

UNIT 7

Writing up research 2: presenting data

- Analysing data (statistical analysis)
- Summarising data in visual form
- Writing captions for figures
- Describing visual data



Analysing data (statistical analysis)

- 1 a** Some organisms have adapted to live in very extreme conditions and are known as extremophiles. Match the type of extremophile to the condition it lives in.

1 acidophile	a survives best in media with high osmotic pressures due to high sugar concentrations
2 alkaliphile	b can survive in areas with high levels of dissolved heavy metals in solution
3 cryophile	c survives best at temperatures between 60 and 80 °C
4 metalotolerant organism	d can survive ultraviolet and even nuclear radiation
5 osmophile	e survives best at pH 3 or below
6 radioresistant organism	f survives best at pH 9 or above
7 thermophile	g survives best at temperatures of 15 °C or lower

- b** In pairs, discuss the following questions.

- How might research on extremophiles be useful for understanding:
 - how organisms adapt to their environment?
 - the beginning of life on Earth?
 - life on other planets in the universe?
- What industrial and commercial applications could research on extremophiles have?

- c** Find a word or phrase in the definitions (a–g) in Exercise 1a with a similar meaning to the prefixes in the extremophile names (1–7). For example, *acid-* and *pH 3 or below*.

d Which suffix used in Exercise 1a (-phile, -resistant, -tolerant) is used to describe an organism which:

- does not mind this environment?
- will not be killed by this environment?
- is attracted to and is able to exist in this environment?

e Match an affix (a prefix or suffix) 1–7 with its meaning a–g.

1 neutro-	a dry
2 halo-	b hate
3 hydro-	c many
4 hyper-	d more
5 poly-	e neutral
6 xero-	f salt
7 -phobe	g water



Mid-Oceanic Ridge Shrimp
– *Rimicaris Exoculata*

f Read the definitions of four more extremophiles (1–4). Then choose a suitable name for each extremophile using one or more affixes from Exercises 1a and 1e.

An organism that:

- survives best at temperatures above 80 °C. _____
- does not like to live in salty conditions. _____
- survives best at pH 7. _____
- survives best in very high temperatures with high metal concentrations.

2 a ► 7.1 Tiago is a marine biology student who is studying adaptations in shrimp living near hydrothermal vents. He is explaining his research to Nour, a new student in the lab. Listen to the conversation and answer the questions.

- What two extreme conditions have the vent shrimp adapted to?
- How does Tiago expect the levels of metal-binding proteins to change in the vent shrimp?
- How will he use the two species of Rio Formosa lagoon shrimp in his research?
- What other compounds is he looking at?

b Tiago is just beginning his statistical analysis. Match the words or phrases used in statistics (1–10) to the definitions (a–j).

1 Analysis of Variance (ANOVA)	a a relationship between two factors
2 coefficient	b small groups which should be representative of a whole population
3 correlation	c shows how much variation from the mean there is within the group
4 mean	d the average, found by adding all the values together and dividing by the number of values
5 p-value	e the measure of significance, which shows if it is likely that the variation in results is just chance
6 regression analysis	f the test used to compare whether the means of two groups are equal
7 samples	g the test used to produce an equation showing the relationship between two factors
8 standard deviation	h the test used to compare whether the mean values of more than two groups are all equal
9 t-test	i the things that change in an experiment
10 variables	j a mathematical value which is always written before another value it multiplies

C Tiago has written notes on how to analyse his data. Complete the notes using the words and phrases in Exercise 2b.

Variables

Dependent: MT levels/antioxidant levels

Independent: Different species of shrimp (2 x vent species, 2 x lagoon species)

Multiple (1) _____ from each one to accurately represent populations

Statistical analysis

- 1 Calculate (2) _____ MT level for each species
Use (3) _____ to test whether the means of the groups are all equal
(Could do lots of (4) _____, but more likely to make mistakes)
- 2 Repeat for enzyme activity for each group
Look for low (5) _____ to show significance (usually ≤ 0.05)
- 3 Look at the (6) _____ within each species - to assess variation from the mean within the group
- 4 Calculate the (7) _____ coefficient to see if there is a relationship between MT concentration and antioxidant enzyme levels.
If there is a correlation, do a (8) _____ to produce an equation of the relationship
(Use this to predict levels of MT from antioxidant enzymes or vice versa)

3 a Tiago has done some statistical analysis of his results. In pairs, look at the table below and discuss what you think the most interesting results might be.

