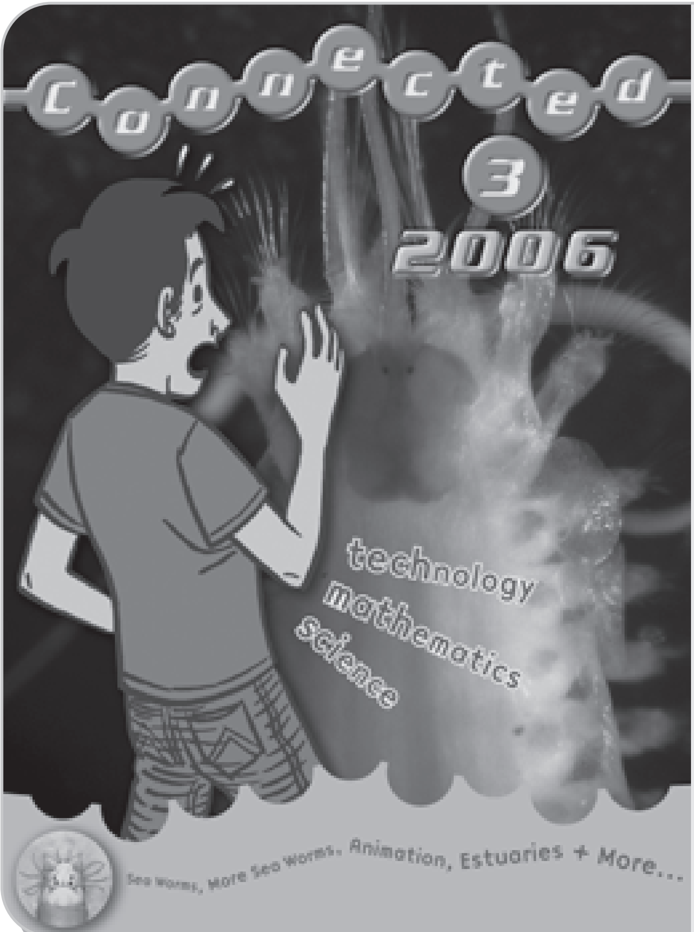
MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga



Notes for Teachers

Connected 3 2006

Contents and Curriculum Links

Introduction

Connected is a series designed to show mathematics, science, and technology in the context of students' everyday lives. The stories and articles are intended to stimulate discussion and to provide starting points for further investigations by individuals, groups, or a whole class. A **shared or guided reading approach** to using these texts will support students in their understanding of the concepts and the technical vocabulary.

Connected 3 is designed to appeal to **year 5–8** students who are working at **levels 2–4**.

General Themes in *Connected 3 2006*

1. Communicating Science Ideas through Digital Media

A class visit to the New Zealand Marine Studies Centre and Aquarium near Dunedin was the starting point of an exciting ICT unit for students from George Street Normal School. They ended up working with a professional film-maker to develop a resource to highlight the importance of sea worms in estuarine and marine ecosystems. After researching all sorts of possibilities, they created an entertaining and educational video animation for young visitors to the centre. "What's So Special about Sea Worms?" and "The Adventures of Gary the Worm" tell how, with the help of their film-making mentor and the Marine Centre staff, the students illustrated and filmed the animation themselves. The notes that support this article focus on the opportunities and challenges of developing ICT outcomes that involve moving images.

2. Sea Worms

The main character in the animation above was Gary the hairy-footed paddle worm. To begin with, the students thought that sea worms would turn out to be a fairly dull bunch, but the more they learnt about the fascinating variety of polychaete (many-bristled) worms, the more enthralled they became. "Marine Worms: The Weird and the Wonderful" explores the amazing array of body forms and other adaptations within the polychaete class. The teachers' notes expand that focus to explore how and why scientists divide the living world into taxonomic groups.

3. The Ecology of Harbours and Estuaries

"The Secret Life of Estuaries" and its notes explore why estuaries are such varied and nutritionally rich environments and how they support their own biodiversity as well as that of entire oceans. The ecological importance of small and apparently insignificant animals and plants in food webs is a key idea, as is the importance of scavengers or "recyclers". The notes also approach the topic of estuaries from an Earth science perspective, detailing how landscapes and living things interact with and impact on each other.

4. Financial Planning and Working with Positive and Negative Integers

When Kynan hits on the idea of setting up a petcare business to raise a little money during the holidays, he doesn't realise that managing his debts, daily outgoings, and occasional income will be like riding a financial roller coaster. Mum has lent him the start-up cash and suggested a simple "bean counter" device for keeping track of cash in hand and debts. As the comical story unfolds, readers can ride along and experience how positive and negative numbers behave in real life!

“What’s So Special about Sea Worms?” and “The Adventures of Gary the Worm”

Possible Technological Areas

Information and Communications Technology

Electronics and Control Technology

(See the Specific Learning Intentions for links to relevant Achievement Objectives and to the Components of Technological Practice: Brief Development [BD], Planning for Practice [PfP], and Outcome Development and Evaluation [ODE].)

The Specific Learning Intentions

The students will be able to:

- establish the needs of the key stakeholders in the Gary the Worm case study and explore how the students integrated and balanced stakeholder priorities as they made the most of the given opportunity (**AO 3, 5, 7–8/BD**);
- describe and explain the key stages in establishing and refining a technological brief for an ICT project both in general terms and with reference to specific examples (**AO 2–3, 7–8/BD**);
- analyse and explain some features of animation projects that distinguish them from print-based and other static ICT options – in technical terms and with reference to the “grammar of film” (**AO 1–3, 6, 8/BD**);
- explore the use of models in the case study, describing how the various models guided the students’ decisions in different ways throughout the project (**AO 2–3, 6, 7–8/PfP**);
- compare key features of this case study with other examples from Connected, using the shared and distinguishing features to guide their own practice – possibly in another ICT context (**AO 1–8/PfP**).

The Key Ideas

The following aspects of technological practice are exemplified in “The Adventures of Gary the Worm”. By exploring these aspects, your students could use the case study to guide their practice in a wide range of technological contexts and activities. The notes that follow are divided according to the three strands of the *Draft Technology Essence Statement*: Technological Practice, Technological Knowledge, and the Nature of Technology. (See **www.tki.org.nz/r/nzcurriculum/whats_happening/technology_e.php**)

Technological Practice

- A **conceptual statement** is a key element of a technological brief. It records and communicates what is to be developed and why.
- A conceptual statement is often very general. As Brief Development proceeds, the statement can be tested and refined.
- Having refined their conceptual statement, the students had to make sure that their animation would fulfil its purpose and meet the requirements of the brief. They needed to develop an understanding of the **“grammar of film”**, including ways in which film-makers compose frames, scenes, and entire storyboards so that the images, words, and sounds combine to convey key messages.

- The final choice of simple stop-motion video suited their topic, message, audience, skill levels, and available support, as defined in the final brief.

Technological Knowledge

- The students' technological practice involved an early experimentation with **models**, such as flick books and thaumatropes.
- The models provided information that the students had to **evaluate**. This evaluation helped them with character and storyline development and with selecting an appropriate animation medium and techniques.
- Another form of modelling used by the students was **storyboards**.

The Nature of Technology

- The success of a technological outcome often depends on the technologists' **integration of knowledge** from a number of domains. In this case, knowledge and practices from technology, English, the arts, and science were all key.
- In terms of the Nature of Technology, a technological outcome needs to be understood as something that functions in its intended social, cultural, and physical environment. (The animation had to be entertaining for children, who would be viewing it in a working science institution.) This differs from a Nature of Science perspective, according to which the success of the outcome hinges on its ability to describe and explain the natural world. (The animation had to convey clear and accurate information and ideas.) The final outcome therefore had to address two sets of priorities.

Developing the Ideas

The following notes explore the key ideas in more detail. After your students have read the article, you could introduce discussion points by posing focus questions. Each of the questions suggested below is followed by key points that you should look for in the students' responses.

Discussing Technological Practice

How did the students in the article work out exactly what their project was going to be?

