The world we have created is a product of our thinking; it cannot be changed without changing our thinking.

Albert Einstein
Think about these

Which part of your brain is responsible for your ‘life-support systems’?
What are some ways to manage anger?
How can your mood be influenced by neurotransmitters?
How can you use thinking hats to help you solve problems and make decisions?
Why do you often get drowsy when it’s dark and wake up when it’s light?
How do ‘uppers’ and ‘downers’ cause their effects?
Which tools can you use to help you to sequence your thoughts?

Key outcomes

Generate questions that explore perspectives.
Make informed decisions based on their analysis of various perspectives.
When listening, viewing and responding, they consider alternative views, recognise multiple possible interpretations and respond with insight.
Use complex verbal and non-verbal cues, subject specific language and a wide range of communication forms.

Who are you? What do you need? Why do you need what you need? Why do you react in the ways that you do? Are you a risk taker? How do you go about solving problems and making decisions? How can chemicals influence who you are and what you do?
What are YOUR essentials?
The introduction on the opposite page poses some questions about the essence of who you are. The answers to these questions may be related to:
- the chemical instructions in the DNA that you inherited from your parents
- your experiences and the environment in which you live
- a combination of both of these.
Scientists refer to this as the nature vs nurture debate: are we a product of our genes or our environment, or do they both contribute to make us who we are?

What are your needs?
What motivates you to do what you do? We are all motivated by needs. Between 1943 and 1954, Abraham Maslow developed a model to explain how needs motivate us. Maslow’s hierarchy of needs suggests that our basic needs must first be met before we are able to deal with the needs on the next levels. It is only when each of the previous needs levels have been at least partially satisfied that we can fulfil our potential growth.

Maslow’s hierarchy
1. (a) Find out more about Maslow’s hierarchy of needs.
   (b) Use the information in the hierarchy of needs figure below to construct a matrix table and rate how important you consider these needs are to you. Use a scale of between 0 and 3 (0 = not at all; 1 = sometimes important; 2 = often important; 3 = always important).
   (c) Compare your results with those of a partner.
   (d) Discuss reasons for your decisions.
2. (a) Do you think the pattern will always be the same for you, or that at different ages it may change? Write down your response to this question, then discuss it with others in your class. Reflect on your discussions in your learning and thinking journal.
   (b) In a team, discuss how Maslow’s hierarchy of needs may affect or influence your learning. Report a summary of the key points of your discussion to the class.

Essential needs?
To help you find out more about how Maslow’s hierarchy of needs works, consider the following needs and products that might satisfy them.

Safety needs: home security products, insurance
Love and sense of belonging: McDonald’s, clubs and societies
Esteem needs: cosmetics, fast cars, fashionable clothes, drinks, lifestyle products and services

Examine magazines, journals, television and the Internet to find as many advertisements as possible that relate to these needs. Use these advertisements to create an individual or team collage and present it to the class.
1.1 Your brain’s ‘chat rooms’

What’s your brain up to?
Are there different ‘conversations’ going on in different parts of your brain? How old are these conversations in your brain?

Brainy beginnings

Although it shares some similarities, your brain looks quite different from those of your vertebrate ancestors. They had brains that developed from a simple neural tube with bulges at one end. These three ancestral bulges can still be seen in the early embryonic developmental stages of all vertebrates.

One of these ancestral bulges was the **forebrain** and it dealt with sense of smell and behaviours such as eating and mating. Another bulge was the **midbrain** and it dealt with vision and other distance-related senses such as hearing. The **hindbrain** bulge was involved in arousal levels and basic motor activities. These ancestral bulges were connected by nerve signals that wove their activities together. In the process of evolution, vertebrate brains became more developed and the number of divisions and connections became more complex.

**Brainstem branching?**

Your **brainstem** is a structure about the size of your finger. It relays information between your body and your brain. It is actually a collective term used to describe a number of specialised structures within your hindbrain and midbrain.

**Hindbrain to midbrain chatter**

On the ‘ground floor’ is your **hindbrain**. It takes up about 2% of your brain’s volume and is really a continuation of your spinal cord. It consists of your **cerebellum**, **medulla oblongata** and **pons**.

While your medulla oblongata is involved in regulating your ‘life support systems’ (heart rate, blood pressure and breathing), your pons regulates sleep, and your cerebellum (located at the back of your brainstem) coordinates movement.

Your midbrain is made up of the middle part of your brainstem and takes up about 4% of your brain’s volume.

Rising from the ‘ground floor’ to the ‘middle floor’ is one of the oldest portions of your brain. Located in the central core of your brainstem and extending through your hindbrain and midbrain is network of fibres and cell bodies called your **reticular formation**. Reticular means netlike.

The reticular formation can be considered as a network of neurons that opens and closes to increase or decrease the amount of information that flows into and out of your brain. It helps regulate...
your alertness (from being fully awake or deeply asleep), motivation, movement and some of your reflexes (such as sneezing and coughing). It has also been linked to sexual activity, introversion and extroversion character traits, chronic fatigue syndrome and attention deficit hyperactivity disorder.

**Forebrain thinking**

Having a discussion or making a decision? Your forebrain will help you out here. It is on the ‘top floor’ and includes your cerebrum, cerebral cortex (outer, deeply folded surface of your cerebrum), thalamus and hypothalamus.

Your cerebral cortex makes up the largest part of your brain and is often referred to as your ‘thinking brain’. It is made up of two hemispheres. Different types of conversations happen in the left and right hemispheres. Although we all use both sides in our thinking, sometimes there may be a preference to use types of thinking from one hemisphere more than types from the other.

So that you learn effectively, each of the two hemispheres of this part of your brain need not only to do their own jobs, but also to communicate with each other. Your corpus callosum connects them.

**Emotional chatter?**

Your ‘emotional brain’ or limbic system is made up of a collection of structures including parts of your thalamus, hypothalamus, hippocampus and amygdala. While your hippocampus has an important role in forming long-lasting memories, your amygdala seems to act as a memory filter, labelling information to be remembered by tying it to events or emotions that are experienced at the time.

When you are experiencing a time of stress, your survival instincts take over. You produce chemicals that place your body in a heightened alert phase, to help prepare you for a possible dangerous situation. When you are in a stressed state it is difficult to use your higher order thinking, and you may find it difficult to learn effectively.

**Left hemisphere:**
- processes language, numbers, symbols
- likes to tell how
- responds to being told what to do
- solves problems sequentially
- prefers talking and writing
- reads articles first
- follows instructions step by step
- punctual and organised
- looks for differences
- controls feelings
- follows directions.

**Right hemisphere:**
- processes pictures and images
- likes to show how
- responds to being shown what to do
- solves problems with hunches
- prefers essay tests
- sees pictures first
- plays it by ‘ear’
- is intuitive
- looks for similarities
- is free with feelings
- is creative.

**activities**

**REMEMBER**

1 Use a Venn diagram to show how your brain is similar to and different from a primitive vertebrate ancestral brain.

2 Use a mind map or cluster map to show the links between the following structures and functions of your brain: brain; hypothalamus; cerebrum; brainstem; pons; hindbrain; midbrain; forebrain; cerebral cortex; cerebellum; thinking brain; regulates sleep; involved in sneezing, coughing and vomiting; regulates your heart rate, blood pressure and breathing; coordinates movement; involved in emotions; hunger and body temperature regulation; surface of cerebrum.

3 State the name of the part of your brain with the function of:
   (a) coordinating movement
   (b) regulating your sleep
   (c) regulating your life support mechanisms such as your blood pressure
   (d) managing your emotions
   (e) making a decision
   (f) managing the communication between left and right hemispheres.

