How much water should I drink?

Teacher guidelines

9

Science

Queensland Comparable
Assessment Tasks
(QCATs) 2011

Queensland Government
Queensland Studies Authority

Queensland Studies Authority

Contact information

Direct questions about receipt of QCAT materials or QCAT implementation to the Senior Operations Officer.
Phone: (07) 3120 6187 email: qcats.administrator@qsa.qld.edu.au

Queensland Studies Authority PO Box 307 Spring Hill Qld 4004
Phone: (07) 3864 0299 Fax: (07) 3221 2553 Email: office@qsa.qld.edu.au Website: www.qsa.qld.edu.au

Cover image Bottles of water: stock image 7220323 ‹www.123rf.com/photo_7220323_waterbottles.html›.

Contents

The 2011 QCATs

What are QCATs?

Queensland Comparable Assessment Tasks (QCATs) are designed to provide evidence of what students know, understand and can do in relation to a selection of Essential Learnings for English, mathematics and science in Years 4, 6 and 9, and to the Standards.

QCATs are authentic, performance-based assessments that:

- engage students in solving meaningful problems
- emphasise critical thinking and reasoning
- provide teachers, students and parents/carers with information about student progress and a focus for future teaching and learning.

Consistency of teacher judgments

QCATs support teachers in making consistent judgments about the quality of student work. Improved consistency of teacher judgments is achieved when teachers:

- engage in professional conversations about the quality of evidence in student responses
- reach consensus about the quality of student work
- adopt a consistent approach when using the Guide to making judgments (back page).

Information gathered may be used by teachers to promote, assist and improve key learning area programs, and to help students achieve the highest standards they can.

Additional resources

2011 QCATs Information statement
www.qsa.qld.edu.au/3163.html

Essential Learnings and Standards
www.qsa.qld.edu.au/574.html

Important dates

Friday 24 June	QCATs packages have arrived in schools
Monday 11 July ↓ Friday 16 September	Schools: • administer QCATs at any time during the school weeks of this period • grade QCATs • select five student samples that are representative of grades awarded
Monday 10 October	Schools are notified if selected to submit student samples for QSA's random sampling process
Monday 21 November	Final day for schools to submit student data to QSA
Friday 9 December*	Schools must retain all Student booklets until the end of the school year

* this date may vary from school to school

Getting ready

Student preparation

Students should have the opportunity to do their best work. For this to occur, student preparation should include:

- opportunities to engage with the Selected Essential Learnings (page 25) well in advance of participating in QCATs — if students have not engaged with the Selected Essential Learnings recently, review and consolidation may be necessary
- experience with the types of questions used within the QCAT.

Suggested learning experiences and resources are outlined in the document 2011 QCATs – Preparation.

The quality of information provided by the QCATs is enhanced by the level of interaction teachers have with their students before, during and after implementation.

Additional resources Queensland Comparable Assessment Tasks (QCATs)
www.qsa.qld.edu.au/3163.html

Catering for diversity — Special provisions

All students should have the opportunity to participate in school-based assessment. Schools are responsible for determining which students require special provisions.

The QCATs are designed to be part of a classroom assessment program, and principles of participation and equity apply. The Queensland Studies Authority (QSA) offers this general advice:

- Students who have been identified as having specific educational requirements may be assisted using those adjustments and supports usually available in the classroom. To make participation possible in all or part of the assessment task, such help may be in the form of inclusive learning technologies, reading support or the use of support personnel.
- Students for whom English is not their first language, and who are assessed as not achieving a reading level appropriate to complete the task, may be assisted by an interpreter or educational devices (e.g. pictures, electronic whiteboards, interactive devices) to allow participation in all or part of the task.
- In exceptional circumstances, where a student's learning difficulties have precluded them from engaging with the Selected Essential Learnings, the principal (in consultation with specialist and support staff and parents/carers) may make a decision about the participation of that student in the task. Some students may be given an opportunity to complete some aspects of the assessment.

Additional resources Inclusive strategies for implementing QCATs
www.qsa.qld.edu.au/3163.html

Equity
www.qsa.qld.edu.au/10188.html

Teacher preparation

Check the contents of QCAT packages as soon as they arrive at your school

- Check that you have the appropriate number of Student booklets (one per student) and Teacher guidelines (one per implementing teacher).
- Check for any defective Student booklets.
- Contact the QSA if any additional copies are required.

Familiarise yourself with the assessment

- Read all the documents provided.
- Review the Selected Essential Learnings (page 25).
- Complete a Student booklet yourself, and then refer to the Model response (page 28) so that you understand what students are required to do.
- Download and view Sample responses from the QSA Assessment Bank (see Additional resources below).

Plan implementation

- Discuss the assessment with your colleagues, and plan any teaching or revision that may be required.
- Set the times and dates for implementation, considering these points:
  - teachers have flexibility to implement the QCATs at any time during the designated period
  - QCATs may be completed in one, two or more sessions over one or more days
  - implementation times may differ for verified students, students with specific educational requirements or students who have English as a second language
  - QCATs will ideally replace an existing piece of assessment in the student portfolio of work for Semester 2.
- Plan:
  - any support required to enable students to do their best work (e.g. teacher aides or other support personnel)
  - any materials or equipment needed to implement the assessment.
- Decide:
  - how you will implement this task for all classes at this year level
  - the processes you will use to achieve consistency of teacher judgment
  - how you will select student samples for the QSA's random sampling process
  - when, how and who will submit your school's data.

Additional resources

Queensland Comparable Assessment Tasks (QCATs)
www.qsa.qld.edu.au/3163.html

Sample responses, QSA Assessment Bank
https://qcar.qsa.qld.edu.au/assessmentbank (registration required)

8 – Using Queensland Comparable Assessment Tasks (QCATs) to support learning
www.qsa.qld.edu.au/3166.html

Implementation

Setting up

Students carry out an investigation as part of preparation for this QCAT (Student booklet pages 4–5). See Preparation for investigation on page 27 of this booklet for a detailed materials list, and guidance on materials preparation.

Students need to set up the experiment then leave overnight before making their observations.

Working with the Student booklet

Use advice given in the Annotated Student booklet (page 8) to set the conditions that ensure all students have the opportunity to do their best work.

Encourage students to interact with teachers to seek clarification when required, and with other students if appropriate to the task.