The inception of the project is described in "What's So Special about Sea Worms?" The students developed and refined a **conceptual statement**, which communicated what they were developing and why. Their actual conceptual statement is not given in the article, but all the elements are in the text. You could ask the students to locate sentences in "What's So Special about Sea Worms?" that reflect the project's key features and purpose. For example:

- "… to create a sea worm information resource for the schoolchildren who visit the marine lab";
- "… to present sea worms in an exciting way for our intended audience";
- "That's how we got the idea of making an animated movie."

A conceptual statement is usually quite general. How did the students develop more detail for their brief?

The students then **explored options** that might achieve their purpose.

- They needed to communicate key information in ways that would appeal to their target audience.
- They evaluated ideas on the basis of whether they would entertain and inform most children. This key factor required them to think carefully about humour, entertainment, *and* science.
- They explored the balance between entertainment and information. They needed to make sure that neither factor would predominate over the other.

- The location was a determining factor. Because real sea worm specimens would be available for their audience to inspect, the students were able to show their characters in a cartoon style that was only semi-realistic.

How did the students keep track of all their decisions, communicate these to stakeholders, and make sure that they didn't lose sight of the project's key purpose and specifications at any time?

As they researched and trialled animation techniques, they **continuously refined the brief**, weaving in new ideas as they **evaluated the opportunities and limitations** associated with stop-motion video animation. They shared their decisions with others and justified them in terms of their developing understandings. They recorded key decisions and briefly noted the justifications so that they could look back and clearly state why they were doing things and why they needed particular resources.

How was developing a film different from some of the other options, such as writing and illustrating an article?

The students began by brainstorming a plot for their movie in the same way that they might have brainstormed the plot of a story or the sections of an article. Their choice of a film medium did, however, add unfamiliar dimensions to the process.

- The students needed to define specific composition elements, such as what was to appear in each frame and scene – bearing in mind how many frames would be manageable to both illustrate and film.
- They needed to work out how the frames and scenes would be linked. The way in which all the frames combine to produce a scene with effective movement, light, and sound and the way in which all the scenes combine effectively can be thought of as the "grammar of film".
- Technical points were important, too, for example, appropriate lenses and other equipment had to be selected. Camera angles and lighting had to be adjusted to eliminate glare in some cases.

For detailed information about film composition and associated technical elements, see the Ministry of Education's *Exploring Language* (Learning Media, 1996), pages 210–216. For information about the features of effective visual language, see pages 180–184, 191–196, and 217.

When you've been working on a project for a long time, you can "get very close to it" and lose the ability to evaluate it objectively [without personal bias]. Once the animation was finished, how did the students know whether they'd achieved their aims?

The **film was evaluated against the specifications of the brief**. You could ask your students what sorts of questions the film-makers might have asked themselves about their outcome:

- What specific information and general messages did particular scenes convey?
- Which composition elements combined well to produce the desired effect?
- Which would we change next time?
- How would making these changes affect the information and the messages?

Stakeholder feedback from the marine centre staff and the premiere audience was also an important indicator of their outcome's success. Near the end of a project, film-makers often show their work to a sample audience in order to gauge their reactions. The film "was an instant hit with the audience". Although the premiere wasn't a formal test-screening, you could ask your students what sorts of questions the film-makers might have asked if it had been:

- What aspects of the film appealed most to the different ages represented in the audience?
- What did an age-specific sample and a random sample from the audience think about the film?

- o Which characters were most memorable?
- o Which scenes were most memorable?
- o Were any scenes more interesting than others?
- o Were any scenes hard to understand?
- o What new things did you learn?
- o After seeing the film, did you think differently about estuaries and the organisms that inhabit them? If so, in what way?

The film's inclusion on the interactive CD-ROM used at the New Zealand Marine Studies Centre and Aquarium proved its success as a science education resource.

Discussing Technological Knowledge

How did the students in the article decide on a medium for their display that would be both effective and achievable?

They brainstormed possible static imagery options, including posters, 3-D models, dioramas, and books. They also researched the history of animation to get ideas about the possibility of a moving-image display.

- After researching in books, they moved on to practical explorations.
- Their **models** of thaumatropes and flick books helped them to evaluate the potential functional effectiveness of stop-motion techniques.
- Their hands-on experimentation allowed them to experience and understand the crucial principle of persistence of vision.
- From personal experience, they knew how effective stop-motion animation can be – when produced by expert staff in high-tech studios. The functional models allowed them to **evaluate** whether their own skills and resources would be enough to create an effective animation. This was confirmed when they found an animation on the Internet that had been produced by school students.

The information collected from the models helped the students to make the characters and storyline work. The models also helped with key technical decisions. For example, the students decided on using cardboard cut-outs instead of clay models because with clay, the detail and the required movement would pose significant problems in the animation process.

In short, the models were a key tool at many stages and helped to ensure the overall success of the outcome.

Storyboards were another form of modelling used by the students but not highlighted in the article. Storyboards help film-makers plan how to break the action into manageable scenes and sequences of movement. The students used storyboards to highlight the important aspects of the storyline and eliminate extraneous detail. Different groups of children could then work on different sequences. Reference to storyboards and associated activities can be found in *Exploring Language*, page 221, and English Online (Note that unitecnology has no "h"!):
http://english.unitecnology.ac.nz/resources/units/sound_advice/home.html

Discussing the Nature of Technology

The success of a technological outcome often depends on the technologists' **integration of knowledge** from a number of domains. "The Adventures of Gary the Worm" exemplifies the integration of knowledge and skills from technology, English (especially visual and oral language), the arts, and science.

The George Street students had to accommodate aspects of both the Nature of Technology and the Nature of Science. A successful technological outcome/solution relies on its ability to function in its intended social, cultural, and physical environment. From a scientific point of view, the outcome's success relied on its ability to explain the natural world.

The students in the article decided that cartoon-style characters would be suitable, even though the display would be located in a scientific institution. Can you find an explanation for this decision in the text? (You could frame the question more generally: *It may sound a little strange, but for the animation to succeed as a tool for communicating science to children, it had to be a bit unscientific. Can you find a section in the article that explains this?*)

On page 7, the students state, "We decided that, although our message was scientific, the characters could be cute or wacky rather than lifelike. That way, our audience would relate to the characters – but for a reality check, they could also view living examples at the Marine Centre."

You could progress the discussion by asking whether the students might have made different decisions for another audience. For example, what if the audience had been secondary school students? What if the display were intended to inform parents so they could teach their children about sea creatures and ecology when visiting an estuary?

For activities that explore the relationship between the physical aspects of visual language and the functional aspects of visual language, see
http://english.unitecnology.ac.nz/resources/units/persuading/home.html
http://english.unitecnology.ac.nz/resources/units/visual_journals/home.html
http://english.unitecnology.ac.nz/resources/units/lens/home.html

Further Activities

The technological practice undertaken by the students in "The Adventures of Gary the Worm" exemplifies a number of key ideas in technology education. Having explored these ideas in relation to one case study, your students could recontextualise them by examining other examples.

Exploring and Evaluating Others' Learning in Technology

Divide the class into groups and have them read and discuss either "Room 5's Amazing Meeting Seating" (*Connected 2 2005*) or "Our Pātaka" (*Connected 3 2005*). The suggested questions and activities explore principles that underlie these case studies and "The Adventures of Gary the Worm".

Technological Practice

What do you think helped motivate the students in the article(s) to work so enthusiastically?

Who were the stakeholders in each case?

What was the attribute (intended feature of the outcome) that the students in the article(s) thought was most important when developing their brief? What were the other important attributes?

Draw a flow chart that shows how the technological outcome was developed. Include:

- key resources;
- questions asked of or by subject experts and other important stakeholders;
- important decisions made by the students;
- stages where it was important to evaluate the developing outcome before progressing.

Devise a checklist that you might use to evaluate the final outcome against its intended purpose.

Technological Knowledge

Describe any models used by the students in the article(s).

- How did these models help the students to develop their technological outcome?
- What information did the stakeholders feed back about the models?

The Nature of Technology

List the people who helped the students.

- What information did each contribute to the decisions made by the students?
- How did they help the students to develop their skills?
- How did the intended function of the outcome affect the selection of materials, techniques, and design features?