		Hydrothermal vent species		Coastal (lagoon) species	
		<i>Rimicaris exoculata</i>	<i>Mirocaris fortunata</i>	<i>Palaemon elegans</i>	<i>Palaemonetes varians</i>
Metal binding protein	MT level (mg.g ⁻¹ w/w protein)	7.30 ± 0.66 a	1.27 ± 0.27 c	4.34 ± 0.99 b	1.65 ± 0.39 c
Antioxidant enzymes	Cytosolic SOD (U mg ⁻¹ protein)	2.56 ± 0.66 c	16.15 ± 5.66 a	5.14 ± 1.58 b	5.67 ± 1.73 b
	Cytosolic CAT (mmoles min ⁻¹ mg ⁻¹ protein)	0.0042 ± 0.0005 a	0.0048 ± 0.0010 a	0.0014 ± 0.0005 b	0.0020 ± 0.0005 b
	GPx (μmoles min ⁻¹ mg ⁻¹ protein)	0.010 ± 0.002 c	0.040 ± 0.010 a	0.023 ± 0.004 b	0.015 ± 0.007 bc

Values followed by the same letter are not significantly different ($p > 0.05$).

b Complete the following sentences describing Tiago's results using the words in the box.

a significantly higher not significantly different from no significant differences
approximately sixfold higher than in the lowest threefold higher in

- 1 MT levels in *Rimicaris exoculata* were _____ *Mirocaris fortunata*.
- 2 MT concentrations in *Palaemonetes varians* were _____ those in *M. fortunata*.
- 3 The hydrothermal vent shrimp *R. exoculata* exhibited _____ SOD activity.
- 4 _____ were found in the activity of cytosolic SOD between the two coastal shrimp species, *P. elegans* and *P. varians*.
- 5 The activity of cytosolic CAT was approximately _____ the two vent shrimp species compared with their coastal counterparts.
- 6 _____ GPx activity was observed in *M. fortunata* compared with all the other shrimp species.

c Write four more sentences comparing and contrasting the data in the box.

d Think of an experiment you have done. Explain to your partner:

- what your variables were
- how many samples you had
- what statistical analysis you needed to do and what tests you used
- what significant results you found

Summarising data in visual form

4 a In pairs, discuss the following questions.

- 1 Why are visuals used in scientific papers?
- 2 What visuals do people in your field commonly use to show data? Why?

b Match the beginnings and endings of the sentences about setting data in tables and charts.

- | | |
|---|---|
| 1 Tables, graphs, etc. are necessary | a be consistent with them. |
| 2 Visual summaries allow | b reduced in size in a paper. |
| 3 Deciding how to present data visually makes you | c show trends; tables to show exact numbers. |
| 4 Visuals need to be clear even when | d the reader to check the data for themselves. |
| 5 Graphs should be used to | e think carefully about what your results mean. |
| 6 Too much information in a visual | f to avoid filling up the text with lists of numbers. |
| 7 Use standard symbols and | g will confuse the reader. |

c Which advice in Exercise 4b do you think is the best? What other advice would you give to someone producing visuals to portray their data?

5 a Look at the visuals. Complete the labels (1–16) using the words in the box.

Tables

column row

1 _____

2 _____

Site	Illa Formosa 37°03'N, 07°47'W	Rainbow 36°13'N, 33°54'W	Seawater
T (°C)	17.3 ^a	36.5 ^c	—
pH	8.28 ^a	2.8 ^c	7.8
Si (µM)	—	1.0 ^c	0
CO ₂ (µM)	—	< 16 ^c	—
CH ₄ (µM)	—	2.2–2.5 ^c	0
Cd (µM)	0.9–4.5 ^a	130 ^c	0.7
Cu (µM)	0.02–0.05 ^a	140 ^c	0.0033
Zn (µM)	0.02–0.03 ^a	160 ^c	0.028
Fe (µM)	8–52 ^b	24000 ^c	0.0045
Mn (µM)	2.5–6.3 ^b	2750 ^c	0.0013
Cl (µM)	—	750 ^c	—
Co (µM)	—	13 ^c	<2
Ag (nM)	—	47 ^c	0.023
Ni (µM)	—	3 ^c	<2
Si (µM)	—	6.9 ^c	<0.2

^aInstituto Hidrográfico (1998).