**INVESTIGATE AND DISCUSS**

4 Find out the roles of each hemisphere of your brain when you listen to music.

5 (a) Research the effects of at least three different human hormones, such as testosterone, adrenaline, cortisol and oestrogen, and then report your findings back to your team.
   (b) Use this information and your own opinions to discuss the following question: Do our hormones determine who we are and what we do, or can we have some conscious control over this?
   (c) In your team, decide on a brief statement that summarises the opinion.
   (d) How strongly do you agree with your group’s opinion? Rate your response on a scale of 0 to 5, with 0 ‘Strongly disagree’ and 5 ‘Strongly agree.’ Give reasons for your response.
   (e) Survey your class or do a class spectrogram to determine how many of, or the degree to which, your class members agree with this statement.
   (f) Find out and record differing opinions of as many of your classmates as you can.
   (g) Have you changed your initial opinion or has it stayed the same? Explain.
‘I’m sorry, but I was so angry that I had no control over what I said or did…’ Is this you? Have you ever been so angry that you’ve hurt someone else’s feelings?

Anger may be one of our most primitive emotions. It is certainly a powerful one. Uncontrolled anger can lead to physical fights, arguments and self-harm. Controlled anger, however, can be a very useful emotion that can help motivate you to make positive changes.

Your angry brain
Feeling angry? Is your heart racing; are your hands cold; do you have a ‘sick’ or ‘sinking’ feeling in your stomach? When you feel angry, your hypothalamus responds by sending messages to your pituitary to instruct your adrenal glands to release adrenaline. This hormone acts to increase your heart rate, dilate your pupils, constrict skin blood vessels and shut down digestion. This helps you to see any threats better and provides your muscles with more glucose and oxygen just in case you need to face the danger and fight, or take flight and escape it by running away.

Playing ‘tag’?
Your ‘flight or fight’ response actually originates in your amygdala. It is this tiny part of your limbic system (about the size of your thumb nail) that decides the emotional value of what is happening. It asks you: ‘Does this mean something significant to me?’ It may sense a particular facial expression or tone as being threatening, or it may detect an event that was previously ‘tagged’ as being a negative experience.

Keeping the anger
Staying angry, or long periods of stress, can damage another part of your limbic system called your hippocampus. If the stress or anger lasts more than a few minutes, your adrenal glands also release cortisol. Sustained high levels of this hormone can lead to the death of hippocampus neurons, which may result in diminished learning, spatial recall and memory.

False alarms?
Your prefrontal cortex or thinking brain is also involved in assessing a threat and placing it in context. If your thinking brain considers it to be a false alarm, it sends a message to your hypothalamus to trigger actions to calm things down; it does this by sending out messages to decrease your stress hormone levels and their effects.
**Anger management**

Feeling constantly angry or stressed can be unhealthy. It can not only make you feel unhappy and possibly be hurtful to others, but also interfere with the normal functioning of your body. It’s good to be able to manage your anger and to do this you need some strategies to help calm you down and prevent outbursts.

- Take several slow deep breaths.
- Slowly count to ten.
- Try to understand different points of view.
- Don’t react straight away, ‘sleep on it’.
- Practise assertion rather than aggression.
- Communicate your view calmly without raising your voice.
- Listen carefully to other opinions.
- Go for a run or be involved in an active sport.
- Listen to soothing music.
- Try to manage your impulsiveness.
- Practise tolerance.
- Be willing to admit you are wrong and apologise.
- Be prepared to remove yourself from a situation until you can face it calmly.

**Mood chemistry**

**Neurotransmitters** are chemicals involved in passing messages between your nerve cells (neurons). Within your brain there are many neurotransmitters that influence how you feel and react; serotonin, norepinephrine and dopamine are three examples. Imbalances of these neurotransmitters can contribute to a variety of mental illnesses.

Serotonin acts like the ‘brakes’ on your emotions. It can produce a calming effect and is important for maintaining a good mood and feelings of contentment. It also plays a role in regulating memory, appetite and body temperature. Low levels of serotonin can produce insomnia, depression and aggressive behaviour and are also associated with obsessive–compulsive and eating disorders.

Norepinephrine can be like the ‘accelerator’. It can promote alertness, better focus and concentration. Your brain also needs this chemical to form new memories and to transfer them to your long-term storage.

Dopamine is important for healthy assertiveness and autonomic nervous system function. Dopamine levels can be depleted by stress or poor sleep. Too much alcohol, caffeine and sugar may also lead to reduced dopamine activity in your brain. People with Parkinson’s disease have a diminished ability to synthesise dopamine.
Feeding your emotions

To be able to make these neurotransmitters, your body needs the raw materials from nutrients in the food that you eat. Of particular importance are amino acids such as tryptophan, tyrosine and phenylalanine. Both dopamine and noradrenaline are made up of these three amino acids. Tryptophan is important in the synthesis of serotonin.

Fooling the brain

In order to pass a message from one neuron to another, neurotransmitters are recognised by a ‘matching’ receptor on the membrane of the receiving nerve cell. Even though the receptor is supposed to recognise and accept only one specific neurotransmitter (green in the diagram at right), it can be fooled. Some drugs, medicines or plant compounds (orange in the diagram) have a chemical structure similar enough to trick a receptor and hence have an effect on your brain. (See 1.8 Drugs on your brain? on page 24).

Mimic neurotransmitters (orange) block receptors at a synapse so that the real neurotransmitters (green) cannot carry the message from one neuron to the next.

Gender and stress

Differences in the ways that male and female brains are ‘wired up’ can mean that their responses to some situations may be different. Being confronted with danger and anxiety is one such example. In reaction to danger or stress, your brain gives a signal to produce hormones that will trigger a chain reaction in your body. While most of the hormones are the same for both males and females, there are some differences.

When males are faced with danger, they often have a stronger tendency towards action, reacting in an outward directed fashion. This is due to the effects of testosterone. Females, however, are influenced by the effects of the hormone oxytocin. This can result in a tendency to look after the ‘nest’, seek safety, talk with others they trust and often to internalise their behaviour.
If anger is one of our most primitive emotions, it must be a case of not being able to control emotions. Although the child’s amygdala is fully mature, the necessary links with the cortex are not yet fully developed. Find out more about these links between different parts of the brain and their effects on behaviour. How could you explain this to the parent of a toddler?

Find examples of music that helps relax you and calm you down when you are feeling stressed. Share your music with others to see if it has the same effect on them.

Some convicted murderers may have killed in a ‘fit of rage’. Find out if there are any documented links between committing murder and frontal lobe activity in the brain.

A high carbohydrate meal can increase your brain’s tryptophan levels.
(a) What effect might this have on your mood?
(b) Which neurotransmitter is likely to be involved?
(c) At what time of the day would it be a good idea to have such a meal? Why?

A high protein meal can raise tyrosine levels in your blood and brain.
(a) What effect might this have on your mood?
(b) Which neurotransmitter(s) is likely to be involved?
(c) At which time of the day would it be a good idea to have such a meal? Why?
(d) If tyrosine is also needed to make active thyroid hormones, what may result if there are insufficient levels of this amino acid in your blood?

Find out about the connections between brain neurotransmitters, behaviour and the following medications: Prozac, Zoloft, Topamax, Provigil and Abilify. Report your findings to the class.

In 1947, the Swedish biologist Ulf von Euler discovered norepinephrine and later won a Nobel prize for his research. Find out more about research on this neurotransmitter and how it may be involved in helping you to learn.

‘Our emotions are our personalities.’ Do you agree with this statement? Discuss your opinion with others in your team. Present a summary of your discussion to the class.