An ICT Project of Our Own

After analysing other people's technological practice, your students may wish to apply what they have learnt to their own ICT project. Ideally, the students will suggest a need or opportunity of their own. This will allow them to develop general understandings about Technological Practice and the Nature of Technology as well as specifically ICT-focused skills and knowledge. If necessary, you could stimulate the students' ideas by suggesting general possibilities, for example:

- a CD-ROM or another outcome to accompany a static display at the local museum;
- a film segment, animation, or interactive aspect to enhance the school website;
- a CD-ROM to communicate messages about safety around the school or home, fire safety, or road safety;
- an induction resource for new students at the school;
- a short film to raise awareness of a local environment issue.

When developing their brief and subsequently, the students should:

- identify the key messages to be conveyed;
- identify the audience and research their characteristics, needs, and priorities;
- explore a range of possible ICT media for conveying the particular messages. For example:
  - video (animated or live action);
  - audiovisual (sound plus static images or models);
  - audiovisual (sound plus moving images or models);
- consider the necessary resources, skills, knowledge, setting, equipment, and associated costs;
- plan how to manage the project so it:
  - meets the requirements of its brief within budget and on schedule;
  - effectively integrates words, images, and sound to convey the key information and ideas.

Marine Worms: The Weird and the Wonderful

Possible Achievement Objectives

Science

Living World

- 3.1: Distinguish between living things within broad groups on the basis of differences established by investigating external characteristics.
- 3.2: Investigate special features of common animals and plants and describe how these help them to stay alive.
- 4.1: Investigate and classify closely related living things on the basis of easily observable features.

Developing Scientific Skills and Attitudes

- Record observations and measurements (Information Gathering, level 3/4).
- Identify trends and relationships in recorded observations and measurements by making links within organised data (Processing and Interpreting, level 3/4).

The Specific Learning Intentions

The students will be able to:

- describe the key features shared by all animals within the annelid (segmented worm) phylum;
- describe how the annelid phylum is subdivided into a number of classes, giving examples:
  - describe key similarities shared by all polychaete worms;
  - describe key differences between polychaete worms and oligochaete worms;
- observe a polychaete's anatomy in order to deduce its probable lifestyle and, conversely, analyse a description of a polychaete's lifestyle in order to suggest its probable anatomical features.

The Key Ideas

- Polychaetes belong to the annelid phylum, also known as the segmented worms.
- Polychaetes are classified as annelids because of the features they share with other members of this phylum.
- The polychaete class is distinguished from other classes within the annelid phylum because of their many distinctive features, such as bristled parapodia.
- Distinctive polychaete anatomical features and behaviours have evolved in response to the many opportunities and challenges presented by their varied habitats. This has made the polychaetes an extremely diverse class.

Developing the Ideas

Before reading "Marine Worms: The Weird and the Wonderful" (and before any discussion of worms), you could appraise the students' existing knowledge. (By reading the articles in the students' book first, you will gain much of the information needed to support this prior discussion about polychaete worms' habitats and adaptations. After the students have read the article, the Further Activities section develops the ideas in more detail.)

Begin with some general discussion about worms.

- What springs to mind when you hear the word worm?
  - Where do worms live?
  - What are their main features?
  - How many types of worm can you name? (As well as segmented earthworms, the students may mention tapeworms, roundworms, threadworms, and lugworms – of which only earthworms and lugworms are annelids.)
- Ask the students to sketch what they think a marine worm might look like.
  - Do they simply draw a segmented earthworm underwater?
  - Or do they include structures that might help a worm to move and feed in a watery environment?

Many of the students will have based their sketches on earthworms, so you could begin the discussion by briefly reviewing earthworm anatomy and behaviour and the role earthworms play in the ecosystem as soil scavengers or "recyclers of detritus". For background information and simple observation activities, see the Ministry of Education's *Making Better Sense of the Living World* (Learning Media, 2001), pages 98–103.

The class could carry out one of the observation activities suggested above so that they can view a living earthworm as they discuss possible similarities and differences between it and its marine relatives. You could guide the discussion by posing questions. The following questions are designed to focus students' minds on relationships between anatomy, behaviour, and environment. Referring to the students' sketches:

- In what ways do you think sea worms might be like earthworms? In what ways do you think they might be different from earthworms?
  - What might be some of the advantages of living in a fertile and protected part of the sea, such as an estuary? (In particular, think about finding food, moving around, and breeding.)
  - What might be some of the disadvantages?
  - What factors in an estuary environment might allow marine worms to grow bigger than their relatives on land?
  - How might they move?
  - What might they eat?

Explain that we can sometimes learn important things about plants and animals by taking apart their scientific names.

- Scientifically, earthworms are called oligochaetes. "Oligo" means few, and a "chaeta" is a bristle. The students could look at a real earthworm to check how bristly it is. (Explain that an earthworm has only four sets of tiny bristles on each segment, which are too small to see – although you might be able to hear the faint rustling sound they make when a worm moves across a drum skin or a sheet of paper.)

- "Poly" means many. What might that tell us about polychaete worms? (You could show the class the first two pages of "Marine Worms: The Weird and the Wonderful", which includes images of two polychaetes that both have numerous and prominent bristles.)

Read the whole article with the students and follow up with a discussion in which they reflect on their sketches and associated ideas. To what extent did the article confirm or challenge those ideas? The initial discussion raised general ideas about structure and function. The students could now explore this topic in more detail.

Further Activities

Activity: Worm Watch

What You Need

- Live lugworms, if possible (They are common on estuarine mudflats.)
- Sea water and sand in a glass container
- Images of a variety of polychaetes – useful sources:
  www.wormguy.com/wormcurious.html – includes photographs of New Zealand species and a question forum
  www.biology.ualberta.ca/facilities/multimedia/index.php?Page=252 – includes animations of locomotion
  www.mesa.edu.au/friends/seashores/worm_feeds.html – includes an animation of eversible mouthparts

What You Do

Part 1: Observation

- If you have a live polychaete, place it in a glass-sided container with sand and sea water so that the students can examine it. They could also study polychaete locomotion by viewing a specimen in a glass container that's been placed on an overhead projector. (For collection techniques, see the notes for "The Secret Life of Estuaries", Activity: The Interplanetary Zoo.)
  - Ask the students to identify as many body parts as possible, for example, head, parapodia, segments, mouth, and tentacles.
  - On the basis of observable anatomy, ask the students to suggest which of the lifestyles mentioned in the article the specimen might pursue: burrowing, roving, or filter-feeding.
  - Ask focus questions to help the students make connections between structure and function. For example:
    What would help a predatory worm to grab live prey?
    How would an attached tubeworm get food?
    In how many ways do polychaetes use their parapodia?

- You could record the students' ideas in the form of a simple chart. For example:

	Locomotion	**Sensing**	**Feeding**
Burrowing recyclers	Reduced parapodia Burrow by using muscles to change shape of body segments	Fewer sensory appendages than other polychaetes	Simple jawless mouth for swallowing sediment
Roving predators	Rove or swim with well-developed parapodia and body muscles	Well-developed eyes, tentacles, and palps	Strong, sharp mouthparts Often have eversible pharynx to extend grabbing range
Filter-feeding tubeworms	Have hooklike bristles that are used as brakes to hold worm in tube	Feeding tentacles often have sense organs, such as eyes	Crown of filtering tentacles catches food and conducts it to simple mouth

Part 2: Follow-up Activities

High-speed Sketch Challenges

- The students could make up playing cards, each of which has a polychaete body structure written on it, for example, jaws, everted pharynx and mouthparts, retracted pharynx and mouthparts, tomopterid parapodia, tubeworm parapodia, antennae, palps, segments, feeding crown.
- The students divide into two teams.
- A card is selected, and one student from each team is allowed to look at it.
- Those two students race each other to sketch the body part while the other members of their team race to identify it.

