Science (1999)

Years 1 to 10
Sourcebook Guidelines
(Part 7 of 8)

Note: The PDF version of this document has been split into sections for easier download. This file is Part 7 of 8.

Queensland Government
Queensland Studies Authority
Partnership and Innovation

Using the sourcebook modules

A module is a resource for teachers that provides learning and teaching ideas to assist students to develop and demonstrate understandings related to specified core learning outcomes. Science sourcebook modules contain activities, resource materials and information regarding assessment strategies, background and reference material to support the implementation of the Years 1–10 Science Syllabus.

The modules are not intended to be used as complete units or sequenced courses of study. Rather, they provide a selection of activities as a basis for teachers to develop customised units suited to the needs of their students. While useful in the order presented, activities in a module may be arranged in other sequences and combined with activities from other modules and sources. Teachers are encouraged to select and adapt activities and to sequence them in whatever way is most appropriate for their students. The policies of schools and school authorities will need to be considered in the adaptation and use of these activities.

In all modules, the focus is on:

- facilitating an outcomes approach to learning and teaching, with multiple opportunities for students to demonstrate the specified outcomes;
- offering a variety of ways for students to develop their conceptual understandings and practices and dispositions of 'working scientifically';
- promoting constructivist approaches to learning.

In keeping with an outcomes approach, activities in the modules provide opportunities for students to progress through the conceptual continua outlined in the syllabus. The modules, and the activities within them, are typically designed for two or three levels of learning outcomes. They allow students to demonstrate what they know and can do at the specified levels.

Activities in the Science sourcebook modules are written with particular core learning outcomes in mind. It is possible that activities could be altered to enable students to develop and demonstrate a variety of learning outcomes.

Modules and planning

Sourcebook modules assist planning by:

- providing teachers with specific guidance and activities to support students as they develop conceptual understandings and the practices and dispositions of 'working scientifically';
- indicating how students might demonstrate what they know and can do.

Teachers may use activities from a variety of modules to prepare units appropriate for their students.

There should be a clear link between learning outcomes, planning and assessment. This involves:

- planning assessment at the same time as planning activities;
- planning how activities can be utilised for ongoing assessment;
- establishing clear expectations of student performance;
- determining how student progress will be monitored;
- providing opportunities for students to demonstrate what they know and can do;
- using assessment to inform future planning and as an opportunity to learn.

Within an outcomes approach, it is essential that the intended outcomes of a unit are clearly stated for students. At the commencement of a unit teachers need to help students understand the unit's purpose and the ways in which particular learning outcomes can be demonstrated.

Each core learning outcome contributes equally to the Science key learning area. Notionally, the amounts of time allocated to the demonstration of each outcome are equal. The actual amounts of time used for the demonstration of specified outcomes will depend on a number of factors, including:

- the overall school program;
- the needs, prior knowledge and experience of students;
- resources available.

When planning units, teachers need to consider possible learning contexts as well as the prior knowledge, experience and learning needs of students. Teachers are encouraged to adapt activities and ideas from across the range of Science sourcebook modules so that the activities are inclusive of all students and meet individual needs. Meeting these needs may require flexible pathways and special equipment in some cases. A variety of ways of demonstrating an outcome, as well as numerous opportunities to do so, should be planned. Factors related to special needs and cultural and linguistic diversity may be significant issues in the teaching–learning process. In these situations, the teacher, student and relevant advisors should jointly plan ways of ensuring activities are supportive and accessible.

While different activities may have different emphases, it is important to ensure that in creating a unit, it incorporates the cross-curricular priorities in a manner inclusive of all students.

The key features of a typical module are highlighted and explained on the following pages.

Key features of modules

The first part of the Science sourcebook modules provides general information about the core learning outcomes and the core content incorporated in the module, as well as information on assessment.

It is intended that the assessment strategy section of each module provide teachers with an indication of the pattern of behaviour to look for when making judgments about students' demonstrations of the specified outcomes.

The list of typical demonstrations is not necessarily an exhaustive one. There are suggestions for gathering information within each activity; similar information may also be collected during activities not included in the module.

Activities in the modules are organised into three phases — **introductory**, **developmental** and **culminating**.