Suggested implementation timeline

Preparation

Setting the scene: Group discussion	10 minutes
Investigating the effect of changing salt concentration on living tissue	30 minutes + overnight

The assessment task

Analysing and explaining the results	30 minutes
Explaining the Kokoda deaths	30 minutes
Reflecting on water and sodium needs	30 minutes

Annotated Student booklet

Queensland Studies Authority PO Box 307 Spring Hill Qld 4004
Phone: (07) 3864 0299 Fax: (07) 3221 2553 Email: office@qsa.qld.edu.au Website: www.qsa.qld.edu.au

Images Cover, Bottles of water: stock image 7220323 <www.123rf.com/photo_7220323_waterbottles.html>; p. 2 used with permission from Ipswich State High School; Creative Commons Attribution 2.0 Generic licensed photos <http://creativecommons.org/licenses/by/2.0> accessed 6 Jan 2011; Drinking cyclist: bradleygee's photostream, "drinking water while riding bike", <www.flickr.com/photos/icanchangethisright/4731244382>; Kokoda trail: Arthur Chapman's photostream, "Between Deniki and Isurava, Kokoda Track, Papua New Guinea", <www.flickr.com/photos/arthur_chapman/3640475744>; Triathlon: foleymo's photostream, "Triathlon_22", <www.flickr.com/photos/foleymo/5019710372>; Bottled water: shrff14's photostream, "water bottles", <www.flickr.com/photos/11147789@N00/128127862>; Rugby: Peter_Byrnes' photostream, "Cam Smith Passing", <www.flickr.com/photos/peter_byrnes/3908623230>; Kokoda trail crossing stream: Arthur Chapman's photostream, "Crossing Ofi Creek, Kokoda Track, Papua New Guinea", <www.flickr.com/photos/arthur_chapman/3639766055>; Boy drinking: One From RM's photostream, "Finlandia - Drinking in Helsinki", <www.flickr.com/photos/onefromrome/1172374982>; p. 2 & p. 12 Tennis player: sub_lime79's photostream, "Samantha Stosur, Round 1, Roland Garros, 2010", <www.flickr.com/photos/ mistybushell/4668806370>; p. 12 Boy on beach: xJasonRogersx's photostream, "Day 186 / 365 - Walking on the beach", <www.flickr.com/photos/restlessglobetrotter/1393560546/sizes/o/in/photostream>. All other images © QSA.

Suggested time: 10 minutes

Setting the scene: Group discussion

Six die on Kokoda track

Since 2006, six Australians have died from unknown causes while walking the Kokoda track, a gruelling 96 km trek through rugged mountains in the tropics of Papua New Guinea.

Theirs were not the only Kokoda deaths; a number of walkers have died from dehydration. What made these six deaths a mystery was that the six walkers were fit and healthy, and drank plenty of water.

The mystery was solved in 2010 when two Queensland doctors decided to test their theory that some walkers were drinking too much water.

The doctors took blood samples from almost 200 trekkers who had walked for a full day. They found that a small number had severely low sodium concentrations in their blood and had developed headaches. These trekkers had consumed large amounts of fluids.

The doctors advised the walkers to stop drinking water until their sodium concentrations returned to normal, and then to drink only when they were thirsty.

Adapted from Life in the Fastlane.com, "Kokoda Medicine" 7 Jun 2010, accessed 7 Apr 2011, <http://lifeinthefastlane.com/2010/06/kokoda-medicine>.

Use the stimulus pictures, the newspaper story and the questions below to promote discussion on how much water we should drink.

We are often reminded to keep well hydrated and are warned of the dangers of dehydration.

- How is it possible to die from drinking too much water?
- How does our body control the correct amount of water?
- What does sodium have to do with water balance?

In this assessment, you will:

- observe the effects of changing salt concentration on living tissue
- use your results and your understanding of cells and water balance to provide an explanation for the Kokoda deaths
- reflect on your understandings to provide advice and evaluate claims made about water needs.

Work through the Guide to making judgments on the last page of the Student booklet with students to highlight the assessable elements for this QCAT.

Explain, in student-friendly terms, the task-specific descriptors. These identify what is being valued in the student responses.

Suggested time: 30 minutes

Discuss the aim of the investigation.

At Kokoda, the Queensland doctors showed that drinking too much water reduces the sodium concentration in the blood and in the fluid surrounding the cells.

The investigation below models the effect of changing sodium concentration on living tissue.

- Plant tissue (potato) is used because it is not practical or ethical to use human tissue.
- Salt is used as a source of sodium.

Investigating the effect of changing salt concentration on living tissue

Place students in appropriately sized groups and provide materials.

See Preparation for investigation (page 27) for guidance on preparing materials.

Follow your teacher's directions to carry out the investigation.

Aim: To measure the effect of changing salt concentration on the length of a potato slice.

Method

Provide an appropriate level of support for all students to engage with the investigation.

1. Label 5 test tubes A to E.
2. Obtain 5 freshly cut, narrow potato slices, all the same length.
3. Measure the length of each slice, to the nearest mm, and record in Table 1 (Original length).
4. Place each slice in a test tube.
5. Into test tube A, pour pure water until the potato slice is covered.
6. Into each of test tubes B to E pour salt solution corresponding to the concentration shown in Diagram 1 until each potato slice is covered.
7. Leave the potato slices to soak overnight.
8. Pour out the solutions and measure the length of each potato slice to the nearest mm.
9. Record the length of each slice in Table 1 (Final length).
10. Calculate the change in length of each slice and record in Table 1 (Change in length).
11. Observe any other changes to the potato slice and record in Table 1 (Other changes).

The chemical name for salt is sodium chloride (NaCl).

Diagram 1: Investigation set-up

Test tube	A	B	C	D	E
Water/solution Potato slice					
Salt concentration in grams/Litre (g/L)	0	5	10	15	20

Stop here: Leave your potato slices in the solutions until the next lesson.

Stop here directions are placed at convenient points to finish a session, or to discuss the next part of the QCAT.

Table 1: Investigation results

	Test tube	A	B	C	D	E
	Salt concentration (g/L)	0	5	10	15	20
Potato slice	Original length (mm)					
	Final length (mm)					
	Change in length (+/– mm)					
	Other changes					

Stop here: Discuss your results.