Looking at Locomotion

- If you have collected a live lugworm, the students could watch and discuss how it moves and burrows.
- For an animated perspective, they could access the following website, which provides animated diagrams of locomotion:
  www.biology.ualberta.ca/facilities/multimedia/index.php?Page=252
  - o Discuss with the students the different changes in segment shape that allow a nereid worm to rove and that allow an earthworm to burrow.
  - o Burrowing polychaetes and earthworms use similar sets of muscles to move. The wall of each segment has circular muscles and longitudinal (lengthwise) muscles. As one muscle group contracts, it stretches the other group. The circular muscles contract to make the segment long and thin. The lengthwise muscles contract to make the segment short and thick.
  - o A body segment that's short and thick presses against the wall of the burrow and anchors itself with the help of its bristles. At the same time, circular muscles in the segments in front contract. This action lengthens those segments and pushes the body forward.
  - o The students could use a partially inflated balloon to emulate how a segment changes shape.

Polychaete Pairing Game

- The students make up two differently coloured sets of cards.
  - o One set has pictures of various polychaete species from the students' book and online references above.
  - o The other set has matching lifestyle phrases: catches live prey, scavenges by swallowing mud, filters particles of food from the water, lives in a tube, and so on.
- The pack is shuffled, and all the cards are randomly laid out face down.
- The players take turns to pick up two cards. If they match, the player gets to keep them. If not, the player replaces them exactly where they were.
- The students could design different packs of cards.
  - o For example, they could play the same game with a different deck that pairs anatomical features with specific functions.
  - o Alternatively, the cards could match an identical food source in different environments with structures and behaviours: "eats particles of detritus in the water" matches a picture of a filter-feeder, and "eats particles of detritus in the sediment" matches a picture of a lugworm burrowing.

What You Look For

- Do the students link anatomy with behaviour by accurately describing how anatomical structures allow particular species to perform tasks that increase their chances of survival?
- Do they understand that the environment is a major factor in determining which structures and behaviours will increase the chances of survival? For example, filter-feeders and consumers of mud eat similar food (particles of detritus) but would starve to death if they swapped environments.
- Can they both:
  - o observe a polychaete's anatomy and deduce its lifestyle?
  - o read or hear a description of a polychaete's lifestyle and suggest its likely anatomical features?
- Do they understand and use basic scientific terminology correctly?

The Secret Life of Estuaries

Possible Achievement Objectives

Science

Living World

- 3.2: Investigate special features of common animals and plants and describe how these help them to stay alive.
- 3.4: Explain, using information from personal observation and library research, where and how a range of familiar New Zealand plants and animals live.
- 4.2: Investigate and describe special features of animals or plants which help survival into the next generation.
- 4.4: Use simple food chains to explain the feeding relationships of familiar animals and plants, and investigate effects of human intervention on these relationships.

Planet Earth and Beyond

- 3.1: Investigate the major features, including the water cycle, that characterise Earth's water reserves.
- 3.2: Gather and present information about the origins and history of major natural features of the local landscape.

Making Sense of the Nature of Science and its Relationship to Technology

- 3.3: Investigate the impact of some well-known technological innovation or scientific discovery on people and/or the local environment.

Developing Investigative Skills and Attitudes

- Use appropriate instruments to enhance observation or to introduce quantification (Information Gathering, level 3/4).
- Record observations and measurements (Information Gathering, level 3/4).
- Identify trends and relationships in recorded observations and measurements by making links within organised data (Processing and Interpreting, level 3/4).

The Specific Learning Intentions

The students will be able to:

- describe the main characteristics of an estuary in terms of physical geography and geographic processes, diverse habitats, and diverse flora and fauna;
- offer specific examples to illustrate how an estuarine environment impacts on living things and how living things, including humans, impact on an estuary;
- describe in general and specific terms how human activities directly affect an estuary's freshwater catchment and therefore indirectly affect the estuary downstream;
- understand that animals have the same basic needs but fulfil those needs in different ways, depending on environmental opportunities and challenges;
- present observations of estuary organisms, describing how they're anatomically and behaviourally adapted to survive an estuary's challenges and take advantage of its opportunities;
- make accurate observational comments and diagrams.

The Key Ideas

- Estuaries are unique, semi-enclosed environments where land, fresh water, and sea water meet.
- The landscape of an estuary and the geographical processes that take place within it affect the organisms that live there. Equally, organisms and biological processes within an estuary affect the landscape.
- Estuaries funnel all the waterborne substances from their catchment and concentrate them into a small area, from which they eventually flow into the sea.
- Estuaries display the same general characteristics everywhere, with only the local organisms changing with latitude. The basic "blueprint" or "plan" for an estuary involves fresh water flowing from upland areas, through a fringe of salt-tolerant plants, over an intertidal sand- or mudflat, and finally to the estuary's deeper channel and out to sea.
- The organisms in an estuary absorb both beneficial and harmful substances from the land and the sea. The absorption can be either direct, for example, when plants absorb nutrients or contaminants from the environment, or (indirectly) by way of food web interactions, for example, when herbivores and carnivores consume nutrients or contaminants that were originally absorbed by plants.

- Decay is a natural and healthy process in which organisms interact to physically and chemically break down and recycle nutrients.
- An estuary can be overloaded by the inflow of excessive sediments and substances such as fertilisers. The result can be eutrophication – an unhealthy breakdown in the dynamics of a food web.
- At the base of an estuarine food web are plants, of which only a small proportion have grown in the estuary itself. Most of the plants on which the food web is founded are in the form of detritus – dead plant material imported by way of the catchment.

Developing the Ideas

Students will probably not realise the extent to which estuaries have shaped settlement patterns and other aspects of civilisation. Many modern cities were strategically founded as early encampments at the edge of estuaries. Help the students to explore what an estuary is in simple terms. (Estuaries are places where fresh water from the land mingles with salt water from the sea. Many harbours are estuaries or include estuarine areas.) Then ask questions to focus discussion on familiar examples.

- Who were the first inhabitants of our town, city, or region?
- Why did they settle here?
- What resources were available to them here?
- What did water have to do with their decision to settle here?
- Was there a good source of fresh water?
- Is the sea nearby? Why are so many New Zealand towns and cities located near the coast?
- Look at a map of New Zealand. Are the seaside towns and cities evenly distributed along the coast, or are they usually near to harbours and estuaries? If so, can you offer an explanation?
    - Estuaries are often sited at the edge of a fertile flood plain, which makes them attractive for human settlement. Rivers and streams bring water for drinking, agriculture, and industry.
    - The sea brings food and enables transport and trade.
    - Because there are so many resources within estuaries, people often compete for different uses of estuaries, including for recreation, living space, industry, aquaculture, fishing, and shipping.

If possible, illustrate those points with a specific example. Identify an estuary that the students are familiar with and ask them what kinds of plants, animals, and human activities the environment supports. This discussion should extend the students' concept of an estuary from being just "a nice place to live" to an environment that may:

- offer protection from storm waves (and even tsunami);
- enable the importation of the clothes they wear, the electronic equipment that entertains them, and much of the food they eat;
- act as a nutrient-rich nursery for young fish and other animals that eventually leave the estuary and mature in the open ocean;
- act as a breeding and feeding ground for bird populations that take advantage of the shelter and the food sources.

Read "The Secret Life of Estuaries" with the class and revisit the prior discussion, focusing on the students' ideas that the article confirmed and those that it challenged.

Further Activities

Activity: The Interplanetary Zoo

In this creative scenario activity, students begin by "designing" an alien organism that's adapted to a habitat similar to an estuary on Earth. You then present them with photographs of real estuary organisms, which you have located in print and online resources. The students closely examine these "specimens", comparing them with their initial designs and commenting on their adaptations.