Select one of the following statements, then find out what information you need to know in order to make a decision as to whether the statement is ‘correct’ or ‘incorrect’:

- Males need competition so that they feel stimulated and know their place in the hierarchy, whereas females first do things to be liked and, if that doesn’t work, then use the ‘victim strategy’.
- Boys are more interested in objects, and girls in human relations.
- In order for boys to achieve at school, they need to compete and struggle through the class hierarchy.
- Male thinking is more competition driven whereas female thinking is more security driven.
- Males collect facts whereas females are more interested in the relationship between the facts.

If you were angry with one of your team members or classmates, suggest appropriate ways of managing your anger.

(a) Which amino acids are required for the synthesis of dopamine and norepinephrine? Name some foods that these are found in.
(b) Which amino acid is important for the synthesis of serotonin? Name some foods that it can be found in.

Construct a cluster or mind map to summarise what you know about neurotransmitters in your brain.

State five strategies that may be used to help manage anger.

Suggest why males and females may not always react the same way when faced with a ‘stressful’ situation.

On your own, in a pair or in a team, write a story about anger management.

(a) Present your story to the class as a puppet play, picture storybook or song.
(b) Present your story to the class as a puppet play, picture storybook or song.

Discuss appropriate ways of managing behaviour. Which of these appeal to you? Why?

If anger is one of our most primitive emotions, it must have some survival advantages. Discuss with your team what these advantages might be. Present your findings in a visual tool.

INVESTIGATE AND DISCUSS

18 Have you seen a young child ‘throw a tantrum’? This is a case of not being able to control emotions. Although the child’s amygdala is fully mature, the necessary links with the cortex are not yet fully developed. Find out more about these links between different parts of the brain and their effects on behaviour. How could you explain this to the parent of a toddler?

19 Find examples of music that helps relax you and calm you down when you are feeling stressed. Share your music with others to see if it has the same effect on them.

20 Some convicted murderers may have killed in a ‘fit of rage’. Find out if there are any documented links between committing murder and frontal lobe activity in the brain.

21 A high carbohydrate meal can increase your brain’s tryptophan levels.
(a) What effect might this have on your mood?
(b) Which neurotransmitter is likely to be involved?
(c) At what time of the day would it be a good idea to have such a meal? Why?

22 A high protein meal can raise tyrosine levels in your blood and brain.
(a) What effect might this have on your mood?
(b) Which neurotransmitter(s) is likely to be involved?
(c) At which time of the day would it be a good idea to have such a meal? Why?
(d) If tyrosine is also needed to make active thyroid hormones, what may result if there are insufficient levels of this amino acid in your blood?

23 Find out about the connections between brain neurotransmitters, behaviour and the following medications: Prozac, Zoloft, Topamax, Provigil and Abilify. Report your findings to the class.

24 In 1947, the Swedish biologist Ulf von Euler discovered norepinephrine and later won a Nobel prize for his research. Find out more about research on this neurotransmitter and how it may be involved in helping you to learn.

25 ‘Our emotions are our personalities.’ Do you agree with this statement? Discuss your opinion with others in your team. Present a summary of your discussion to the class.

26 Select one of the following statements, then find out what information you need to know in order to make a decision as to whether the statement is ‘correct’ or ‘incorrect’:

- Males need competition so that they feel stimulated and know their place in the hierarchy, whereas females first do things to be liked and, if that doesn’t work, then use the ‘victim strategy’.
- Boys are more interested in objects, and girls in human relations.
- In order for boys to achieve at school, they need to compete and struggle through the class hierarchy.
- Male thinking is more competition driven whereas female thinking is more security driven.
- Males collect facts whereas females are more interested in the relationship between the facts.

11 (a) On your own, in a pair or in a team, write a story about anger management.
(b) Present your story to the class as a puppet play, picture storybook or song.

12 What if no-one ever got angry? Would this be a good thing? Imagine what the world would be like. Construct a P&I on your imagined world.

13 (a) List some examples of angry behaviour that you have seen.
(b) Suggest ways in which this angry behaviour could have been managed.

14 Discuss appropriate ways of managing behaviour. Which of these appeal to you? Why?

15 (a) If you were angry with one of your team members or classmates, suggest appropriate ways of managing your anger.
(b) With your team, agree on a set of rules or strategies that could be used to manage anger or conflicts if they occur.

16 (a) Suggest questions to find out viewpoints, perspectives and opinions of others.
(b) With your team or class, discuss strategies that could be used to deal with situations when viewpoints differ.

17 If anger is one of our most primitive emotions, it must have some survival advantages. Discuss with your team what these advantages might be. Present your findings in a visual tool.

THINK AND DISCUSS

10 Suggest why males and females may not always react the same way when faced with a ‘stressful’ situation.

CREATE AND CONSTRUCT

9 State five strategies that may be used to help manage anger.

8 Construct a cluster or mind map to summarise what you know about neurotransmitters in your brain.

7 (a) Which amino acids are required for the synthesis of dopamine and norepinephrine? Name some foods that these are found in.
(b) Which amino acid is important for the synthesis of serotonin? Name some foods that it can be found in.

6 How can some drugs trick your nervous system?

5 What do neurotransmitters do?

4 Where is your amygdala located in your body?

3 Name two hormones that may be involved when you are stressed.

2 Is anger always a bad thing? Explain.

1 Name one of our most primitive emotions.
1.3 Essential problem solving

Here is a six-step strategy that can be used to solve problems. Ask yourself:
1. What is the perceived problem? What’s wrong?
2. What are the facts?
3. After finding out the facts, what do you now see as the problem?
4. What are some possible solutions or ideas?
5. Which is the best idea?
6. What is your action plan?

1. What is the problem?

If there is a problem, this often suggests that something could be improved or better. Your black thinking hat is a good hat to put on for thinking about this. (For more information on thinking hats, refer to Science Quest 1, Third Edition, page 3.)

Once you have pinpointed your problem, you can start thinking about what end results or outcomes you would like. It is sometimes also helpful to consider the hurdles that may impede your success and how high you will need to jump to overcome them!

It is often useful to write a problem statement to help you focus on the issue. For example, you may state ‘who’, ‘does’ (action verb) and ‘what’ for your problem. However you express it, it’s important that you take ownership of the problem and phrase it in your own words.

2. What are the facts?

This is the time to put on your white thinking hat and move into your first-floor thinking room. (See Science Quest 2, Third Edition, page 3 for more information on thinking floors.) It is here that you lay the groundwork. If you are accurate, persistent and thorough in this stage then your progress through the other phases is likely to be much smoother.

Start with what you already know about the problem. Ask yourself questions about who, where, when, why, how and what has been tried so far. You can document this initial information as a KND chart by listing what you ‘know’, ‘need to know’ and ‘need to do’ in a table or columns with these title headings.

3. After the facts

Once you are clear about what the problem is, you need to look at it from different perspectives. Remember that there is usually more than one side to a problem. When you are finding your information, consider different points of view so that you can better understand the issue. It is also useful to talk to others to find out how they feel about it.

During this phase, the information that you find may require you to modify or rephrase your problem statement.

4. What are some possible solutions?

Now it is time to move up to your second floor of thinking and put on your blue and yellow thinking hats.

With your blue hat on, you can think about what you now know and try to make sense of it. You can use target maps to determine what is relevant to possible solutions and what is not.