Ensure all students record their results.

Share results and discuss with the class to ensure that any misconceptions are not carried through the task.

Some groups may record results that do not show expansion at low salt concentrations and contraction at high concentrations.

To enable these students to complete Question 1, provide them with data from other groups or from the model response.

Suggested time: 30 minutes

Analysing and explaining the results

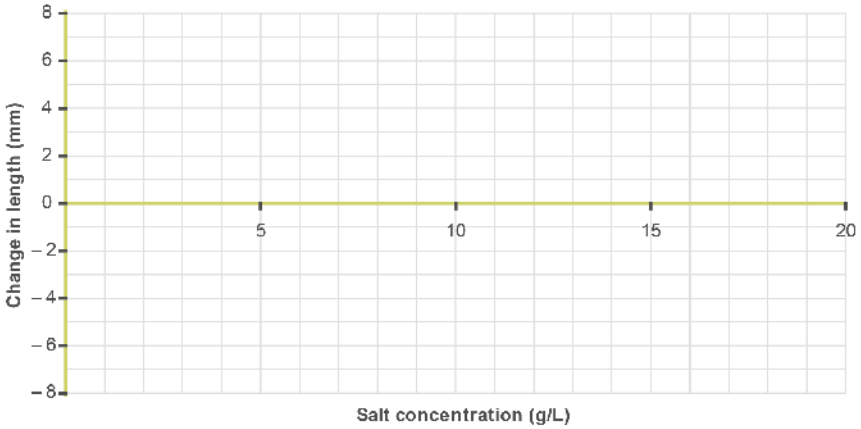
Individual work

Work on your own to complete the assessment.

Discuss the purpose of this section, i.e. *Graph the results, determine if the investigation was a fair test, and interpret and explain the results.*

1. Present the data from the investigation as a line graph below.

Graph 1: Effect of salt concentration on length of potato slice



2. a) What is the independent variable? .....

b) What is the dependent variable? .....

c) Complete Table 2 to show how other variables were controlled.

Table 2: Other variables

Variable	Controlled or not controlled?	Explain how it was controlled (or not controlled)
temperature	controlled	salt solutions and potato slices were all at room temperature

If the question is raised, explain to students that even though the temperature was not constant, the **temperature conditions** were the same for all test tubes.

6 | QCATs 2011 Student booklet Year 9 Science

What is being assessed

Questions 1–3 gather evidence about presenting the results of an investigation and evaluating its fairness.

As you work through the QCAT with students, check for understanding of the task and provide clarification as needed.

Where students ask individual questions, answers should be shared with all students wherever possible.

3. Is the investigation an example of a fair test? Explain by referring to Question 2.

.....

.....

.....

4. What do your results tell you about the effect of high and low salt concentrations on the length of a potato slice?

.....

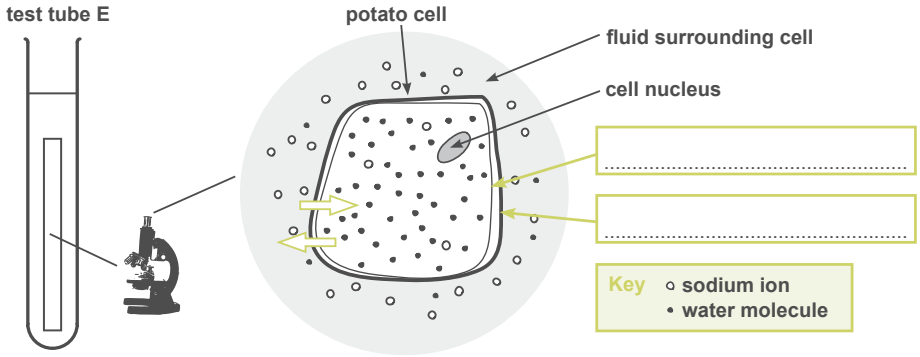
.....

.....

5. At what salt concentration would the length of the potato slice not change?

.....

Diagram 2: Potato cell from the potato slice in test tube E (high salt concentration)



6. a) Complete the missing labels in the potato cell in Diagram 2.

b) Circle the arrow on Diagram 2 (⇦ or ⇨) that shows the overall direction that water molecules will move between the cell and the surrounding fluid.

c) What effect would the movement of water have on the potato cell?

.....

What is being assessed

Questions 4 and 5 gather evidence about drawing conclusions from data.

Question 6 and 7 gather evidence of understanding of cell structure and water movement in cells.

Suggested time: 30 minutes

7. **What common structure of plant and animal cells allows us to use potato cells to model water movement in human cells? Explain.**

Hint: Look at Diagram 2 on page 7.

.....

Stop here: Wait for your teacher's directions.

Discuss the purpose of this section, i.e. *Use your understanding of cells and body systems to explain the Kokoda walkers' symptoms*.

Explaining the Kokoda deaths

The doctors at Kokoda thought that the walkers who died were drinking too much water.

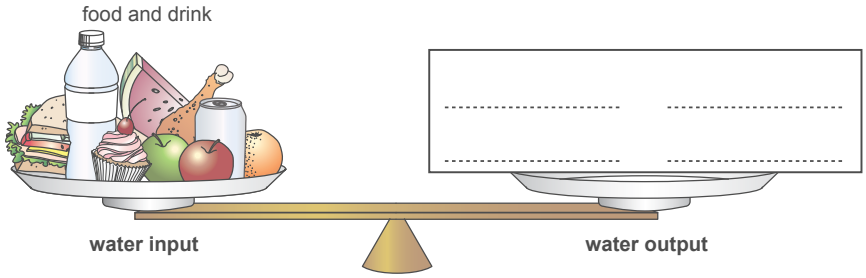
Our body systems work together to balance water inputs and outputs, so that cells have the amount of water they need to function normally.

Diagram 3 illustrates how the human body balances water input and output.

8. **Complete Diagram 3 by listing ways water is removed from the body (water output).**

Diagram 3: Balancing water input and output in the human body

Discuss: Many foods contain water, and all foods produce water during metabolism.