Introductory activities can serve a number of purposes. They may:

- elicit students' current knowledge and understanding in relation to the outcomes;
- arouse student interest;
- orientate students towards the intended outcome.

While it may be practical in some cases to proceed to developmental activities after just one introductory activity, it is possible that more than one will be required.

Developmental activities are intended to help students develop conceptual understandings and the practices and dispositions of 'working scientifically'. These activities also provide opportunities for students to demonstrate what they know and can do.

Culminating activities can serve a number of purposes. They may:

- complete a sequence of activities;
- draw together various parts of a unit into a cohesive whole;
- allow students further opportunity to demonstrate what they know and can do;
- provide a time and means for reflecting on the learning that has occurred and implications for future learning.

Key learning area

Band of schooling

Levels at which activities are directed. Dark shading indicates the principal focus; light shading indicates the secondary focus.

Title of the module

Strand(s) and key concept(s) on which the module is based

Explains the intention of activities in the module in terms of what students are expected to understand and be able to do.

Lists activities and shows the structure of the module.

SOURCEBOOK MODULE

SCIENCE

UPPER PRIMARY

Level

F	1	2	3	4	5	6	B6

Force and motion

Strand
Energy and Change

Key concept
The forces acting on objects influence their motion, shape, behaviour and energy.

Purpose

Activities in this module are designed to help students understand that there are different forces that affect the motion, behaviour and energy of objects, and that energy is transferred and transformed. Students have opportunities to:

- investigate how forces affect the motion and energy of particular objects;
- analyse the relationship between the forces applied to objects and their motion and energy;
- communicate their understandings of the relationship between the forces applied to familiar objects and the motion and energy of those objects.

Overview of activities

The following table shows the activities in this module and the way in which these are organised in **introductory**, **developmental** and **culminating** phases.

Introductory	Developmental	Culminating
Types of forces	Bouncing balls	Guided investigation: Force, energy and motion
Kinetic energy in toys	Making a flic flac	
	Friction	
	Swings and seesaws	
	Paper planes	