^bChetano et al. (1997).

^cDauville et al. (2002).

Two-variable graphs

bar chart histogram
line graph line of best fit
point scatter plot x-axis
y-axis

3 _____

4 _____

5 _____

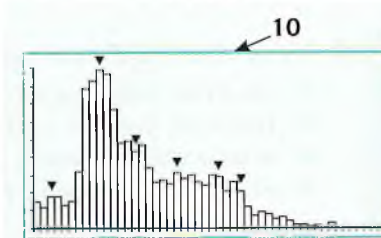
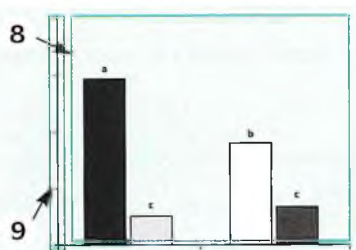
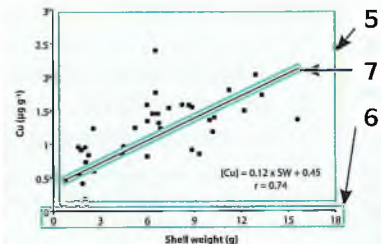
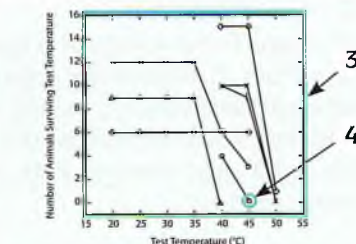
6 _____

7 _____

8 _____

9 _____

10 _____



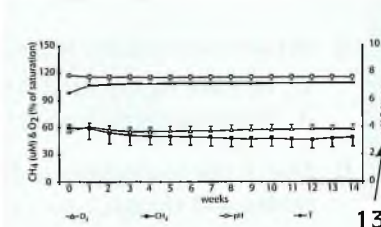
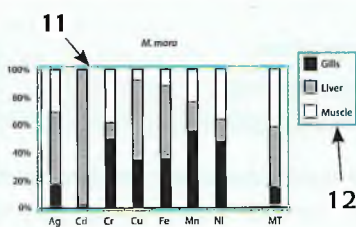
Three-variable graphs

key label
stacked bar chart

11 _____

12 _____

13 _____



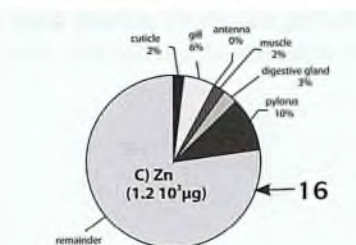
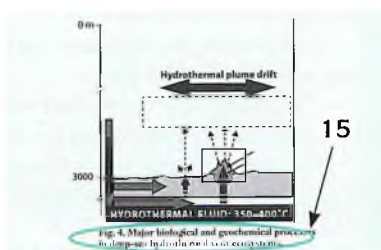
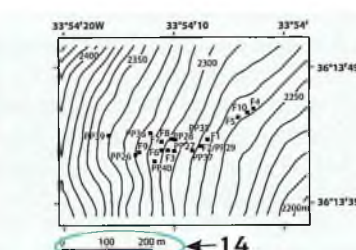
Other

caption pie chart scale

14 _____

15 _____

16 _____



- b The statements below describe which type of visual is best for representing different kinds of information. Complete them using the words in the box.

bar chart diagram histogram line graph map pie chart scatter plot
stacked bar chart table

It is best to use a:

- a _____ or _____ to show a comparison between items
- b _____ to show a correlation
- c _____ to describe a location
- d _____ or a _____ to show proportions of a whole
- e _____ to describe a structure
- f _____ or a _____ to show trends

- 6 a ► 7.2 Tiago has produced some visuals to depict the data from his research and is now showing them to Océane, his supervisor. Look at the bar chart in Exercise 5a and, using your own words, complete the notes on the four changes Océane suggests Tiago makes to the chart.