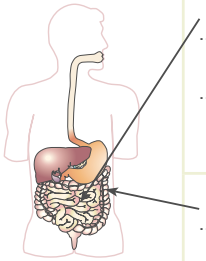
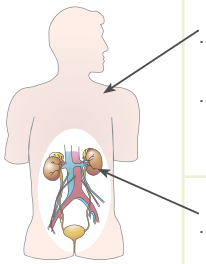
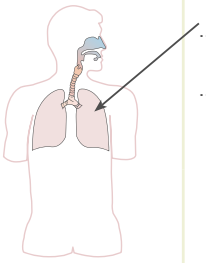


In addition to drinks, food can contribute 1 to 2 litres of water to the human body a day.

9. **Complete Table 3 below.**

- Name each body system.
- Label the organs, and describe their role in water input or output.

Table 3: Water input and output in the human body

Body system	Organ	Role in water input or output
 ..... system	....	....
 ..... system	....	....
 ..... system	....	....

Emphasise that students are required to name **organs** in this column.

What is being assessed

Question 8 and 9 gather evidence of understanding of how body systems work together to control water balance.

10. Describe how the Kokoda walkers' water inputs and outputs became unbalanced.

Refer to each of the body systems in Table 3 on page 9 in your answer.

.....

.....

.....

.....

- The walkers who drank too much water had severely low sodium concentrations in their blood and in the fluid surrounding their cells.
- The doctors advised Kokoda walkers to drink only when they were thirsty.

11. Suggest one other way that Kokoda walkers could avoid low sodium concentrations.

.....

.....

12. Complete the flowchart below to show how unbalanced water input and output may have caused the Kokoda walkers' deaths.

When the walkers' water input greatly exceeded their water output

↓

the sodium concentration in the fluid surrounding the cells of their bodies became very low.

↓

Hint: Think about your investigation results, and Diagram 2 on page 7.

This caused the cells to ..... in size because .....

.....

.....

.....

↓

As a result, walkers experienced headaches, possibly due to .....

.....

.....

↓

The walkers' symptoms became worse.

They lost consciousness and eventually died.

Stop here: Wait for your teacher's directions.

What is being assessed

Questions 10 to 12 gather evidence about using understandings to explain the Kokoda walkers' symptoms.

Suggested time: 30 minutes

Discuss the purpose of this section, i.e. *Reflect on your understandings to determine water needs during exercise, and evaluate claims made in advertisements.*

Reflecting on water and sodium needs

Aaron walks for 30 minutes

Samantha plays tennis for 2 hours

Use the information below to answer questions about Aaron and Samantha's water and sodium needs.

- The data was gathered through scientific investigations.
- The data shows average or approximate values and should be used as a guide only.
- Actual values vary between people and depend on humidity.

Discuss the information provided in the cautionary bullet points, and in Tables 4, 5 and 6.

Table 4: Water loss during activity at 28 °C

Activity	Examples	Typical water loss (mL/hour)		
		Sweat	Breath	Urine produced
Resting	watching TV sleeping	35	15	50
Mild physical activity	walking ten-pin bowling	300	25	30
Moderate physical activity	jogging skateboarding	1000	50	20
Intense physical activity	football match tennis tournament	2000	100	10

Table 5: Typical sodium measures

Sodium content of sweat	1.2 g/L
Sodium loss without affecting cell function	3 g

Point out that the body can cope with a small amount of sodium loss without affecting cell function.

Table 6: Sodium content in some popular drinks

Drink	water	sports drink	fruit juice
Sodium content (g/L)	0.0	0.5	0.03

Sources of data: <www.jacn.org/cgi/content/full/25/suppl_3/231S#T1>, <http://journals.lww.com/acsm-msse/_layouts/oaks.journals/ImageView.aspx?k=acsm-msse:2007:02000100022&i=T12>, <www.water.org.uk/home/water-for-health/medical-facts/adults>

13. **Provide advice to Aaron and Samantha about how much and what to drink to balance their water and sodium needs.**

Justify your answer by using:

- your knowledge of water balance
- the information in Tables 4, 5 and 6 on page 12
- any other relevant information in the task.

Discuss the meaning of **justify** and encourage the use of all three points.

a) Aaron walks for 30 minutes at 28 ºC.

How much would Aaron need to drink for his walk?

What should Aaron drink?

b) Samantha plays 2 hours of intense competitive tennis in one afternoon at 28 ºC.

How much would Samantha need to drink during the afternoon?

What should Samantha drink?

What is being assessed

Question 13 gathers evidence about using understandings to determine water needs during exercise.

Encourage students to look through the whole task for relevant information.

14. Do you agree with the statement made in the advertisement above?

Justify your answer by referring to relevant information in the task.

.....

.....

.....

.....

.....

.....

.....

Many advertisements make claims to persuade you to buy a product.

15. Make a generalisation about how scientific methods can be used to test claims made in advertisements.

.....

.....

.....

.....

.....

.....

What is being assessed

Question 14 gathers evidence about reflecting on understandings to evaluate claims made in advertisements.

Making judgments

Use the Guide to making judgments (GTMJ) on the back page to grade student responses.

The Model response (page 28) and Sample responses are provided for reference purposes only. They each demonstrate possible responses and should be used to support the GTMJ.

Making judgments is not about determining whether one student's work is better than that of another. Rather, you should make standards-based judgments by matching evidence in student responses to descriptors in the GTMJ.

Read and consider all of the evidence in the student's responses before making and recording a judgment about the quality of the performance for each assessable element.

Additional resources Sample responses, QSA Assessment Bank
https://qcar.qsa.qld.edu.au/assessmentbank (registration required)

Using the GTMJ

This QCAT uses a continua-style GTMJ, where descriptors are placed along a continuum within each column. The diagrams below show the different parts of the GTMJ continua model, and how to use the GTMJ when grading student responses.

Record a nil award of "N" only when there is insufficient evidence to make a judgment for an overall grade.

In the following diagrams:

- Diagram 1: Understanding the GTMJ points out the different parts of the GTMJ
- Diagram 2: Using the GTMJ — the judgment process gives steps to follow when grading student responses.