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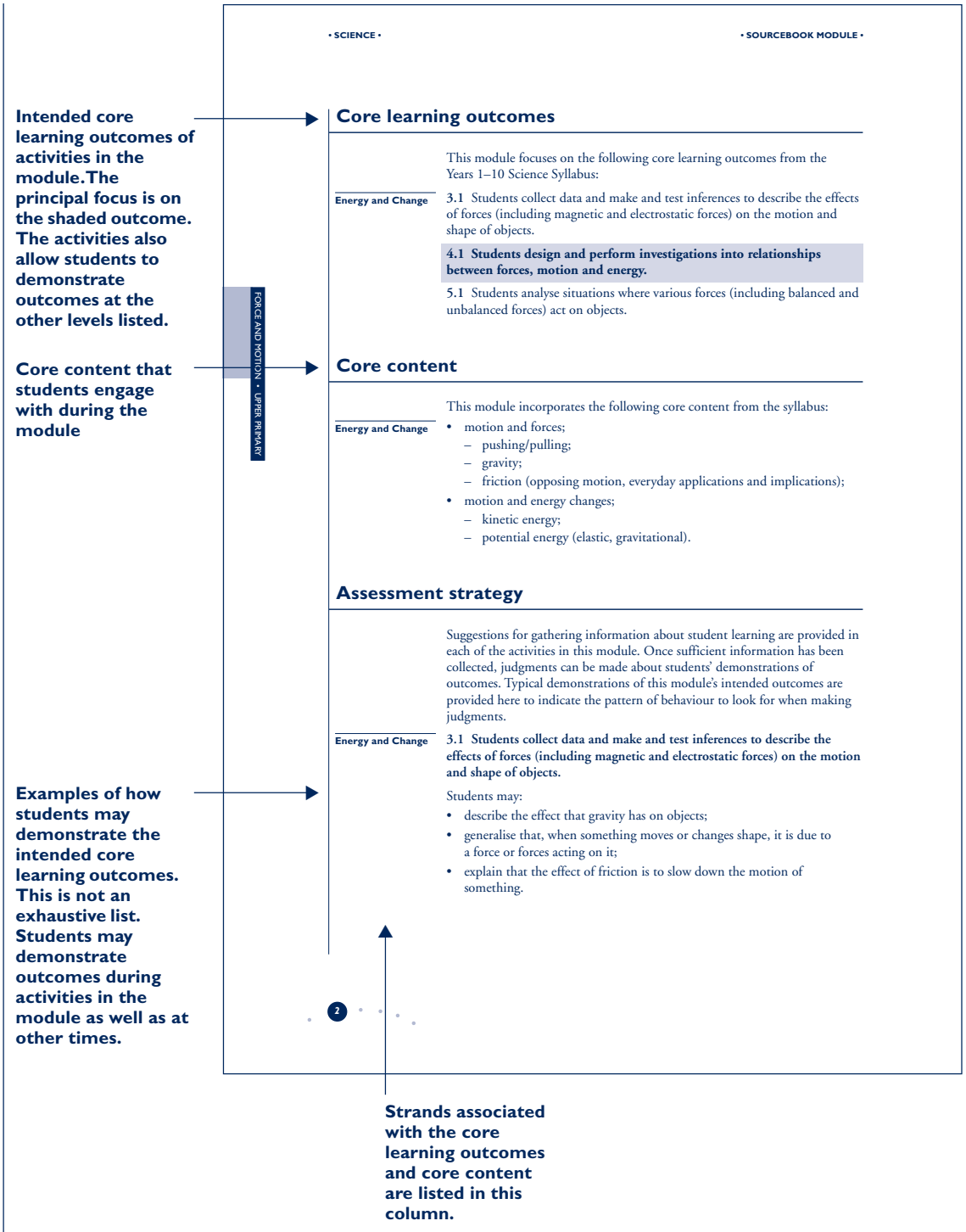
• SCIENCE •
• SOURCEBOOK MODULE •
Core learning outcomes
This module focuses on the following core learning outcomes from the Years 1–10 Science Syllabus:
Energy and Change
3.1 Students collect data and make and test inferences to describe the effects of forces (including magnetic and electrostatic forces) on the motion and shape of objects.
4.1 Students design and perform investigations into relationships between forces, motion and energy.
5.1 Students analyse situations where various forces (including balanced and unbalanced forces) act on objects.
FORCE AND MOTION • UPPER PRIMARY
Core content
This module incorporates the following core content from the syllabus:
Energy and Change
• motion and forces;
– pushing/pulling;
– gravity;
– friction (opposing motion, everyday applications and implications);
• motion and energy changes;
– kinetic energy;
– potential energy (elastic, gravitational).
Assessment strategy
Suggestions for gathering information about student learning are provided in each of the activities in this module. Once sufficient information has been collected, judgments can be made about students' demonstrations of outcomes. Typical demonstrations of this module's intended outcomes are provided here to indicate the pattern of behaviour to look for when making judgments.
Energy and Change
3.1 Students collect data and make and test inferences to describe the effects of forces (including magnetic and electrostatic forces) on the motion and shape of objects.
Students may:
• describe the effect that gravity has on objects;
• generalise that, when something moves or changes shape, it is due to a force or forces acting on it;
• explain that the effect of friction is to slow down the motion of something.
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Intended core learning outcomes of activities in the module. The principal focus is on the shaded outcome. The activities also allow students to demonstrate outcomes at the other levels listed.
Core content that students engage with during the module
Examples of how students may demonstrate the intended core learning outcomes. This is not an exhaustive list. Students may demonstrate outcomes during activities in the module as well as at other times.
Strands associated with the core learning outcomes and core content are listed in this column.

Energy and Change

4.1 Students design and perform investigations into relationships between forces, motion and energy.

Students may:

- explain that a force must be applied to an object before its motion can be changed;
- relate the motion (direction and speed) of an object to the forces acting on it;
- interpret that, when a force is applied to an object, energy is transferred or transformed;
- conclude that an object has energy if it has the ability to change the motion of another object;
- design and perform investigations that allow them to illustrate the relationships between the forces acting on an object, its energy and its motion.

Energy and Change

5.1 Students analyse situations where various forces (including balanced and unbalanced forces) act on objects.

Students may:

- analyse the effects of applying different amounts of force to an object;
- identify the relationships between variables which affect the motion of an object;
- explain the motion of an object in terms of a number of forces acting, such as air resistance and gravity.

Background information

Outlines current scientific understanding about concepts introduced in the module.