What You Need

- Resource materials that include information about and images of the animals and plants found in New Zealand estuaries
- A sieve or fine colander (with about 1- to 2-mm holes)
- A trowel
- A bucket of sea water
- A bottle of sea water
- A large, shallow tray (at least 30 cm x 30 cm x 2 cm)

What You Do

- Begin by setting up an interplanetary scenario.
    - o Most animals on Earth are invertebrates, so if we find animals on other planets, they're likely to be invertebrates too. Imagine that you're a scientist studying aliens that live in different parts of a strange planet.
    - o A probe has been sent to scout an area of the planet's surface. It will send back photographs of aliens, along with information about them and their environment, so that you can begin to analyse them while preparing to mount a field trip.
    - o Readings from the area indicate shallow sea water, which is clean, but sometimes it's very muddy and sometimes it's very salty. Scientists wonder how the aliens can survive in it.
    - o The animals must be tough in other ways, too. The sea water disappears and is replaced by a dangerous gas twice a day. When that happens, the radiation from space is so strong that many aliens hide underground to escape the sudden heat and radiation. Others have built-in body armour that allows them to stay on the surface and move around. It protects them from the radiation and carries breathable liquid within.
    - o Some of the aliens move with many legs, but others have none. Some have a head, but others have none. Some stay in the one spot and grab food that floats by, others hunt, but most wander about looking for food. Some pick up tiny pieces with delicate fingers. Others just swallow gobs of dirt, digest out the good bits, and then pooh out the rest. Some have hard shells or scales on the outside. Others have soft bodies, which are supported by the pressure of their internal fluids. Some swim. Others crawl, wriggle, ooze, or simply grow on the same spot.

- Give each student a data card. Explain that there has been a technical glitch, and the photographs have not survived the transmission. All that the students have to go on are the descriptions above. Ask the students to use their knowledge of aliens from similar environments on other planets to draw one alien each, showing the adaptations it uses to survive. They should make informed guesses as to how it lives in such a strange place.

DATA CARD	Labelled Diagram of the Alien
Detailed Description of the Alien's Habitat **Detailed Description of the Alien's Behaviour before Capture** *What it was doing:* *How it was moving:* *What it was eating:* **Description of Feeding Anatomy and Behaviours** **Description of Defensive Anatomy and Behaviours**	

- The students could share their data cards in group discussion and afterwards construct food chains and simple food webs that show feeding relationships.
- Announce that repairs have been made, and the photographs have now been transmitted. Divide the students into the same groups and give each student a photograph of a real specimen, which they should draw and describe on a fresh data card. They could use a field guide for help with identifying and describing their specimen. See, for example, *Life in the Estuary: Illustrated Guide and Ecology* by Malcolm Jones and Islay Marsden (Christchurch: Canterbury University Press, 2005).
- When the observations are completed, the groups should make a tour of the alien zoo.
  - o At each group's station, the visitors view the data cards of the real specimens.
  - o To add interest and challenge, you could organise for the students in charge of each station to slip one imagined alien data card in among the real specimen cards, and the visitors could be challenged to identify the imagined card among the real examples.
- All that remains is to travel to the planet's surface and collect real specimens.
  - o Visit an estuary at low tide, making sure you keep careful track of local tide times – or you may be caught by rising water!
  - o Some small animals can be found by turning over rocks. (Replace the rocks in the same position in order to disturb the habitat as little as possible.)
  - o Many other animals will be found in the sediments. Trowel a few scoops of sand or mud into the colander. Swish the colander in the bucket of sea water so that the mud falls through but most of the small animals are retained. Wash the animals into the shallow tray with a few squirts of clean sea water. You could place individual specimens in glass or clear plastic containers so that they can be conveniently viewed from different angles with a magnifying glass.
- Sum up with a class discussion.
  - o Did the real specimens display anything as weird as, or weirder than, the imagined aliens?

- How many examples can we find of animals solving the same problem in different ways? (For example, crabs have their gills in special pockets that hold water, so they can breathe when the tide is out. Many worms line their burrow with mucus, so it holds water better.)

- Return the specimens to their original habitat.

What You Look For

- Can the students transfer their knowledge and understanding of how real animals survive in estuarine ecosystems to the imaginary scenario by developing plausible descriptions of aliens and their adaptations?
- When analysing real specimens (or images), are the students' observational comments and diagrams accurate?
- Can they hypothesise a reasonable function for the structures they observe?
- Do they understand that animals have the same basic needs but fulfil those needs in different ways depending on environmental opportunities and challenges?

Activity: Flushing a City down an Estuary

Depending on the resources available, you could copy maps onto overhead transparencies and allow the students to mark these directly. Alternatively, you could photocopy the maps onto paper, and the students could mark up clear transparencies placed over the top. The activity could be run as an individual, group, class, or homework activity.

What You Need

A topographic map of a nearby estuary and its catchment

Blank overhead transparencies

Coloured OHP markers

Grid paper copied onto an overhead transparency

What You Do

- In whole-class discussion, start by asking the students to identify or mark familiar features on the map, for example, towns, mountains, highways, camping grounds, and parks.
- Have the students work individually, in groups, or as a whole class to identify sheltered places, such as harbours or bays, where a river or stream meets the sea.
  - Ask them to mark these estuaries in red.
  - Depending on the range of the map, there may be several. If so, the students should select for further investigation a large example near a city or town.
- Have the students mark in blue all the rivers and streams that flow into the estuary, starting from the coast and tracing them as far inland as possible.
  - Between the blue lines will be flat or hilly areas of land that drain into the waterways, adding water and dissolved sediments.
  - Using a brown pen or pencil, the students should fill in these areas, taking care not to obscure the blue lines. The brown areas mark the estuary's catchment.
- The students can then approximate the relative sizes of the estuary and its catchment.
  - How big is the catchment? Place the OHP grid sheet over the map and count the number of squares inside the blue and brown areas.
  - How big is the estuary? Count the number of squares within the red area.

- Allow time for discussion of, and research into, human impacts on the catchment and estuary. If working with a local map, it may be possible for you to arrange for an education officer from your regional council to visit the school and discuss the local issues in specific detail.
  - Make the point that an individual human activity, such as washing your car next to a stormwater drain, may have only a small effect – but a whole population of people carrying out that activity will cause a major impact. Note also that a lot of people all doing the right thing in small ways will add up to a significant environmental benefit. For example, if each person in a city of 250 000 people saved a litre of water a day, the total weekly saving would be 1.75 million litres!
  - What human activities take place inside the brown area? Do any activities positively affect the estuary? If so, how? Do any negatively affect the estuary? If so, how? What can we and our families do to promote the positives and lessen the negatives?
  - Are any parts of the brown area covered by bush? Are there other types of uncultivated land within the brown area? If so, what wild plants and animals live there? How do their activities positively or negatively affect the estuary? How do human activities affect these plants and animals?
  - Discuss the idea that human impacts on an estuarine environment can be long term and irreversible.
- The students could devise a strategy for:
  - communicating to the local community the negative effects of human activities in and around an estuary;
  - promoting attitudes and behaviours that minimise those impacts.

What You Look For

- Can the students describe the main characteristics of an estuary?
- Can they identify a few ways in which estuaries are important to humans and other organisms?
- Do they understand the graphical conventions of topographical maps and/or understand the legends and captions on a map well enough to identify important features such as rivers, marine areas, sandy shores, muddy shores, vegetation, and urban areas?
- Do they use words and expressions that show they understand the way in which many small individual impacts on the catchment can make a big difference in an estuary?

References

The following resources can be used to both support and expand on the suggested activities above.

Ministry of Education Resources

The following Ministry of Education publications provide background information for teachers and activities for students on the topic of estuarine environments and biological interactions.

- Up the Creek is a digital interactive that can be used to connect river explorations with estuary studies. See **www.learningmedia.co.nz/nz/online/activities**
- Food webs are investigated in *Tidal Communities*, Book 22 in the Building Science Concepts series (Learning Media, 2002).
- Beach observations, activities, and vocabulary from *Life between the Tides*, Book 21 in the Building Science Concepts series (Learning Media, 2002), can be adapted for the study of estuaries.

- Many of the earthworm activities on pages 100–104 of *Making Better Sense of the Living World* (Learning Media, 2001) can be adapted for the study of lugworms, which are found in many New Zealand estuaries. Earthworms and lugworms fulfil very similar functions in different environments. Since most students will be familiar with earthworms, the activities could be adapted to focus on similarities and differences between earthworms and lugworms. See especially Activity 1: Where Do Worms Live?, Activity 5: A Home for Wild Animals, and Investigation 1: What a Worm Likes.
- On pages 109–119 of *Making Better Sense of the Living World,* there is a sequence of activities that explore relationships between living things and their environment, using aquarium and pond life as a focus.