Then you can put on your yellow hat. This is when you and your team can become a real ‘think tank’. You may find thinking keys and visual thinking tools very useful in this creative part of problem solving. Some of the really useful keys are the ‘What if?’ and the ‘ Forced relationship’ keys. (See

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**KND Chart Example**

<table>
<thead>
<tr>
<th>Know</th>
<th>Need to Know</th>
<th>Need to Do</th>
</tr>
</thead>
<tbody>
<tr>
<td>John’s performance</td>
<td>1. John’s grade in math is lower than expected.</td>
<td>1. Review John’s math homework.</td>
</tr>
<tr>
<td>2. John’s grade in science is lower than expected.</td>
<td>2. Review John’s science homework.</td>
<td></td>
</tr>
<tr>
<td>3. John’s grade in English is lower than expected.</td>
<td>3. Review John’s English homework.</td>
<td></td>
</tr>
</tbody>
</table>

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**Notes**

- John’s grades are lower than expected in all subjects.
- Review homework to identify areas of weakness.
- Consider tutoring or extra help.

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**Suggested Solutions**

- Tutoring in math, science, and English.
- Extra practice with math, science, and English homework.
- Encourage John to ask questions in class and seek help when needed.

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**References**

may help you to use intellectual behaviours that support the development of critical thinking. This is when task-specific graphic organisers such as priority grids can help you to structure your thinking, organise your ideas and stay focused.

Selection criteria can also be useful to help you to select the most appropriate alternative or idea. These may include consideration of its usefulness in achieving something, effects that it may have or how feasible it is.

6. Your action plan
Up on the third floor now. This is where your green thinking hat can be put to good use. The time has come to divide and prioritise tasks and check your timelines. You can use thinking process maps to help both creative and critical thinking. You may use them to decide what needs to be done and then to order or sequence this within a time frame. Visual maps that may help you with this include timelines and flowcharts.

REMEMBER
1 Construct a flowchart to show the six steps that can be used to solve problems.
2 If there is a problem, what does this often suggest?
3 Suggest a way that a problem statement can be constructed.
4 Which thinking hat and thinking floor are used for fact finding?
5 Suggest how target maps can help you in the problem-solving process.
6 How can yellow thinking hats and visual tools help you to solve problems?
7 Which visual tools may be useful in helping you develop your action plan?

THINK AND DISCUSS
8 (a) Suggest five criteria that could be used to judge each of the following.
   (i) A good movie
   (ii) A yummy meal
   (iii) A best friend
   (iv) A great student
   (v) A fantastic teacher
(b) Discuss your criteria with at least two other class members.
   (c) Comment on the similarities and differences between the criteria selected.

9 Appropriate use of language can also help you to clarify problems. Some personal problem statements may begin as shown below. For each of these, complete the sentence to describe a personal problem that may be experienced by someone your age.
   (a) ‘I feel angry when . . .’
   (b) ‘It worries me that . . .’
   (c) ‘I’d love to be able to . . .’
   (d) ‘I hate it when . . .’
   (e) ‘It stresses me that . . .’

10 (a) In your team or class, brainstorm examples of problems that would fit under each of the problem categories below.
   (i) What is unjust in Australia?
   (ii) What takes too long?
   (iii) What costs too much?
   (iv) What is disorganised?
(b) Select one of these problems to research and put together a suggested action plan solution.

INVESTIGATE, THINK AND DISCUSS
11 (a) Some believe that teaching people to think critically is the best training for informed and intelligent democratic citizens. Do you agree with this idea? Why? Show your responses in a SWOT analysis.
(b) Are asking questions, probing assumptions and seeking reasons valued in all cultures? Give examples to support your response.

12 (a) Brainstorm a list of at least 10 things that need improving at your school.
(b) For each item, suggest a reason why it needs to be improved.
(c) Select one of these things to investigate and creatively problem solve.

13 Select one of the following categories of problems and then focus on one problem that is relevant to it. Use your creative problem-solving skills to come up with an action plan.
(a) Social problems (examples include drug abuse, bullying, racism)
(b) Environmental problems (examples include pollution, endangered species)
(c) Global problems (examples include terrorism, disease/health, national disasters)
Have you ever been misunderstood? It’s not always because of what you say, but sometimes the way that you say it!

**Turning on your transmission**

*Interpersonal communication* is the transmission of information between two or more people. The sender encodes the message and the receiver decodes the message. Verbal communication involves speaking or writing the words whereas non-verbal communication relies on other methods.

**Verbal communication**

Verbal communication includes not only what we say, but also how we say it. We often modify our verbal messages to match our perceptions of the intended receiver. You can also learn a lot about the attitudes of others not only by what they say or write, but also by interpreting how they communicate it.

**Non-verbal communication**

Non-verbal communication can be divided into three general categories: kinesics, personal space and paralinguistics. *Kinesics* involves the use of bodily movements or actions to convey a specific meaning or idea and is often referred to as body language. Personal space is the ‘invisible’ physical area surrounding your body that you regard as your personal territory. *Paralinguistics* involves how or the way that something is said.
**REMEMBER**

1 Describe what is meant by ‘interpersonal communication’.

2 What is the difference between verbal and non-verbal communication?

3 Is verbal communication related only to what we say? Explain.

4 Use a cluster map to show details of the three general categories of non-verbal communication.

**THINK AND DISCUSS**

5 (a) In your team, discuss examples of appropriate and inappropriate methods of verbal and non-verbal communication.

(b) Share a summary of your discussion with other teams.

(c) Back in your teams, reflect on similarities and differences of the discussions.

(d) Suggest what your class can do with the information gained and communicated during this activity.

**INVESTIGATE, DISCUSS AND PRESENT**

6 Just a slip of the tongue?

‘I really love your new blue mess — I mean, dress!’ Unintentional remarks like this one are also called Freudian slips after the psychologist Sigmund Freud who believed that these slips could provide insight into our unconscious and display hidden desires, thoughts and anxieties. Have you ever had a ‘slip of the tongue’? Share these with members of your group. Find out more about these slips and report on current research on what may cause them.

7 Find out more about kinesics, personal space and paralinguistics. Discuss with your team some rules or guidelines that could be used to make your communications with each other more effective. Present your findings and discussion summary as a communication guideline or rule book, cards, brochure or poster.
Are you a ‘night owl’ or an ‘early bird’? Do you get sleepy during the day or find it hard to wake up in the mornings? Did you know that sleeping is as essential to your health as food and water?

What’s your rhythm?

Your circadian rhythm is the regular pattern of mental and physical changes that happen to you throughout a 24-hour time period. This rhythm may be controlled by your body’s biological clock. This clock is really a pair of pin-sized brain structures made up of about 20 000 neurons called your suprachiasmatic nucleus (SCN), which is located in your hypothalamus, near where your optic nerves cross.

Catch that yawn

Why do you often get drowsy when it is dark and wake up when it is light? The answer lies in your nervous system and levels of chemicals in your brain. Photoreceptors in the retina of your eye detect light and create signals that travel along your optic nerve to your SCN. Your SCN then sends signals to a number of different parts of your brain.

In the evening, the signal that light is decreasing travels from your SCN to your pineal gland, which then produces a hormone called melatonin. Increased levels of melatonin in the evening tell your body that it’s time to sleep and you begin to feel drowsy. During adolescence, these levels peak later in the day, which may explain why you get tired later at night and want to sleep in the next morning.

There is also evidence that the accumulation of a chemical called adenosine in your blood while you are awake may cause drowsiness. While you sleep, this chemical gradually breaks down.
Sleeping switches

Neurotransmitters can also control whether you are asleep or awake by acting on particular groups of neurons in your brain. The neurotransmitters serotonin and norepinephrine keep some parts of your brain active while you are awake. During sleep, the production of these neurotransmitters is switched off. As these chemicals are involved in logical and consequential thinking, your judgement of time and location can become distorted.