- 1 Need to label the _____
- 2 Units need to be _____
- 3 Need a key to _____
- 4 Use T symbols to _____

- b In pairs, role play a conversation between a supervisor and a student. Student A, you are the supervisor; look at the visual on page 86 and suggest ways to improve it. Student B, you are the student; make the corrections Student A suggests. Swap roles using the visual on page 87.

Writing captions for figures

Every visual in a scientific paper should have a caption. The caption is a short text which tells the reader what the visual is showing.

- 7 a In pairs, discuss the following questions.

- 1 Should the caption appear above or below the visual it describes? Why?
- 2 What kind of information should the caption include?
- 3 What difficulties might there be when writing a caption in English?

- b Read four captions (A–D) for four different figures. Then answer the questions which follow each one.

A Fig. 3. The relationship between the weight of shell and strontium concentration in the shell of *B. azoricus* from the Mid-Atlantic Ridge (n = 51).

- 1 How is the information about sample size represented?
- 2 Can you see a similarity in the grammatical structure of caption A and the underlined part of caption D?

B Table 1. Temperature, pH and concentration of chemical species in the end-member fluids of lagoon system Ria Formosa (South Portugal) and MAR vent field (Rainbow) compared with average seawater (adapted from Caetano *et al.*, 1997; Douville *et al.*, 2002).

- 3 Are the results in Table 1 from the author's research? How do you know?
- 4 Which two-word phrase explains the main purpose of the information in Table 1?

C Fig. 1. Thermal tolerances for the three symbiotic species under investigation (*Alviniconcha* sp., *Ifremeria nautilei* and *Bathymodiolus brevior*). For all experiments each temperature was held for 1 h, then the temperature was reduced to the starting temperature, the animals removed and mortality assessed. If alive, animals were returned to the aquarium and temperature was increased to the next point.

- 5 What phrase has a similar meaning to *being studied*?
- 6 How are the names of the organisms presented? Why?
- 7 What information do(es):
 - a the underlined part of the caption give us?
 - b the other parts of the caption give us?

D Fig. 2. Metallothionein concentrations (MT) in the edible tissues of hydrothermal (*Rimicaris exoculata* and *Mirocaris fortunata*) and coastal shrimp (*Palaeomon elegans* and *Palaeomonetes varians*). The data represent average $\pm$ standard deviation (SD), $n = 16$. Values followed by the same letter are not statistically different ($p > 0.05$).

- 8 What phrase has a similar meaning to *the results show*?
- 9 What phrase has a similar meaning to *the same for the purposes of the analysis*?
- 10 Can you see a difference in the grammatical structure of the underlined part and the rest of the caption?

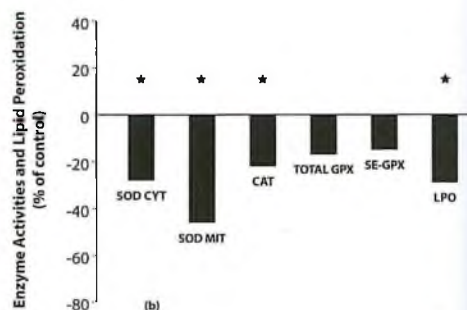
8 a Captions often begin with a noun phrase which tells the reader what the visual shows (see captions A and B and the underlined parts of captions C and D above). Remove four words from each sentence (1–3) to make noun phrases.

- 1 The figure depicts the length-frequency of four samples of mussels collected at three different sites of the Lucky Strike area.
- 2 The figure shows the copper concentration in the soft and exoskeleton tissues of four shrimp species.
- 3 The table presents a comparison of the physical and chemical characteristics of the hydrothermal fluids at Menez Gwen, Lucky Strike and Rainbow (adapted from Douville *et al.*, 2002).

b Tiago's colleague, Nour, has written a caption for the following figure. Complete the caption below with the words in the box.