Current scientific conceptions

Force

A force is an influence that produces, or tends to produce, a change in the motion of an object. When there is a push, a pull, a bend, a twist, a turn, a squeeze, a tear, a lift, a stretch, friction or resistance, at least one force is being exerted.

A force can move something, make it go faster or slower, change its direction, stop it, or change its shape. Often, an object will be affected by a number of forces at once. If these forces are balanced, the object will be held in place and will keep its shape.

When a force is applied, energy can be transferred or transformed. **Transfer of energy** refers to the shifting of energy from one object to another. For example, a bowling ball with kinetic energy (energy of movement) hits the tenpins and gives them kinetic energy. **Transformation of energy** refers to the change from one form of energy to another. For example, electrical energy is transformed to light and heat energy when you switch on a light.

Presents some ideas and views students may have about the concepts.

Students' prior understandings

Students' prior understandings may differ from current scientific conceptions in a range of ways.

Force

Some students may:

- believe that the force of an object resides within the object rather than being an external effect. This may relate to the common belief that if an object is **not moving** there are **no forces** acting on it, and if an object **is moving** there **is a force** acting on it in the direction it is moving. This belief is incorrect. For example, if an object is stationary on the ground, gravity is acting downwards and a reaction force from the ground is acting upwards. If an object such as a toy car is given a push across a flat surface, there is initially a forward force acting on it; however, once it is allowed to move freely, there is no forward force. Friction exerts a force in the opposite direction to the object's motion and is the reason it eventually stops moving.
- believe that forces can be applied only by living things. Thus, they may realise that a human can apply a force but may not consider the effects of gravity or friction.
- be aware of one or several forces being exerted on an object but may not consider all forces. For example, students may realise that gravity is acting on a ball rolling down a hill but may not consider the effect of friction acting in the direction opposite to the motion of the ball.

Resource Sheet 1

Teachers can help students build on their prior understandings by asking them to discuss and reflect on everyday situations that involve forces. (Some examples of situations are provided on Resource Sheet 1.)

Energy

Some students may:

- use the terms 'energy transfer' and 'energy transformation' interchangeably;
- have heard about energy only in relation to food such as bread, breakfast cereals and sports drinks;
- not be aware of potential (stored) energy;
- believe that energy is associated only with living things or moving things.