Some foods and medicines can change the balance of your neurotransmitters and affect how alert or drowsy you are and also how well you sleep. Drinks or foods that contain caffeine stimulate some parts of your brain and can cause insomnia (inability to sleep).

Neurons involved in controlling sleep also interact closely with your immune system. Infectious diseases like the flu can make you feel sleepy. This may be because of the powerful sleep-inducing chemicals of our immune system called cytokines. Sleep may also help you to conserve energy and other resources that the immune system may need.

Catching sleep waves

During the night, your body experiences sleep cycles lasting 90–110 minutes, with periods of REM (rapid eye movement) and non-REM sleep. You might have three to five sleep cycles each night.

Dropping off

There are four stages of non-REM sleep, and about 75 per cent of your night’s sleep is spent in non-REM sleep. Stage one lasts for about 5 per cent of your sleep and is a transition period from wakefulness to sleep. During this stage, your muscles may contract and you may feel ‘jumps’ or ‘twinges’ in your legs. In the second stage (45 per cent of an average night’s sleep) your brainwaves become larger and eye movements cease. In your third (12 per cent) and fourth (13 per cent) stages of non-REM sleep, your brain will show delta wave activity. You will be in a deep sleep and be difficult to arouse.
Dream time

Your REM sleep is your dream time, and usually makes up about 20–25 per cent of the night’s sleep. In REM sleep your breathing becomes more rapid, irregular and shallow and your eyes flick in different directions. Your first REM sleep each night lasts about 70–90 minutes. If you are woken during REM sleep, you can often describe your dreams.

REM sleep is triggered by the pons in your brain. Your pons also shuts off neurons in your spinal cord to temporarily paralyse your limbs so that you don’t act out your dreams. The REM sleep signal is sent by your pons to your thalamus, then to the cerebral cortex. As REM sleep stimulates the regions of your brain used in learning, some believe that dreams are the cortex’s attempt to interpret and put meaning to new information and experiences.

Heavy smokers may have reduced amounts of REM sleep and sleep lightly. Although alcohol can help you to fall into a light sleep, it also reduces REM and deep restorative stages of sleep.

<table>
<thead>
<tr>
<th>Beta 14-30 Hz</th>
<th>Awake, normal alert consciousness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha 9-13 Hz</td>
<td>Relaxed, calm, lucid, not thinking</td>
</tr>
<tr>
<td>Theta 4-8 Hz</td>
<td>Deep relaxation and meditation, mental imagery</td>
</tr>
<tr>
<td>Delta 1-3 Hz</td>
<td>Deep, dreamless sleep</td>
</tr>
</tbody>
</table>
Sleep learning

Recent research has shown that, while you are asleep, your brain consolidates and practises what has been learnt during the day. This suggests that learning continues to take place while you sleep. If this is true, it is another reason for getting a good night’s sleep before a test or exam, rather than staying up all night studying!

REMEmber

1. What is a circadian rhythm?
2. Where is your suprachiasmatic nucleus (SCN) located and what does it do?
3. How is light involved in whether you are sleepy or not?
4. What effect do increased levels of melatonin have on your body?
5. What effect can the switching off of serotonin and norepinephrine have on you?
6. Suggest why infectious diseases like the flu might make you feel sleepy.
7. Do you spend more time in REM or non-REM sleep? In which one are you likely to dream?
8. What stops you from acting out your dreams?
9. Which types of brainwaves are seen in deep dreamless sleep?

THINK AND DISCUSS

10. Discuss the impact of light pollution in your bedroom.
11. Why might you be more vulnerable to asthma at night-time?

INVESTIGATE

12. Travelling from one time zone to another can disrupt your circadian rhythm and you can experience a condition known as ‘jet lag’. Find out more about how light therapy has been used to help reduce the effects of jet lag by helping to reset biological clocks.
13. While most adults need about 7 or 8 hours sleep, teenagers usually require about 9 hours. Find out more about research into adolescence and sleep.
14. Investigate and report on one of the following sleep conditions: sleep apnoea, narcolepsy, restless leg syndrome, talking in your sleep, sleepwalking, night terrors.
15. If you don’t get enough sleep, you may be drowsy and unable to concentrate. Severe sleep deprivation may result in hallucinations and mood swings. What are some other consequences of sleep deprivation?
16. If someone is in a coma or under anaesthesia, are they really asleep?
17. There is an ‘early morning dip’ in blood pressure at about 2 or 3 am. Investigate and discuss why there are more records of heart attacks within the first six hours of waking than at any other time.
18. Find out about and report on one of the following.
   • The effects of decongestants and antidepressants on sleep
   • Theories for why we yawn. Do you agree with any of these? Why?
   • Ways to sleep more effectively
   • Theories of how sleep may affect learning
   • Patterns of age and sleep
   • The effects of ‘sleep debt’
   • Microsleeps
   • Driver fatigue
   • The effects of shift work on sleep
   • The effects of total blindness on sleep
   • Can dreams predict the future?
   • History and dreams
   • Dreams and their interpretations

sciFacts

An electroencephalograph (EEG) can be used to measure the overall patterns of electrical activity of your brain. When you are asleep, theta and delta wave activity is present. When you are awake, your brain tends to show alpha waves if you are relaxed and beta waves if you are alert.

An EEG records electrical activity in the brain via electrodes on the scalp.
Find out how you remember, to help you to remember how to remember better!

**The first day of the rest of your life?**

Do you remember your first day at school? How about the eighth day of school? While memory of your first day at school may be remembered for the rest of your life, unless something significant happened on the eighth day, you have probably forgotten it. Why do you remember one day and not others? Scientists are still trying to answer this question, but they suggest that it has something to do with the way that the information is stored and retrieved.

**What is memory?**

If a friend gave you her phone number, how long could you remember it without writing it down? While learning is about gaining new knowledge, memory is about retaining and then retrieving that learned information.

That is, for us to remember something we have to be able to record the experience and store it in an appropriate part of the brain. If we are unable to retrieve or pull out that information, we have forgotten it.

**Building memories**

Your memory is laid down in stages. *Short-term memory* processes information that you
have just received. This type of memory, however, has a very limited ‘lifespan’ and may last only seconds or, at most, hours. **Long-term memory** processes information that has been selected for ‘storage’ over time. Long-term memory can last days or years. You can transfer things from your short-term memory into your long-term memory by rehearsing information (practice) and applying meaning to it (what we call ‘understanding’).

A part of your brain called the **hippocampus** transfers information from short-term memory into long-term memory. If your hippocampus is damaged, you may be unable to perform an intended sequence of actions (such as making a cup of coffee) because you would have forgotten what you planned to do. Damage to your hippocampus can also result in a condition known as anterograde amnesia, in which you can remember the distant past but cannot form new memories.

**Memory systems**

You actually have a number of different memory systems for different types of learning. These include:

- spatial memory
- procedural memory
- episodic memory
- working memory
- semantic memory

**Memory aids**

Have you used a **mnemonic** in your learning today? A mnemonic is something that helps you to remember something else. It may take the form of a word, poem, story or image. Here are some examples of mnemonics:

- **Tell a tale**: Using the words or information that you need to learn, make up a story.
- **Link-it**: Link the words or pieces of information together with images.
- **First letter**: Acronyms use the first letters of the words to make a new word, like the SPEWES example above.
Mind mapping

Mind maps are a way of creating memory (learning) in a way similar to that of the brain by presenting information in a visual and connected form. Mind maps contain information in a predigested form which the memory can most easily assimilate and access.

Why use them?