Diagram 1: Understanding the GTMJ

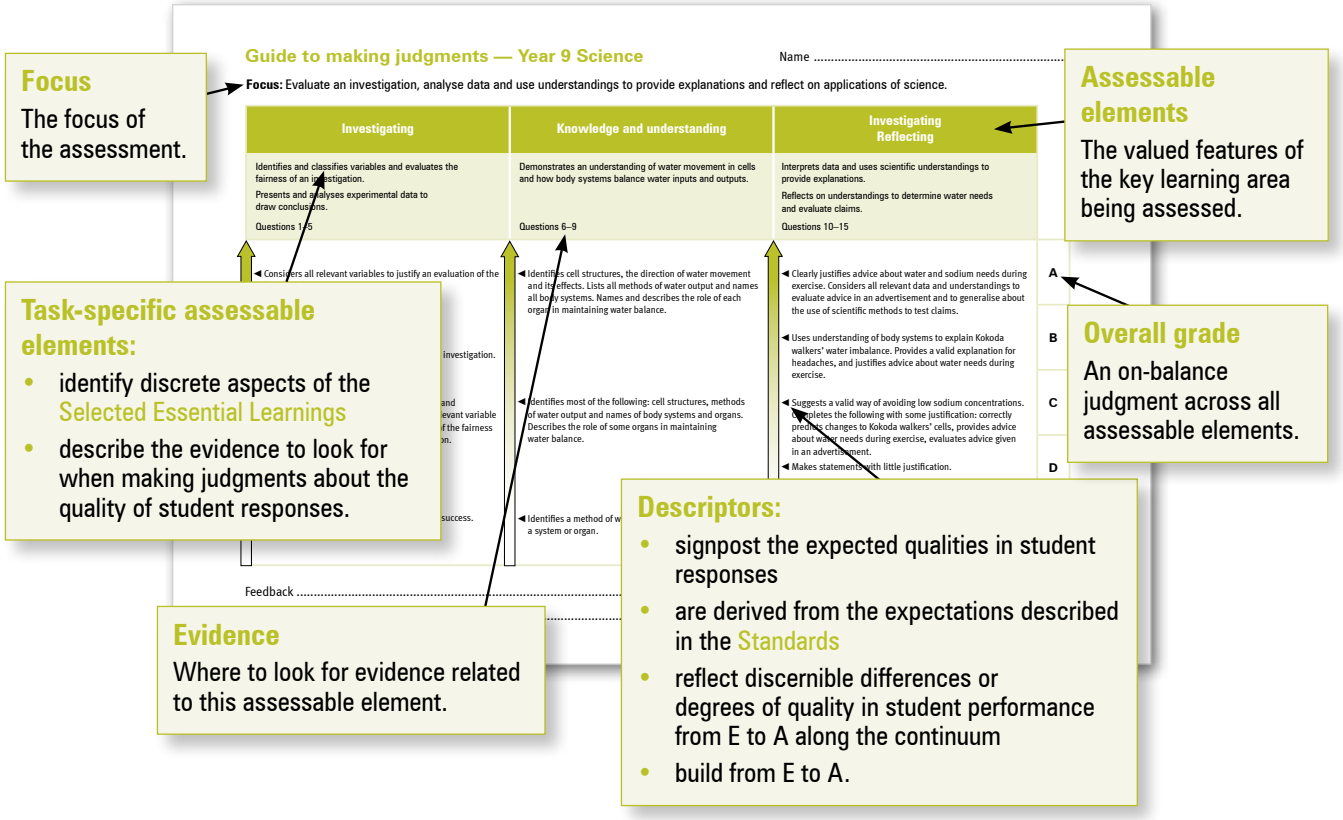


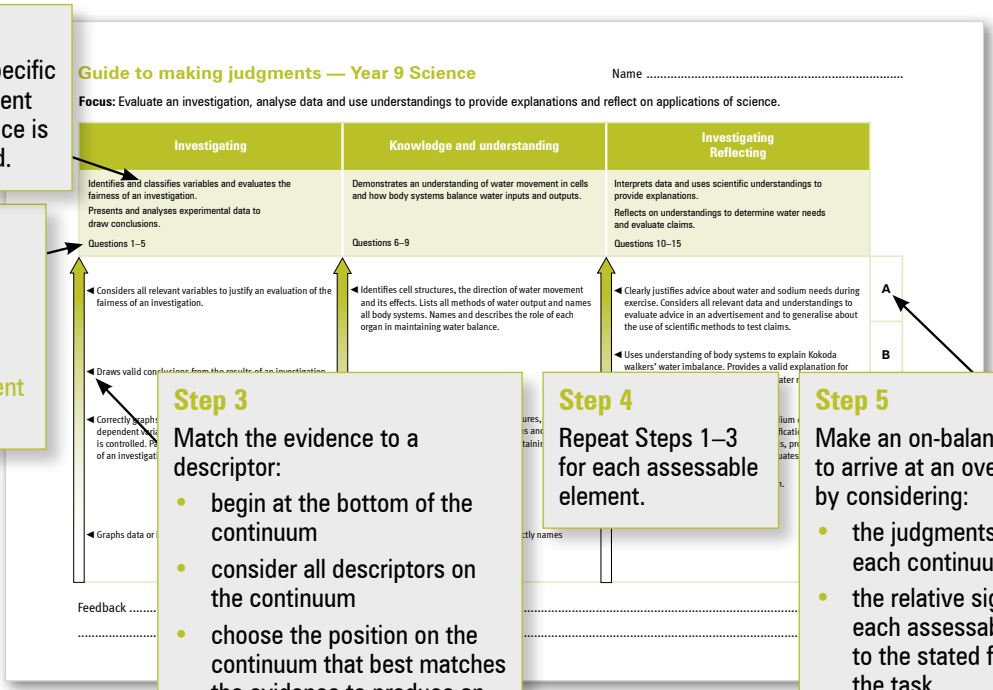
Diagram 2: Using the GTMJ — the judgment process

Step 1

Read the task-specific assessable element for which evidence is being considered.

Step 2

Locate all the evidence for an assessable element in the completed Student booklet.



Step 3

Match the evidence to a descriptor:

- begin at the bottom of the continuum
- consider all descriptors on the continuum
- choose the position on the continuum that best matches the evidence to produce an on-balance judgment for the assessable element
- look at Model and Sample responses for clarification if necessary.

Step 4

Repeat Steps 1–3 for each assessable element.

Step 5

Make an on-balance judgment to arrive at an overall grade by considering:

- the judgments recorded on each continuum
- the relative significance of each assessable element to the stated focus of the task.

