polystyrene beads, was placed at one end of the CNT with a glass micropipette. The drop (19) _____ approximately 6 µm of the CNT. The suspension (20) _____ the CNT by capillary action.

b Read through the extracts again. Which of the verbs in the box are used in:

a the passive?
b the active?

consist cover estimate evaporate fill investigate place prepare range suspend

c Below are extracts from the materials and methods section of three different papers and the notes on which they are based. For each extract, use the notes to put the words from the paper in the correct order. The underlined noun phrase at the beginning of each sentence is in the correct position.

%RBC change ~ +8.0 to -7.4

1 <u>The change in red blood cells</u> / approximately / from / plus / minus / 8% / ranged / to / 7.4%.

Float cells in incubation med - into flask

2 <u>The cells</u> / incubation / medium / placed / and / an / were / in / then / in / a / suspended / flask.

Stream sediment samples - soak 1:1 HCl.

3 <u>The stream sediment samples</u> / soaked / 1-to-1 / in / volume / a / HCl / at / ratio / were.

14 **Write a paragraph for the materials and methods section in an appropriate style for an experiment you are working on or for an experiment you are familiar with.**