Mind maps appeal to the right side of the brain, which processes colours, relationships, pictures and symbols. Using mind maps can increase your understanding of information and boost your recall of it dramatically.

Memory blockers?

Scientists are working on drugs to improve or even erase memory. Drugs that can enhance learning are being sought as an ‘easy’ way to do well in tests and exams. However, there are disadvantages and advantages to drugs designed to block memories.

Current research includes studies on drugs that specifically block or erase problem memories at the molecular level. While this can be a great advantage to those who suffer PTSD, there are concerns that other memories could also be erased.

Researchers are exploring the possibility of using chemicals called beta-blockers, cortisol and hydrocortisone to alter our memory processes. Beta-blockers can bind to the receptors on the cell surface that would usually bind to adrenaline and noradrenaline. By blocking these hormones, beta-blockers may stop the hormones’ stressful effects and prevent deep memory formation.

While all this research is exciting and innovative, what are the ethical considerations? Who controls which memories are to be ‘erased’ and when? What do ‘bad’ memories have to do with our consciences and our perceptions of right and wrong? Will there be global rules and regulations? If so, who will write them and make sure that they are maintained?
Stressful memories down deep

Your hippocampus and amygdala are also involved in emotional responses to an experience or memory. When your sense organs pick up a stimulus it goes to your thalamus and is then dispatched to your amygdala to assess its ‘emotional quality’. If it is recognised as potentially threatening, it triggers your body to release adrenaline and noradrenaline to set you up for ‘fight or flight’. The hippocampus then processes the memory and imprints it deeper than it would other memories. This will allow you to be primed quickly for action if it occurs again.

In this way, memories of traumatic or highly emotional events are ‘burnt’ into your brain more deeply and are remembered for longer. While in evolutionary terms this may have increased our chances of survival, traumatic events can result in post-traumatic stress disorder (PTSD).

Theories about growing new brain cells are being questioned. Currently there are some exciting research projects on neurogenesis (meaning ‘the birth of new neurons’). This research is investigating whether factors such as exercise and different moods can influence how many neurons are being born each day and how many neurons survive.
Getting it right

Whether it’s birds singing songs, spiders spinning webs, dogs scratching itches or students asking questions, doing the right thing at the right time can be an advantage. How do we know what to do and when to do it?

The behaviour of an animal describes what that animal does. Nearly all the behaviour displayed by animals is in response to stimuli in their environment. For example, a kangaroo will seek shelter when it is very hot and a snail will withdraw into its shell in dry conditions. Behaviour tends to help animals survive by helping them obtain food, protect themselves and other animals, and reproduce.

**Programming for success**

Many kinds of animal behaviour do not have to be learnt — they are **innate** or inborn. A spider, for example, does not have to learn how to spin its web. Innate behaviour is controlled by the programming of the nervous system and is inherited. It can be simple, such as in a reflex action, or more complex.

There are several types of innate behaviour, including courtship, communication, group organisation, migration and competition. **Courtship** refers to the rituals of mating. The courtship behaviour of birds programs prospective mates to recognise and respond only to the mating rituals of their own species. **Communication** behaviours allow organisms to transfer information, such as the location of food and the borders of territories. **Group organisation** defines the roles that each organism plays in its own society. Bees in a hive, for example, have a distinct hierarchy of a queen bee, which lays all the eggs; female worker bees, which collect pollen and nectar; and drones, which mate with the queen bee. **Migration** behaviours govern the movement of large numbers of animals, usually over large distances. Many types of animal, including fish and birds, migrate annually because of climate changes. **Competition** refers to the innate ability of animals to compete for food, shelter and mates.

**Changing for the better**

Animals, including humans, can change behaviour as a result of other experiences. This is called **learned behaviour** and can take place in a number of ways. For animals to be able to learn, they have to be programmed with the ability. Therefore, the ability itself is innate.

There are a number of learned behaviours, including conditioning, imprinting, trial and error, habituation and insight learning. **Conditioning** occurs when an organism associates one stimulus with another, such as you thinking of food when the school lunch bell rings. **Imprinting** is a behaviour that occurs when an organism forms an attachment to something in its environment shortly after birth, such as the attachment a newly hatched duckling forms with its mother.
**Rewarding the positive**

How do you feel when you get a ‘pat on the back’ or you are congratulated for something you did? Are you likely to do it again? A newly hatched chicken pecks at nearly everything, but it soon learns what is food and what is not. Through **trial and error** and reinforcement, which can be positive or negative, useful kinds of behaviour are learnt.

**Getting used to it**

Your brain can sometimes pick and choose what stimuli it will respond to. If you tap gently on the shell of a moving snail, it will withdraw into its shell. If you repeat the procedure, it will eventually ignore the tap. The snail has become familiar with the stimulus and there are no nasty consequences. This decreased response to repeated stimulus is called **habituation**.

**Insight and getting it right**

The ability to reason and solve problems is a type of learning which chimpanzees, dolphins and humans often use. Getting yourself out of awkward situations can often require considerable thought and ‘figuring out’, sometimes involving past experiences to give you some clues about the approach that you will take. The ability to use past experiences to solve new problems is called **insight learning**. The ‘Think’ questions in the Activities sections of this book exercise this ability.

Think about which sorts of thinking tools and strategies you could use to assist you in solving problems and figuring out what to do or how to act in a particular situation.

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**Experiment**

> **DOES PRACTICE MAKE PERFECT?**

Drawing on your own experience, predict what your answers to the questions in this experiment may be. Then carry out the experiment.

**You will need:**
- retort stand, bosshead and clamps
- a partner
- plane mirror
- stopwatch
- pencil
- A4 paper
- cardboard

- Draw a figure ‘8’ or a star to fit the sheet of paper and another line following the shape about 5 mm inside the outline.
- Set up the equipment as shown in the diagram below. Use the clamps to hold the mirror in place.
- Position yourself in such a way so that you can look into the mirror and see the figure ‘8’ or star diagram. Draw a line between the double lines of your diagram while your partner times you. If you touch a line, you must go back to the start while the timing continues.
- Repeat the procedure at least five times, timing each attempt separately.

1. Record your results in a table as you proceed. Draw a bar graph of the results with the number of attempts on the horizontal axis and the times taken on the vertical axis.
2. Analyse your results. Was there any difference between the times of each attempt?
3. Predict what might happen if you were to repeat the experiment another ten times.
4. What conclusions can you make from this experiment? How reliable are your conclusions? Explain. How could the reliability of your findings be increased?

**Activities**

**REMEMBER**
1. Construct a double bubble map to show the similarities and differences between learned and innate behaviour.

**THINK AND DISCUSS**
2. What are some advantages of:
   - (a) insight learning?
   - (b) trial and error learning?
   - (c) habituation?
3. Make a list of things you have learnt through trial and error.

Compare your list with others in your class. Comment on any interesting findings.

**INVESTIGATE**
4. Find out how ants follow a trail, and how and why birds migrate.
5. Find out some of the innate behaviours of babies. Why might they be useful to a baby?
6. Dogs often ‘know’ when you are about to take them for a walk or feed them. How do you think they ‘know’ this?
Health: Drugs on your brain?

Popping a pill or ‘taking’ something that you shouldn’t? Are you aware of the short- and long-term effects of your actions?

Introducing various chemicals into your body can have both beneficial and terrifying consequences. After all, we all need to eat and drink to obtain our nutrients. But there are some chemicals that can cause you great damage.

Passing the message . . .

Neurotransmitters are key players in our memory, learning, mood, behaviour, sleep and pain perception. These chemicals pass a message from one neuron (pre-synaptic neuron) to another (post-synaptic neuron) across a gap between them called a synapse.