Using feedback

Assessment alone will not contribute significantly to improved learning — it is what teachers and students do with the information gathered that makes the difference. Providing quality and useful feedback is a crucial step in using assessment information to support future learning.

Assessment feedback goes beyond a simple mark or grade. Comments on the strengths of students' achievements, and on areas for improvement, provide quality feedback that can be used to inform future teaching and learning. Assessment feedback is most helpful if the specific elements of the knowledge and skills are identified and specific suggestions are provided.

The information gathered from the implementation, marking and moderation of QCATs should feed back into future planning of teaching and learning.

Feedback to help students learn

Quality feedback to a student:

- focuses on their achievement in relation to either the assessable elements with their task-specific descriptors or the Selected Essential Learnings (page 25) and their associated questions
- includes strengths of achievements
- identifies areas for improvement and strategies for future learning
- is communicated in student-friendly language
- is appropriate (e.g. in quantity and detail) to the student's age and their capacity to respond
- includes the use of Sample responses to provide examples of the quality of work corresponding to each standard.

Feedback to help teacher planning

Individual and collective student performance on QCATs, along with other school-based assessment, can be used to inform teaching and learning.

Additional resources

Using feedback to inform teaching and learning
www.qsa.qld.edu.au/3163.html

Sample responses, QSA Assessment Bank
https://qcar.qsa.qld.edu.au/assessmentbank (registration required)

Resources

Selected Essential Learnings

This QCAT will assess what students know, understand and can do in relation to the following selection of Essential Learnings.

Science Essential Learnings by the end of Year 9	
Assessable elements The valued features of the key learning area about which evidence of learning is collected and assessed.	**Ways of working** The processes students use to develop and demonstrate their knowledge and understanding. Students are able to:
Investigating	• plan investigations guided by scientific concepts and design and carry out fair tests • research and analyse data, information and evidence • evaluate data, information and evidence to identify connections, construct arguments and link results to theory • draw conclusions that summarise and explain patterns, and that are consistent with the data and respond to the question
Reflecting	• reflect on different perspectives and evaluate the influence of people's values and culture on the applications of science • reflect on learning, apply new understandings and justify future applications.
	Knowledge and understanding The essential concepts, facts and procedures.
Knowledge and understanding	***Life and living*** **Organisms interact with their environment in order to survive and reproduce.** • Complex organisms depend on interacting body systems to meet their needs internally and with respect to their environment.

Source: www.qsa.qld.edu.au/7297.html

Connection to the Australian Curriculum

This QCAT connects to the following content descriptions of the Australian Curriculum.

The Australian Curriculum: Science		Version 1.2
Strands		**Content descriptions**
Science Understanding	Year 9	***Biological sciences*** • Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment.
Science as a Human Endeavour	Year 9	***Use and influence of science*** • People can use scientific knowledge to evaluate whether they should accept claims, explanations or predictions.
Science Inquiry Skills	Year 8	***Planning and conducting*** • In fair tests, measure and control variables, and select equipment to collect data with accuracy appropriate to the task.
	Year 9	***Processing and analysing data and information*** • Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies. • Use knowledge of scientific concepts to draw conclusions that are consistent with evidence. ***Evaluating*** • Critically analyse the validity of information in secondary sources and evaluate the approaches used to solve problems. ***Communicating*** • Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations.

Source: Australian Curriculum, Assessment and Reporting Authority (ACARA) 2011, www.australiancurriculum.edu.au/Science
Resources: QSA 2011, www.qsa.qld.edu.au/13658.html

Preparation for investigation

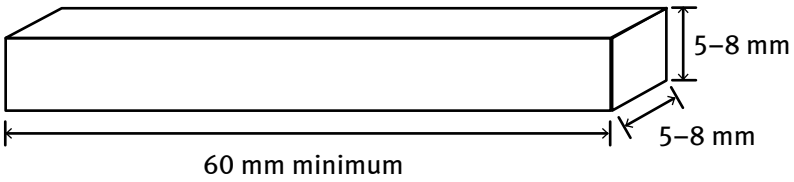
Investigating the effect of changing salt concentration on living tissue (Student booklet page 4)

Materials list

Each group will need:

- ruler, graduated in mm
- permanent marker
- test-tube rack
- 5 test tubes (18 x 150 mm)
- 50 ml of each:
  - distilled/deionised water
  - NaCl solution, 5.0 g/L
  - NaCl solution, 10.0 g/L
  - NaCl solution, 15.0 g/L
  - NaCl solution, 20.0 g/L
- 5 freshly cut potato slices (ideal dimensions are shown in Diagram 1 below)
- knife to trim potato slices (at teacher's discretion).

Diagram 1: Potato slice, with ideal dimensions



Notes

It is recommended that teachers trial the investigation well in advance of implementation.

Preparing potato slices

- For best results, slices should be prepared by staff no more than 30 minutes before use.
- A mandolin vegetable slicer may be useful.
- Actual dimensions are not crucial, but changes in length are more apparent in longer slices.
- Slices should not be stored in water.
- Students can trim slices to the same length.

Storage of potato slices while soaking

- The soaking potato slices should be stored in a cool place, and should not be left for more than 24 hours.
- If slices need to be left for periods longer than 24 hours and weather is warm, consider refrigeration, as potato may begin to decompose.

Model response

This Model response gives one example of a very high quality response for each question. The Sample responses, available for download from the QSA Assessment Bank, demonstrate the quality of student responses for each standard, A to E.

At Kokoda, the Queensland doctors showed that drinking too much water reduces the sodium concentration in the blood and in the fluid surrounding the cells.

The investigation below models the effect of changing sodium concentration on living tissue.

- Plant tissue (potato) is used because it is not practical or ethical to use human tissue.
- Salt is used as a source of sodium.

Investigating the effect of changing salt concentration on living tissue

Group work

Follow your teacher's directions to carry out the investigation.

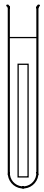
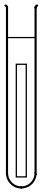
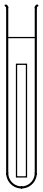
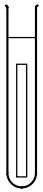
Aim: To measure the effect of changing salt concentration on the length of a potato slice.