Other Resources

- For up-to-date notices and access to the international GLOBE Programme and the National Waterways Project, visit the Environmental Monitoring and Action Project (EMAP) section of the Royal Society's website at **www.emap.rsnz.org**
- For video field trips to estuaries in the US and associated resources, visit **http://estuaries.gov**
- For detailed information on New Zealand estuaries, visit **www.niwascience.co.nz/rc/freshwater/nzestuaries**
- For an activity in which students explore coastal food chains, see the Ministry of Education's Science IS website at **www.tki.org.nz/r/science/science_is/activities/isact_food_chains_e.php**
- For information on how natural and human activities control the flow of estuary sediments, see **www.niwa.cri.nz/pubs/wa/08-4-Dec-2000/estuaries.htm**
- For a Northern Regional Council school information pack on estuaries, see **www.nrc.govt.nz/environmental.education/school.information.packs/estuaries.shtml**
- To access topographic maps and aerial photos of estuaries in your area, visit **www.nztopoonline.linz.govt.nz/website/nzgd2000topo/terms_cond.htm**
- A good pictorial guide to New Zealand estuaries is *Life in the Estuary: Illustrated Guide and Ecology* by Malcolm Jones and Islay Marsden (Christchurch: Canterbury University Press, 2005).
- **http://estuaries.gov/activitydensity.html** provides a hands-on investigation of the ways in which tides, floods, and storms can affect an estuary.
- For activities, comic strips, and games about estuaries and protecting waterways in general, see **www.delawareestuary.org/educationandoutreach/kids.asp**
- The National Science Exemplars include materials that relate to estuary field trips. See:
    - Shellfish, Seaweed, and Stuff at **www.tki.org.nz/r/assessment/exemplars/sci/living/lw_2c_e.php**
    - Crabs at **www.tki.org.nz/r/assessment/exemplars/sci/living/lw_2d_e.php**
    - Long Haul Birds at **www.tki.org.nz/r/assessment/exemplars/sci/living/lw_2a_e.php**

Kynan’s Positive and Negative Adventures

Possible Achievement Objectives

Mathematics

Number

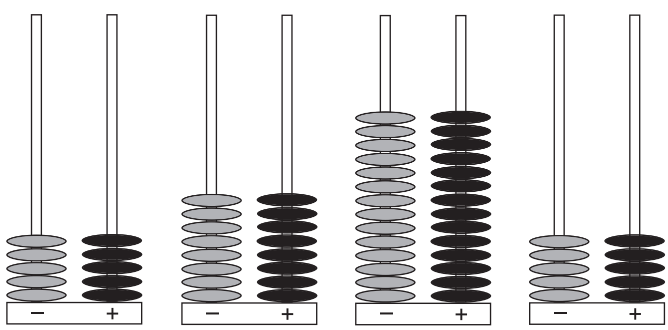
- Explain the meaning of negative numbers (Exploring number, level 4).
- Solve problems involving positive and negative numbers, using practical activities or models if needed (Exploring computation and estimation, level 5).
  [Note that in the revised curriculum, currently in draft form, integers are introduced at earlier levels.]

The Key Ideas

Teachers have often used contexts involving money to help their students understand the addition and subtraction of integers: a positive integer is money in the hand, while a negative integer is money owed (in the form of either a loan or a bill). This story makes use of the same idea but takes it a stage further by creating a whole series of transactions, each building on the one before it.

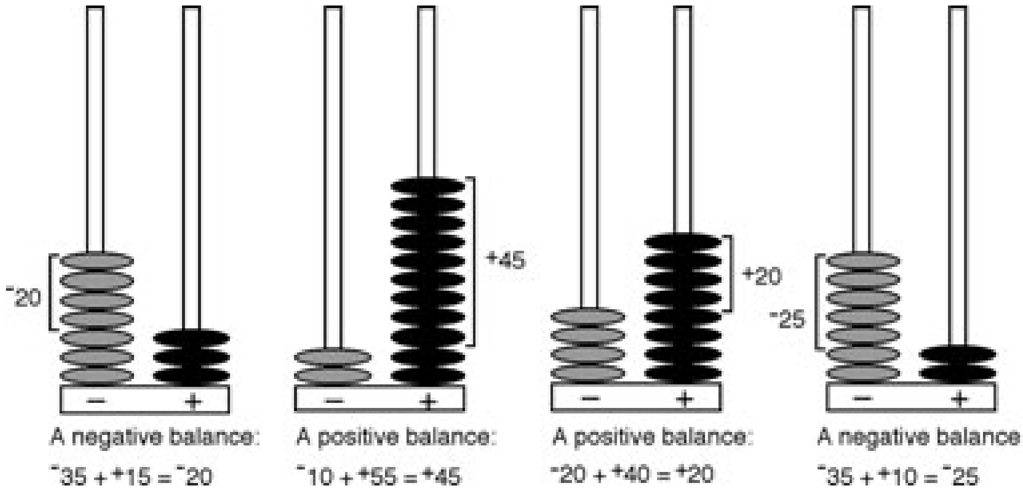
The story also gives students a way of modelling the transactions, using materials. It is important to read the story carefully before using it with the class and to work through the transactions, checking that you understand how the bean counter models each one and how it can be recorded as an equation. There are a number of important understandings for students to grasp as they read and discuss the story:

1. Every red bean (grey in these notes) represents a debt of $5 and can be written as $^{-}5$ (negative 5). Every black bean stands for cash in hand of $5 and can be written as $^{+}5$ (positive 5). If a bean is added to the red stack, this is represented as “+ $^{-}5$” (“add negative 5”). If a bean is removed from the red stack, this is represented as “– $^{-}5$” (“subtract negative 5”). Similarly, adding or subtracting a black bean is represented as “+ $^{+}5$” or “– $^{+}5$” (“add or subtract positive 5”). It is best to keep the words “subtract”, “minus”, “add”, and “plus” to describe the actions of adding or removing beans and to use the words “negative” and “positive” only to describe the kind of bean (red or black).
2. One positive and one negative combine to equal zero. This means that whenever the number of positives and negatives is the same, their sum is zero. Using Kynan’s bean counter, each of the four situations represented below shows a zero balance. In each case, the person concerned effectively owns nothing.



When Kynan first starts his business, he has $50 in cash and a debt of $50, giving him a zero balance. Represented as an equation, $^{+}50 + {}^{-}50 = 0$. This situation is illustrated in the bean counter sidebar on page 27 of the student book.

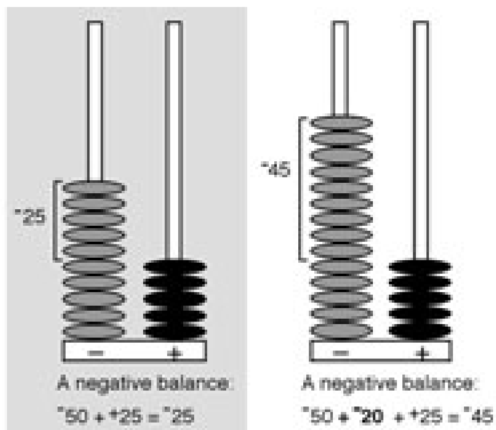
3. It is the difference in the number of positives and negatives that determines whether the overall situation (sum) is positive (money in the hand) or negative (a debt to be repaid) and by how much. If there are more positive than negative beans, the sum will be positive; if the reverse is true, the sum will be negative. Here are four examples that illustrate this idea:



Note how each of these situations can be represented as an equation.