Although there are many different neurotransmitters, only one is used at each synapse. The type of neurotransmitter that is released at the synapse can be used to classify them into groups. For example, in your brain some synapses release acetylcholine, whereas others may release noradrenaline, dopamine or enkephalins. The effect that these neurotransmitters have depends on the type of receptor that is present on the membrane of the neuron that receives it. Once the message has been received, enzymes break the neurotransmitter down.

Uppers and downers

Some drugs can affect your brain or personality by either increasing or decreasing transmission of messages across the synapse. These are collectively known as psychoactive drugs. These drugs can bind to the receptors, mimic the neurotransmitter or block the binding of the neurotransmitter to its receptor. Nicotine is an example of a drug that mimics the working of acetylcholine.

Some examples of excitatory psychoactive drugs include nicotine, caffeine, cocaine and amphetamines (‘speed’). Many of these drugs come from natural sources. They all stimulate or increase the synaptic transmission. Like many other drugs of abuse, these stimulants activate your brain’s reward circuit.

Excitatory psychoactive drugs can be thought of as stimulants or ‘uppers’, while inhibitory psychoactive drugs can be considered as depressants or ‘downers’. As their name implies, they work by inhibiting or decreasing synaptic transmission. Barbiturates, benzodiazepines (such as Valium), alcohol and cannabis (marijuana) are examples of drugs that decrease the activity of your nervous system.
Caffeine

What do coffee, tea, cocoa, chocolate and some soft drinks have in common? They all contain caffeine. In moderate doses, this central nervous system stimulant can increase alertness, reduce fine motor coordination, and cause insomnia, headaches, nervousness and dizziness. In massive doses it is lethal.

One effect of caffeine is to interfere with adenosine at multiple sites in your brain, but this drug also acts on other parts of your body. It increases your heart rate and urine production.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Quantity of caffeine (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter coffee (200 mL)</td>
<td>140</td>
</tr>
<tr>
<td>Instant coffee (200 mL)</td>
<td>80</td>
</tr>
<tr>
<td>Tea (200 mL)</td>
<td>80</td>
</tr>
<tr>
<td>Dark chocolate (30 g)</td>
<td>35</td>
</tr>
<tr>
<td>Typical cola (330 mL)</td>
<td>32</td>
</tr>
<tr>
<td>Milk chocolate (30 g)</td>
<td>15</td>
</tr>
</tbody>
</table>

An adult’s average daily consumption of caffeine is about 280 mg. A fatal dose is about 10 g.

Cocaine

Cocaine (also known as coke, snow, crack, gold dust or rock) is found in all parts of a South American shrub *Erythroxylon coca*. Chewing leaves from this plant has been practised among Andean Indians for over 5000 years. One of the effects of chewing these leaves is a numbing of the tongue. This local anaesthetic effect is caused by the cocaine inhibiting the peripheral neurons that communicate pain signals. The amount of cocaine absorbed using this method, however, is low. It was not until 1860 that cocaine extraction made higher doses possible.

Consequences of high levels of norepinephrine include strokes, organ failure and heart attacks.

Amphetamines

Amphetamines (also known as speed, ice, ecstasy, meth, pep pills or fast) are a synthetic group of chemicals that have effects similar to those of the neurotransmitters dopamine, serotonin and norepinephrine.

While the short-term effects may be a dry mouth, enlarged pupils, headaches and increased confidence, frequent use of amphetamines may result in psychosis.

Cocaine is an odourless white powder with a bitter taste. It works by inhibiting or blocking the re-uptake of neurotransmitters (dopamine, norepinephrine or serotonin) in a synapse, prolonging their effects within and outside your central nervous system. This results in elevated heart rate and body temperature, increased alertness and movement, and dilation of the pupils.

These drugs are very soluble in lipids (fats) and can enter the brain easily and even accumulate there. Short-term effects of amphetamines include an increase in cardiac frequency, respiration, blood pressure and alertness, and a reduced appetite. Long-term use can result in insomnia, hallucinations, tremors, and violent and aggressive behaviour. Some amphetamines and their derivatives are neurotoxic; they can cause neuron death.

Australian scientists are currently in the race to develop ‘smart’ drugs through research on neurotransmitters. Smart drugs belong to a class of drugs called ampakines. These drugs work by boosting chemicals that allow information to flow from one part of the brain to another. Our scientists are also discovering neurotransmitters that were previously unknown, and are trying to find out about the cause and effects of imbalances of brain chemicals and drug addiction.
**Barbiturates**

Barbiturates are often taken to ‘calm’ people down and are used as sedatives. Sleeping pills are an example. One key problem with barbiturates is that they may lead to tolerance and dependence. With sleeping tablets, for example, a greater dose may be needed over time to help the person get to sleep. Barbiturates all have one serious thing in common; there is only a small difference between a dose that produces sedation and one that may cause death.

Barbiturates have ready access to your brain because they can easily cross the **blood–brain barrier**, an arrangement of capillaries in the brain that prevents most substances from entering it. Because they dissolve in fat, barbiturates can also accumulate in the body to later re-enter your bloodstream.

**Benzodiazepines**

Benzodiazepines, such as the drugs Temazepam and Valium, relax muscles and decrease circulation, respiration and blood pressure. They can also elevate the mood and reduce anxiety. This group of drugs is used more widely than barbiturates. One reason for this is safety. There is a very large difference between a lethal dose of benzodiazepine and one that reduces anxiety or induces sleep. This, however, changes if alcohol is taken at the same time.

**Marijuana**

In 1964, the psychoactive ingredient in **marijuana** (also known as grass, pot, reefer or weed) was identified as a **THC** (delta-9 tetrahydrocannabinol). This chemical comes from a plant called **Cannabis sativa**. THC activates cannabinoid receptors in your brain located on neurons in your hippocampus (memory), cerebral cortex (concentration), sensory portions of your cerebral cortex (perception) and your cerebellum (movement). High doses of this drug may cause hallucinations, delusions, impaired memory and disorientation. As it is one of the world’s most commonly used illegal drugs, there has been a great deal of research into how it works and the consequences of using it.

**GHB**

**GHB** (gamma hydroxybutyrate, sodium oxybate, also known as liquid E, fantasy or gamma-OH) is an odourless, colourless, salty liquid that acts as a depressant on your nervous system. One of the dangers of this drug is the difficulty of determining a safe dosage. Although a small
amount may have a euphoric effect, more can lead to amnesia, respiratory difficulties, delirium, loss of consciousness and possibly death. Likewise, combining GHB with alcohol can also lead to deep unconsciousness and may cause coma or death. GHB also has the reputation of being used as a ‘date-rape’ drug.

**Heroin**

Diacetylmorphine or heroin (also known as smack, jive, horse or junk) is an illegal opiate drug that contains morphine as its active ingredient. Its source is the opium poppy, *Papaver somniferum*. Opiates stimulate a ‘pleasure system’ in your brain that involves the neurotransmitter dopamine.

The effects of heroin use include pain relief, euphoria, nausea, drowsiness, hypothermia, breathing difficulties and, in the case of overdoses, death. Heroin is highly addictive and regular use leads to increased tolerance so that larger doses are needed for the same effects over time.

As this drug is often injected, there are other consequences of using it. These include poisoning from added toxins in the drug, hepatitis, collapsed veins, bacterial or viral infections (including HIV/AIDS) and skin infections.

In 1973, scientists found neurons in the brain that have receptors for opiates. These are located in areas involved in pain, breathing and emotions. The discovery of these receptors led to further research about their purpose. Two years later, scientists discovered that the brain manufactures its own opiates known as endorphins. Although endorphins are always present in the brain, when you are in pain or stressed they are released in larger amounts.