Method

1. Label 5 test tubes A to E.
2. Obtain 5 freshly cut, narrow potato slices, all the same length.
3. Measure the length of each slice, to the nearest mm, and record in Table 1 (Original length).
4. Place each slice in a test tube.
5. Into test tube A, pour pure water until the potato slice is covered.
6. Into each of test tubes B to E pour salt solution corresponding to the concentration shown in Diagram 1 until each potato slice is covered.
7. Leave the potato slices to soak overnight.
8. Pour out the solutions and measure the length of each potato slice to the nearest mm.
9. Record the length of each slice in Table 1 (Final length).
10. Calculate the change in length of each slice and record in Table 1 (Change in length).
11. Observe any other changes to the potato slice and record in Table 1 (Other changes).

The chemical name for salt is sodium chloride (NaCl).

Diagram 1: Investigation set-up

Test tube	A	B	C	D	E
Water/solution Potato slice					
Salt concentration in grams/Litre (g/L)	0	5	10	15	20

Stop here: Leave your potato slices in the solutions until the next lesson.

Table 1: Investigation results

	Test tube	A	B	C	D	E
	Salt concentration (g/L)	0	5	10	15	20
Potato slice	Original length (mm)	60	60	60	60	60
	Final length (mm)	65	61	59	57	56
	Change in length (+/– mm)	+5	+1	–1	–3	–4
	Other changes	firm	firm	a bit bendy	soft and bendy	soft and bendy

Stop here: Discuss your results.

Model response

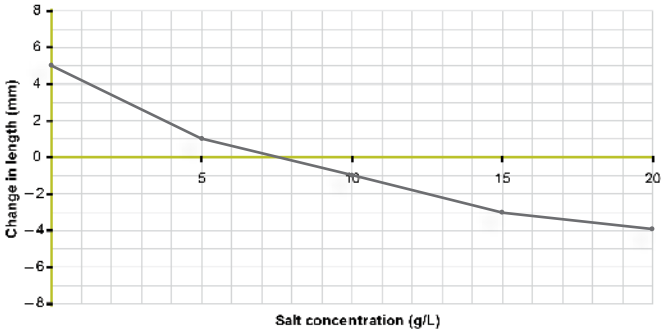
Analysing and explaining the results

Individual work

Work on your own to complete the assessment.

1. **Present the data from the investigation as a line graph below.**

Graph 1: Effect of salt concentration on length of potato slice



2. a) **What is the independent variable?** salt concentration

b) **What is the dependent variable?** change in length of potato slice

c) **Complete Table 2 to show how other variables were controlled.**

Table 2: Other variables

Variable	Controlled or not controlled?	Explain how it was controlled (or not controlled)
temperature	controlled	salt solutions and potato slices were all at room temperature
original length of slice	controlled	all slices were cut to the same length
the time each slice was in the solution	controlled	all slices were kept in solution for the same length of time

3. **Is the investigation an example of a fair test? Explain by referring to Question 2.**

Yes, it was fair. Only one variable was changed, one measured, and all others kept the same.

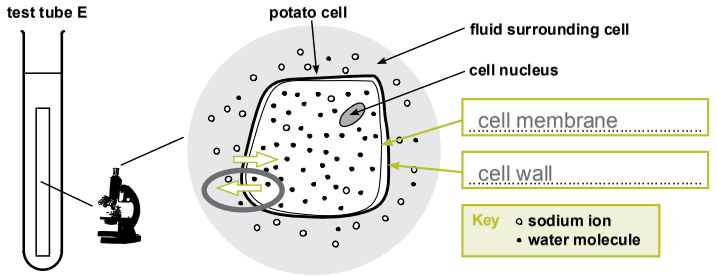
4. **What do your results tell you about the effect of high and low salt concentrations on the length of a potato slice?**

High salt concentrations caused the potato slices to shrink while low concentrations caused the slices to expand.

5. **At what salt concentration would the length of the potato slice not change?**

Approximately 7.5 g/L (from the graph)

Diagram 2: Potato cell from the potato slice in test tube E (high salt concentration)



6. a) **Complete the missing labels in the potato cell in Diagram 2.**

b) **Circle the arrow on Diagram 2 (⇦ or ⇨) that shows the overall direction that water molecules will move between the cell and the surrounding fluid.**

c) **What effect would the movement of water have on the potato cell?**

The cell would shrink.

Model response

7. What common structure of plant and animal cells allows us to use potato cells to model water movement in human cells? Explain.

Hint: Look at Diagram 2 on page 7.

They both have a cell membrane that allows water to pass through.

Stop here: Wait for your teacher's directions.

Explaining the Kokoda deaths

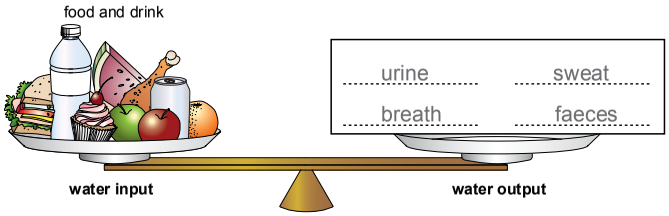
The doctors at Kokoda thought that the walkers who died were drinking too much water.

Our body systems work together to balance water inputs and outputs, so that cells have the amount of water they need to function normally.

Diagram 3 illustrates how the human body balances water input and output.

8. Complete Diagram 3 by listing ways water is removed from the body (water output).

Diagram 3: Balancing water input and output in the human body

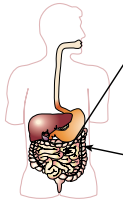
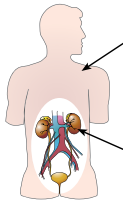
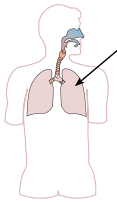


In addition to drinks, food can contribute 1 to 2 litres of water to the human body a day.

9. Complete Table 3 below.

- Name each body system.
- Label the organs, and describe their role in water input or output.

Table 3: Water input and output in the human body

Body system	Organ	Role in water input or output
 digestive system	small intestine	passes water into the bloodstream
	large intestine	re-absorbs some water from waste and passes some on to the rectum in faeces
 excretory system	skin	removes water through sweat
	kidney	removes excess water from the blood for removal in urine
 respiratory system	lung	removes water from the body as water vapour in breath

Model response

10. Describe how the Kokoda walkers' water inputs and outputs became unbalanced.
Refer to each of the body systems in Table 3 on page 9 in your answer.

They drank so much water that it was absorbed by their digestive system faster than it could be removed by the excretory and respiratory systems.