($p < 0.05$) *B. azoricus* expressed Fig. 1 represent values

(1) _____ The activity of SOD cytosolic and mitochondrial, CAT, total and Se-dependent GPx, and lipid peroxidation in the gills of (2) _____ exposed to Cu 0.4 μ M for 24 h in IPOCAMP and (3) _____ as percentage of unexposed gills $n=10$. (4) _____ marked *
(5) _____ a significant difference between contaminated and control antioxidant enzyme activity or lipid peroxidation levels
(6) _____



C Look at Nour's caption again. Find three parts of the text which should have brackets (parentheses) added.

d Sketch a graph for some data you are working on at the moment or that you have worked on. Write a short caption which includes all the necessary information to help explain the graph.

Describing visual data

9

► 7.3 Nour is asking Océane about the best ways to describe visuals in her results. In pairs, discuss the questions (1–8) she asks Océane. Then listen and make notes on Océane's answers.

- 1 Why do I need to write descriptions of my charts in the results section if they can stand alone?
- 2 If I have negative results, should I include those?
- 3 Do I need to say what the results mean here?
- 4 In the results section, do I need to put in every table or chart that I've produced?
- 5 Do I need to write about all the visuals I include in the paper?
- 6 What kind of things are key results?
- 7 When I'm describing a figure, do I need to mention every value?
- 8 Should I include my statistics?

10

a Look at four graphs Nour has prepared and read the two extracts (A and B) from her paper below. Which graphs (1–4) are described in extracts A and B?

A

The SOD, CAT, total and Se-dependent GPx activities and lipid peroxidation shown as a percentage of unexposed gills of *B. azoricus* are shown in Fig. 1. Cd exposure caused a significant inhibition of SOD (cytosolic and mitochondrial), CAT and total glutathione peroxidase activity (ANOVA, $p < 0.05$), while no significant change in Se-dependent glutathione peroxidase ($p > 0.05$) was seen.

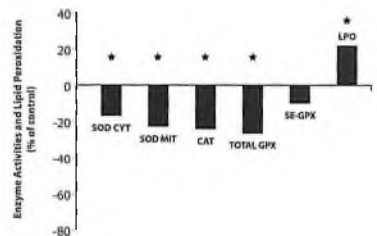
B

Elevated temperature changed H_2S uptake in the three species tested differently (Fig. 3A). As temperature increased, H_2S uptake in *Alviniconcha* sp. decreased, but stayed high at the highest test temperature of 37 °C. *Alviniconcha* sp. clearly had the fastest consumption of H_2S , consistently taking up 3–4 times the quantity per unit tissue compared with the other species. For *I. nautili*, H_2S consumption also decreased as temperature increased. *B. brevior* showed a linear pattern of increasing consumption with temperature as high as 15 °C (Regression analysis, $R^2 = 0.86$). Higher temperatures were attempted with *B. brevior*, but any exposure at those temperatures of a sufficient duration to obtain steady rates resulted in death.

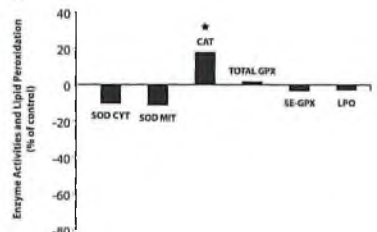
b Match the underlined words or phrases in extracts A and B to a word or phrase with a similar meaning (1–15).

- | | |
|--------------------------------|--------------------------------------|
| 1 affected | 8 led to |
| 2 are presented | 9 reduction in |
| 3 expressed as a proportion of | 10 remained at a high level |
| 4 fell | 11 rose |
| 5 had the greatest rate of | 12 showed a linear relationship of |
| H_2S use | 13 up to |
| 6 in comparison to | 14 was observed |
| 7 produced | 15 whereas no significant difference |

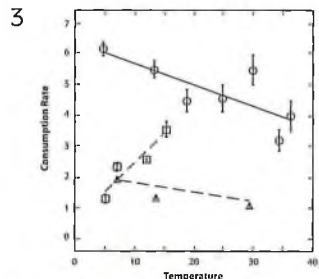
1



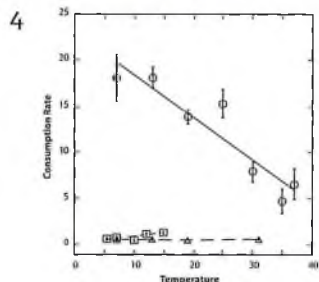
2



3



4



11

Write a description of some visual data you are working on.