### REMEMBER

1. State the name of the gap across which neurotransmitters pass.
2. Use a flow map to show the links between a pre-synaptic neuron, a neurotransmitter and a post-synaptic neuron.
3. List three examples of neurotransmitters.
4. What do the vesicles in neurons contain?
5. What are psychoactive drugs?
6. What is the key difference between excitatory and inhibitory psychoactive drugs?
7. State other names for:
   - (a) inhibitory psychoactive drugs
   - (b) excitatory psychoactive drugs.
8. Construct a double bubble map to show the similarities and differences between excitatory and inhibitory psychoactive drugs.
9. Use a cluster map to show examples of the effects of the following drugs.
   - (a) Caffeine
   - (b) Cocaine
   - (c) GHB
   - (d) Heroin
   - (e) Ecstasy
10. What is meant by the term ‘neurotoxic’?
11. Use a Venn diagram to compare barbiturates and benzodiazepines.

### INVESTIGATE, THINK AND PRESENT

12. Select, research and report on one of the drugs on these pages. Include answers to the following in your report, which may take the form of a poster, PowerPoint, written paper, audio visual/newspaper report, or storyboard.
   - (a) What are other names for the drug?
   - (b) What is the history of the drug?
   - (c) How is the drug introduced into the body?
   - (d) Describe what is known about the way it causes its effects.
   - (e) Outline or describe the short- and long-term effects of using the drug.
   - (f) What sorts of prevention or treatments are available that are related to this drug?
   - (g) Outline any research relevant to this drug.
   - (h) Construct a PMI on the drug.

13. In a team of four, discuss strategies that could be used to help adolescents resist social pressures to abuse drugs.

14. Research and report back to your team, for discussion, on one of the following.
   - (a) The caffeine content in a variety of foods, including different brands of coffee, tea, cola drinks, cocoa drinks and chocolates
   - (b) The history of coffee
   - (c) The symptoms of caffeine addiction
   - (d) The effects and dangers of inhalants and methods of prevention
   - (e) The connection between morphine, opium, codeine and heroin
   - (f) The barbiturate sodium pentothal is also known as ‘truth serum’. Find out how it works.
Thinking tools: ‘See Quest’ tools

There are so many different ways to see and share what is happening inside your brain. Here are some tools that can be used to make your thinking visible so that you can share and discuss it with others.

Structuring your thinking

Like a builder, it is important for you to use the right tool to get the job done.

- **Storyboards, flowcharts, timelines** and cycles are useful tools to sequence your thoughts.
- **Matrixes and affinity tables** are useful when you want to classify or organise your thoughts.
- **Priority grids, target maps, continuums or pie charts** can be used to quantify or rank ideas.
- **PMIs and Y charts** help you to visualise or reflect on an idea.
- **Concept maps, Venn diagrams and fishbones** are useful tools to focus your thoughts, such as when you need to analyse and compare things in order to make a decision.

There are also times when combinations of these tools can help you to use your brain and time more effectively.
REMEMBER
1 State the visual thinking tools that are best for helping you to:
(a) sequence your thoughts
(b) classify information
(c) quantify or rank ideas
(d) analyse and compare.

THINK AND DISCUSS
2 Select a different visual thinking tool to respond to each of the following:
(a) To instruct someone how to tie a shoelace or a necktie.
(b) The similarities and differences between the stories of *Goldilocks and the three bears* and *Jack and the beanstalk*.
(c) The amount of chocolate eaten in a week for each member of your class.

Adapted with permission from Hawker Brownlow Education © 2005 modellearning.com Thinking Skills and EyeQ: Visual Tools for Raising Intelligence by Ian Harris, Oliver Caviglioli and Bill Tindall
Looking back

1. In your learning journal, reflect on:
   (a) what you have learnt from this chapter
   (b) any parts of the chapter that were of particular relevance to you
   (c) ways in which information in this chapter may have changed how you think or react to something.

2. Use the 321 tool shown at right to unlock your thinking on:
   • 3 interesting points
   • 2 important points
   • 1 personal point for each section in this chapter.

3. Use the ‘learning placemat’ to show:
   (a) the key points that each team member (groups of four) remembers
   (b) a group summary of a discussion about individual learning.

4. Revisit the ideas of Maslow’s hierarchy of needs model on page 3 and comment on how it:
   (a) is relevant to you
   (b) could be useful in life
   (c) is limited
   (d) could be improved.

5. For one of the topics below, list at least five questions that you would like to answer about it. Use as many resources as you can to try to answer your questions. While you are searching for your answers, find at least one example of current relevant research in which scientists are involved.
   (a) Anger and brains
   (b) Sleep
   (c) Memory
   (d) Drugs

6. (a) Select one of the areas below and construct a set of cards showing each term on the front of a card.

**Drugs on your brain**
Excitatory psychoactive drugs, inhibitory psychoactive drugs, ecstasy, THC, GHB, marijuana, MDMA, heroin, nicotine, caffeine, cocaine, benzodiazepines, cannabis, amphetamines, barbiturates, alcohol, beta-blockers

**Chemicals in your brain**
Neurotransmitters, hormones, adrenaline, acetylcholine, amphakines, noradrenaline, adenosine, cytokines, enkephalins, serotonin, norepinephrine, dopamine, tryptophan, tyrosine, phenylalanine

**Brain bits**
Cerebrum, cerebral cortex, right hemisphere, left hemisphere, midbrain, forebrain, hindbrain, hypothalamus, corpus callosum, hippocampus, amygdala, medulla, pons, thalamus, cerebellum, SCN, pineal gland
(b) Using this chapter and other resources, write relevant information on the backs of the cards.

(c) Use the cards to mind map connections and links on your table or the floor, stating the links as you place the cards.

(d) Think of quizzes and games that could be used to help people remember the links or relevant information. Use your best ideas to develop a learning tool and then see how well it works with other members of your class.

(e) Find ways to ‘play’ with your set of cards and those of other class members.

7. Using a cluster map or mind map, outline the key roles of your hindbrain, midbrain and forebrain.

8. Construct a game, song or puppet play that helps to teach small children one of the following:
   (a) The difference between left and right hemisphere thinking
   (b) Ways of managing anger or conflict
   (c) Ways to improve your sleep
   (d) Different types of memory systems

9. Construct a model of the three floors of thinking. Include figures inside each floor involved in appropriate activities.

10. Use your knowledge of non-verbal and verbal communication to act out appropriate and inappropriate ways of communicating.

11. Look at the criteria that can be used to assess whether you are an active listener. Then perform the following activity.

(a) Person A talks for two minutes about what they have learnt about the brain, while person B actively listens.

(b) Person A assesses person B using the criteria on the active listening wheel by circling their score from 0–4 for each criterion and then joining the scores with a line to produce their personal listening shape.

(c) Persons A and B exchange roles and steps (a) and (b) are repeated.

(d) Reflect on your active listening strengths and limitations and suggest how you could improve next time.

(e) Suggest your own active listening criteria and construct your own active listening wheel to try out with other classmates.

12. (a) In a team of four, brainstorm:
   (i) examples of situations and tactics that might be used to encourage or pressure young people to take drugs
   (ii) possible consequences of taking the drugs offered
   (iii) strategies (both verbal and non-verbal) that could be used to say ‘No thanks!’ or remove the pressurised person from the situation.

(b) Write a story or play that would help to provide young people with ideas on how to say ‘no’ or get out of difficult drug situations.

(c) Design and construct puppets as characters for your play.

(d) Present your play to the class.