4. A debt can be increased (added to) in two ways: by borrowing more or by receiving a bill.

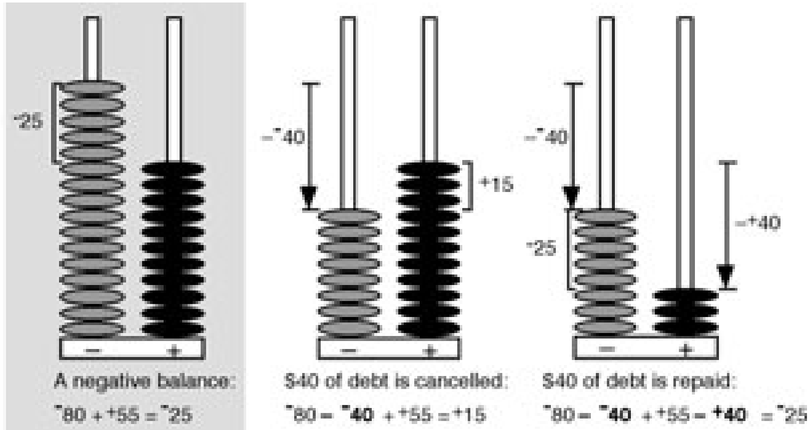
In this example, the first bean counter shows an initial scenario in which a person owes $25. The second shows that they have increased their debt by $20. The increase could be the result either of borrowing $20 more or of receiving a bill for $20:



Kynan gains debt at two points in his adventures, first when he borrows $50 from his mother and then when he receives a fine of $30 to get Fang released from the pound.

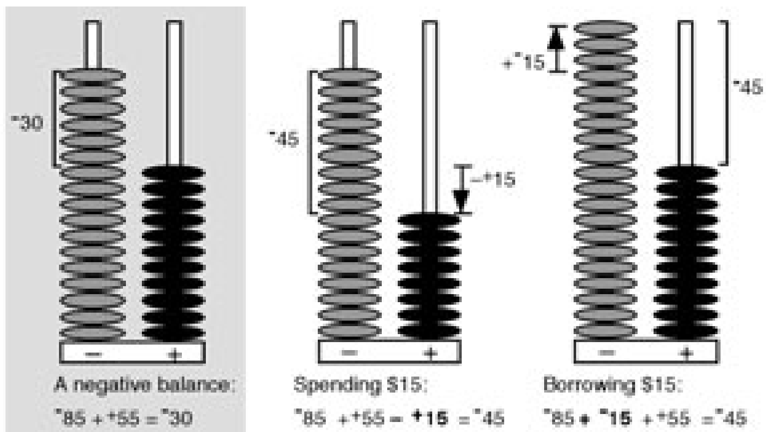
5. A debt can be reduced either by the lender forgiving (cancelling) it or by the borrower paying it back out of earnings, as the following example shows.

The first bean counter shows an initial scenario. The second shows what happens when $40 of debt is forgiven. (Debt is reduced by $40, but cash in hand remains the same.) The third shows what happens when $40 cash in hand is used to pay a creditor. (Debt and cash are both reduced by $40.) As before, these transactions can be written as equations:



6. Subtracting a positive has the same effect as adding a negative (of the same amount), and vice versa.

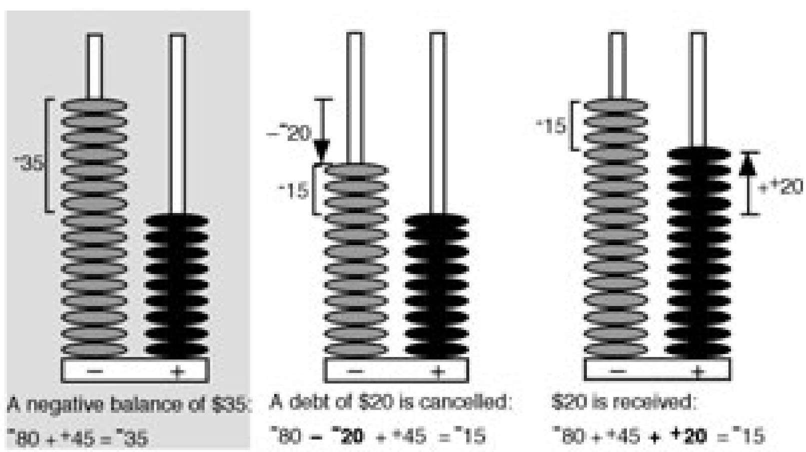
The first bean counter shows an initial scenario. The second and third diagrams show that spending $15 ($-{}^{+}15$) has the same effect as borrowing $15 ($+{}^{-}15$). In other words, "subtracting a positive" has the same effect as "adding a negative". As before, these transactions can be written as equations:



After either of these transactions, the person has $15 more debt than before: they now owe $45 instead of $30

7. Subtracting a negative has the same effect as adding a positive (of the same amount), and vice versa.

The first bean counter shows an initial scenario. The second and third diagrams show that having a debt of $20 cancelled ($-{}^{-}20$) has the same effect as receiving $20 ($+{}^{+}20$). In other words, "subtracting a negative" has the same effect as "adding a positive". These transactions can also be written as equations:

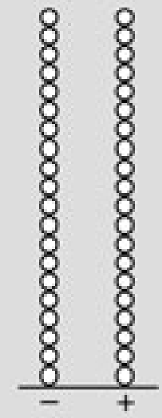


After either of these transactions, the person is $20 better off than before: they now owe $15 instead of $35.

Developing the Ideas

This is an excellent story for reading to the whole class. One approach is to read to the end of page 27 and then stop and discuss the bean counter. The aim of this discussion would be to ensure that all the students can attribute meaning to both kinds of bean and to the two stacks. Counters, blocks, or multilink cubes in two colours could be used as materials. Following this discussion break, you could read the rest of the story through without further introduction so that your students are able to enjoy it as a story.

Once you have finished the story, put the students into their groups and give each group a set of materials that they can use for their own bean counter. The items used do not necessarily have to be of two different colours, but they do need to be of the same size. A simple bean counter could be an A4 sheet of paper with two columns of circles on it, large enough to take standard counters. One column is marked with a negative sign and the other with a positive sign. Counters of any colour can be used as beans. A Number Strip 1–20 (material master 5-1), available at **www.nzmaths.co.nz/numeracy/materialmasters.aspx**, is an even better alternative. Because the positions for the counters are numbered on the material master, students can focus entirely on the transactions.



A simple paper bean counter

Using examples of transactions *not found in the story*, have the groups work out how to model them. Focus students on the action involved in each case. For example, if money is paid from cash in hand, this is represented by the subtraction of a positive amount. If a debt is cancelled, this is represented by the subtraction of a negative amount. Encourage the students to debate different views on how a transaction should be represented on the bean counter until they agree.

Once the students understand how the bean counter works, get them to read the story through again in their groups, identifying each transaction, writing it down in words and numbers, and modelling it on their own version of the counter. They should use the bean counter illustrations that accompany the story to check that they are on the right track.

The students will need to learn how to represent the bean counter transactions using equations. You will have to decide whether to introduce this notation at the outset or leave it until students understand how the bean counter works. Once they have seen how equations can record bean counter transactions, they can be given equations and asked to model them on the counter. The students can then be encouraged to discard the materials and image the operations.

It is very important that you and your students fully explore the seven key ideas at the start of these notes. The ideas can later be used as a checklist of student understanding.

It is important that the students recognise the pairs of operations that have an identical effect on Kynan's financial balance:

- Paying for something has the same effect as incurring a debt for the same amount. That is, subtracting a positive has the same effect as adding a negative of the same amount. (Key idea 6)
- Receiving money has the same effect as having a debt cancelled. That is, adding a positive has the same effect as subtracting a negative of the same amount. (Key idea 7)

Highlight the places in the story where Kynan's payment of a debt makes no difference to his financial balance because the money he pays (subtracting positives) is matched by the debt he reduces (subtracting negatives).

Further Activities

Encourage the students to create their own story, involving a linked sequence of financial transactions. Specify that they must include examples of transactions that illustrate each of the key ideas numbered 4–7. They can then exchange stories and create the matching bean counters and equations for their partner's story.