- The walkers who drank too much water had severely low sodium concentrations in their blood and in the fluid surrounding their cells.
- The doctors advised Kokoda walkers to drink only when they were thirsty.

11. Suggest one other way that Kokoda walkers could avoid low sodium concentrations.

The walkers could take in sodium by drinking a salty drink or eating salty food.

12. Complete the flowchart below to show how unbalanced water input and output may have caused the Kokoda walkers' deaths.

When the walkers' water input greatly exceeded their water output

↓

the sodium concentration in the fluid surrounding the cells of their bodies became very low.

↓

Hint: Think about your investigation results, and Diagram 2 on page 7.

This caused the cells to increase in size because the low concentration of sodium outside the cells caused water to diffuse into the cells, making them expand.

↓

As a result, walkers experienced headaches, possibly due to the brain expanding and pushing against the skull.

↓

The walkers' symptoms became worse.
They lost consciousness and eventually died.

Stop here: Wait for your teacher's directions.

Model response

Reflecting on water and sodium needs

Aaron walks for 30 minutes

Samantha plays tennis for 2 hours

Use the information below to answer questions about Aaron and Samantha's water and sodium needs.

- The data was gathered through scientific investigations.
- The data shows average or approximate values and should be used as a guide only.
- Actual values vary between people and depend on humidity.

Table 4: Water loss during activity at 28 °C

Activity	Examples	Typical water loss (mL/hour)		
		Sweat	Breath	Urine produced
Resting	watching TV sleeping	35	15	50
Mild physical activity	walking ten-pin bowling	300	25	30
Moderate physical activity	jogging skateboarding	1000	50	20
Intense physical activity	football match tennis tournament	2000	100	10

Table 5: Typical sodium measures

Sodium content of sweat	1.2 g/L
Sodium loss without affecting cell function	3 g

Table 6: Sodium content in some popular drinks

Drink	water	sports drink	fruit juice
Sodium content (g/L)	0.0	0.5	0.03

Sources of data: <www.jaon.org/cgi/content/full/25/suppl_3/231S#T1> <http://journals.lww.com/acsm-msse/_layouts/oaks.journals/ImageView.aspx?k=acsm-msse/2007/02000/00022&i=T12> <www.water.org.uk/home/water-for-health/medical-facts/adults>.

13. Provide advice to Aaron and Samantha about how much and what to drink to balance their water and sodium needs.

Justify your answer by using:

- your knowledge of water balance
- the information in Tables 4, 5 and 6 on page 12
- any other relevant information in the task.

a) Aaron walks for 30 minutes at 28 °C.

How much would Aaron need to drink for his walk?

Water loss per hour = 300 + 25 + 30 mL
= 355 mL
∴ water loss in 30 mins = 178 mL

Aaron needs to drink about 180 mL to replace the water lost in the 30 minutes.

What should Aaron drink?

Salt loss = 1.2 grams per litre of sweat
= 1.2 g/L x 0.150 L
= 0.18 g

Aaron loses a tiny amount of salt so only needs to drink water.

b) Samantha plays 2 hours of intense competitive tennis in one afternoon at 28 °C.

How much would Samantha need to drink during the afternoon?

Water loss per hour = 2000 + 100 + 10 mL
= 2110 mL
∴ water loss in 2 hrs = 4220 mL

Samantha needs to drink about 4 litres to replace the water lost in the 2 hours.

What should Samantha drink?

Salt lost = 1.2 grams per litre of sweat = 1.2 g/L x 4 L
= 4.8 grams

As Samantha may lose about 5 grams of salt, she should drink a sports drink rather than water.
4 litres of a sports drink would replace about 2 g of salt, keeping the total loss to about 3 g.

Model response

14. Do you agree with the statement made in the advertisement above?
Justify your answer by referring to relevant information in the task.

No. The amount of water you need depends on how active you are, the temperature and the humidity. A non-active person may need as little as 2.4 L/day (from Table 4) and much of this would come from food (up to 2 L/day). An active person would need much more as shown in Question 13. Thirst is a better guide for how much to drink.

Many advertisements make claims to persuade you to buy a product.

15. Make a generalisation about how scientific methods can be used to test claims made in advertisements.

When you see a claim in an advertisement, you can identify the variables, design a fair test to collect evidence, then analyse the evidence to see if it supports the claim or not.

Notes

Notes

Guide to making judgments — Year 9 Science

Name .....

Focus: Evaluate an investigation, analyse data and use understandings to provide explanations and reflect on applications of science.

Investigating	Knowledge and understanding	Investigating Reflecting	
Identifies and classifies variables and evaluates the fairness of an investigation. Presents and analyses experimental data to draw conclusions. Questions 1–5	Demonstrates an understanding of water movement in cells and how body systems balance water inputs and outputs. Questions 6–9	Interprets data and uses scientific understandings to provide explanations. Reflects on understandings to determine water needs and evaluate claims. Questions 10–15	
◀ Considers all relevant variables to justify an evaluation of the fairness of an investigation.	◀ Identifies cell structures, the direction of water movement and its effects. Lists all methods of water output and names all body systems. Names and describes the role of each organ in maintaining water balance.	◀ Clearly justifies advice about water and sodium needs during exercise. Considers all relevant data and understandings to evaluate advice in an advertisement and to generalise about the use of scientific methods to test claims.	**A**
◀ Draws valid conclusions from the results of an investigation.		◀ Uses understanding of body systems to explain Kokoda walkers' water imbalance. Provides a valid explanation for headaches, and justifies advice about water needs during exercise.	**B**
◀ Correctly graphs data. Identifies independent and dependent variables and explains how one relevant variable is controlled. Partially justifies an evaluation of the fairness of an investigation and draws a valid conclusion.	◀ Identifies most of the following: cell structures, methods of water output and names of body systems and organs. Describes the role of some organs in maintaining water balance.	◀ Suggests a valid way of avoiding low sodium concentrations. Completes the following with some justification: correctly predicts changes to Kokoda walkers' cells, provides advice about water needs during exercise, evaluates advice given in an advertisement.	**C**
		◀ Makes statements with little justification.	**D**
◀ Graphs data or identifies variables with some success.	◀ Identifies a method of water output. Correctly names a system or organ.		**E**

Feedback .....

.....