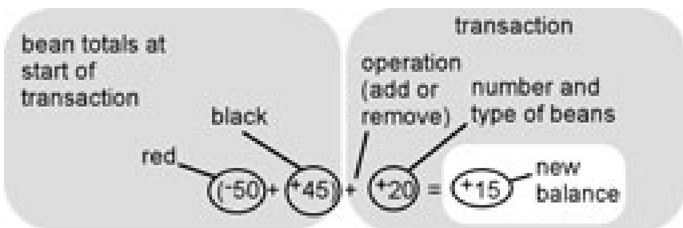
Other Resources

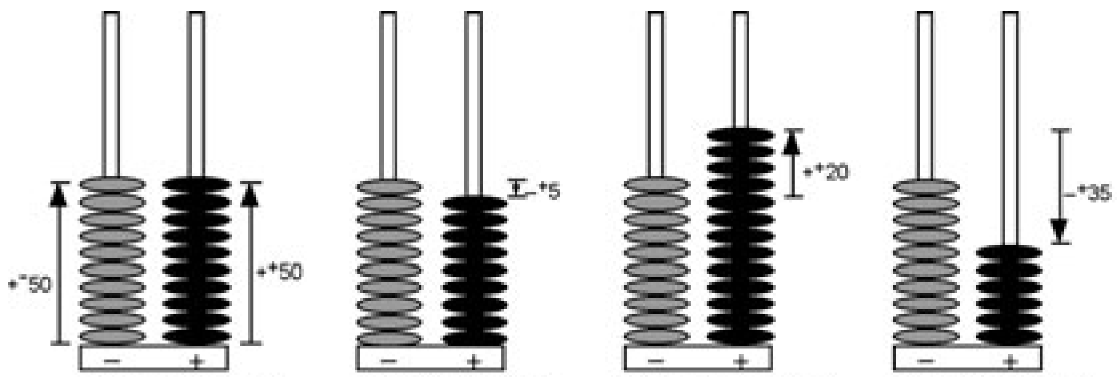
For an alternative way of modelling the addition and subtraction of integers, see Hills and Dales, *Book 5: Teaching Addition, Subtraction, and Place Value*, pages 50–53 (Numeracy Professional Development Projects 2006).

Answers

The diagrams below show the complete sequence of bean counter transactions described in the story, together with the equations.

Here is the meaning of each part of the equations:





(p. 27) Kynan borrows $50 from his mother:

$^{+}50 + {}^{-}50 = 0$

(p. 28) Kynan spends $5 on advertising:

$({}^{+}50 + {}^{-}50) - {}^{+}5 = {}^{-}5$

$0 - {}^{+}5 = {}^{-}5$

Kynan gets $20 from Mr Smythe:

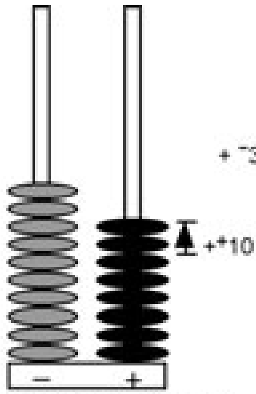
$({}^{-}50 + {}^{+}45) + {}^{+}20 = {}^{+}15$

$^{-}5 + {}^{+}20 = {}^{+}15$

Kynan spends $35 on pet food:

$({}^{-}50 + {}^{+}65) - {}^{+}35 = {}^{-}20$

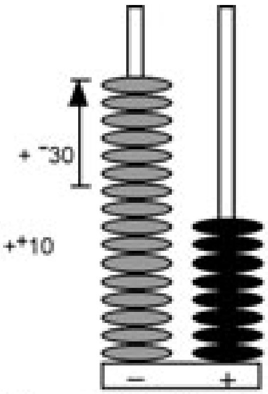
$^{+}15 - {}^{+}35 = {}^{-}20$



(p. 29) Kynan changes the cat food and gets $10 back:

$(^-50 + {}^+30) + {}^+10 = {}^-10$

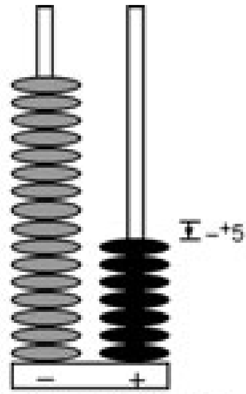
$^-20 + {}^+10 = {}^-10$



(p. 30) Kynan gets a bill for $30 from the pound:

$(^-50 + {}^+40) + {}^-30 = {}^-40$

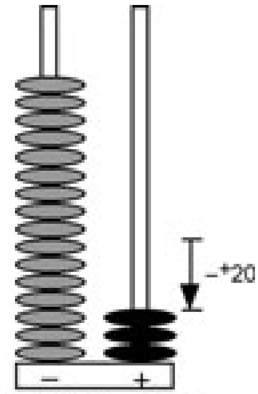
$^-10 + {}^-30 = {}^-40$



Kynan pays $5 for a padlock:

$(^-80 + {}^+40) - {}^+5 = {}^-45$

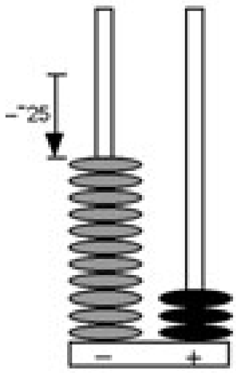
$^-40 - {}^+5 = {}^-45$



(p. 31) Kynan pays $20 for Tweet #2:

$(^-80 + {}^+35) - {}^+20 = {}^-65$

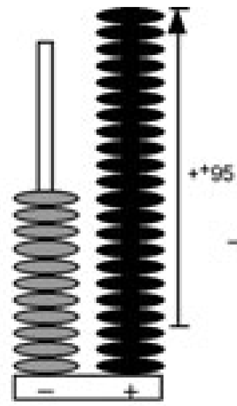
$^-45 - {}^+20 = {}^-65$



(p. 32) Kynan's mother writes $25 off the amount he owes her:

$(^-80 + {}^+15) - {}^-25 = {}^-40$

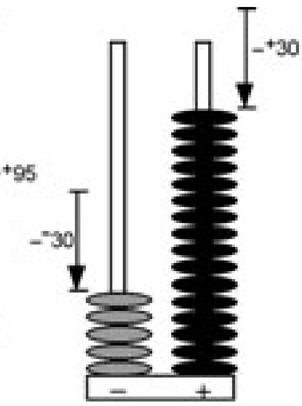
$^-65 - {}^-25 = {}^-40$



Mr Hotere pays Kynan $95 for looking after Fang:

$(^-55 + {}^+15) + {}^+95 = {}^+55$

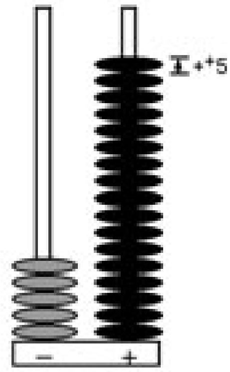
$^-40 + {}^+95 = {}^+55$



Kynan pays the $30 fine from the pound:

$(^-55 + {}^+110) - {}^+30 - {}^-30 = {}^+55$

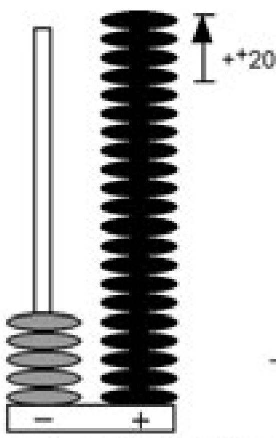
$^+55 - {}^+30 - {}^-30 = {}^+55$



Miss Prisk pays Kynan $5 for the birdseed:

$(^-25 + {}^+80) + {}^+5 = {}^+60$

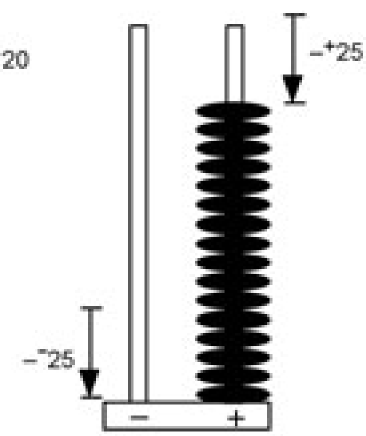
$^+55 + {}^+5 = {}^+60$



Ms Anderson pays Kynan $20 for feeding her piranhas:

$(^-25 + {}^+85) + {}^+20 = {}^+80$

$^+60 + {}^+20 = {}^+80$



Kynan pays his mother back the $25 he owes her:

$(^-25 + {}^+105) - {}^-25 = {}^+80$

$^+80 - {}^+25 - {}^-25 = {}^+80$

Acknowledgments

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