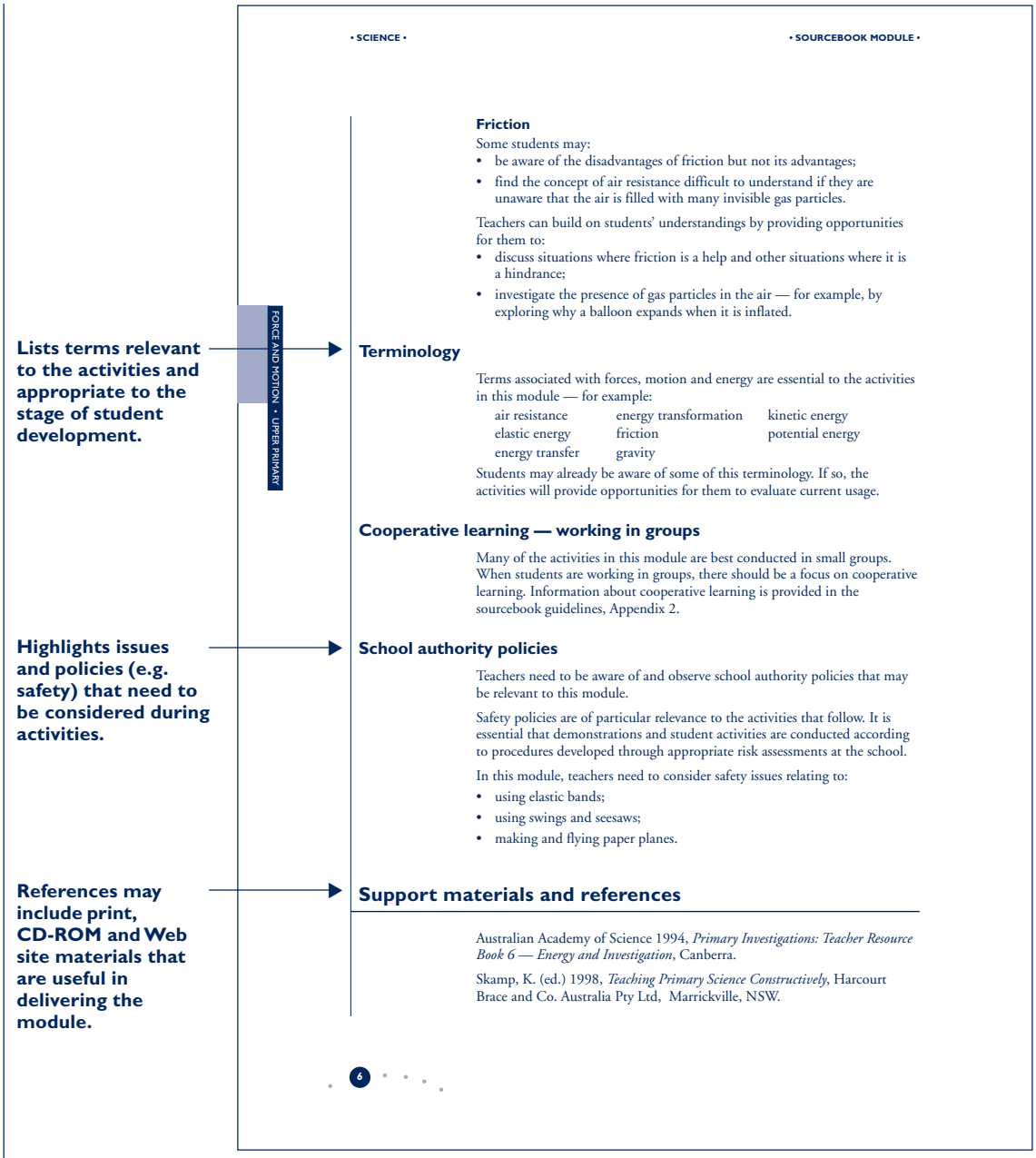
Teachers can enhance students' understandings by emphasising correct usage of the terms 'energy transfer' and 'energy transformation' and by providing opportunities for students to consider different forms of energy, including potential energy.

Gravity

Some students may:

- believe that the moon has no gravity when, in fact, it does. However, the effects of gravity on the moon are less than those on the Earth because the moon has a smaller mass.

Teachers can help students broaden their understandings by encouraging discussion about the relative effects of gravity on the Earth and on the moon.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Friction
Some students may:
• be aware of the disadvantages of friction but not its advantages;
• find the concept of air resistance difficult to understand if they are unaware that the air is filled with many invisible gas particles.
Teachers can build on students' understandings by providing opportunities for them to:
• discuss situations where friction is a help and other situations where it is a hindrance;
• investigate the presence of gas particles in the air — for example, by exploring why a balloon expands when it is inflated.
FORCE AND MOTION • UPPER PRIMARY
Lists terms relevant to the activities and appropriate to the stage of student development.
Terminology
Terms associated with forces, motion and energy are essential to the activities in this module — for example:
air resistance
elastic energy
energy transfer
energy transformation
friction
gravity
kinetic energy
potential energy
Students may already be aware of some of this terminology. If so, the activities will provide opportunities for them to evaluate current usage.
Cooperative learning — working in groups
Many of the activities in this module are best conducted in small groups. When students are working in groups, there should be a focus on cooperative learning. Information about cooperative learning is provided in the sourcebook guidelines, Appendix 2.
Highlights issues and policies (e.g. safety) that need to be considered during activities.
School authority policies
Teachers need to be aware of and observe school authority policies that may be relevant to this module.
Safety policies are of particular relevance to the activities that follow. It is essential that demonstrations and student activities are conducted according to procedures developed through appropriate risk assessments at the school.
In this module, teachers need to consider safety issues relating to:
• using elastic bands;
• using swings and seesaws;
• making and flying paper planes.
References may include print, CD-ROM and Web site materials that are useful in delivering the module.
Support materials and references
Australian Academy of Science 1994, *Primary Investigations: Teacher Resource Book 6 — Energy and Investigation*, Canberra.
Skamp, K. (ed.) 1998, *Teaching Primary Science Constructively*, Harcourt Brace and Co. Australia Pty Ltd, Marrickville, NSW.
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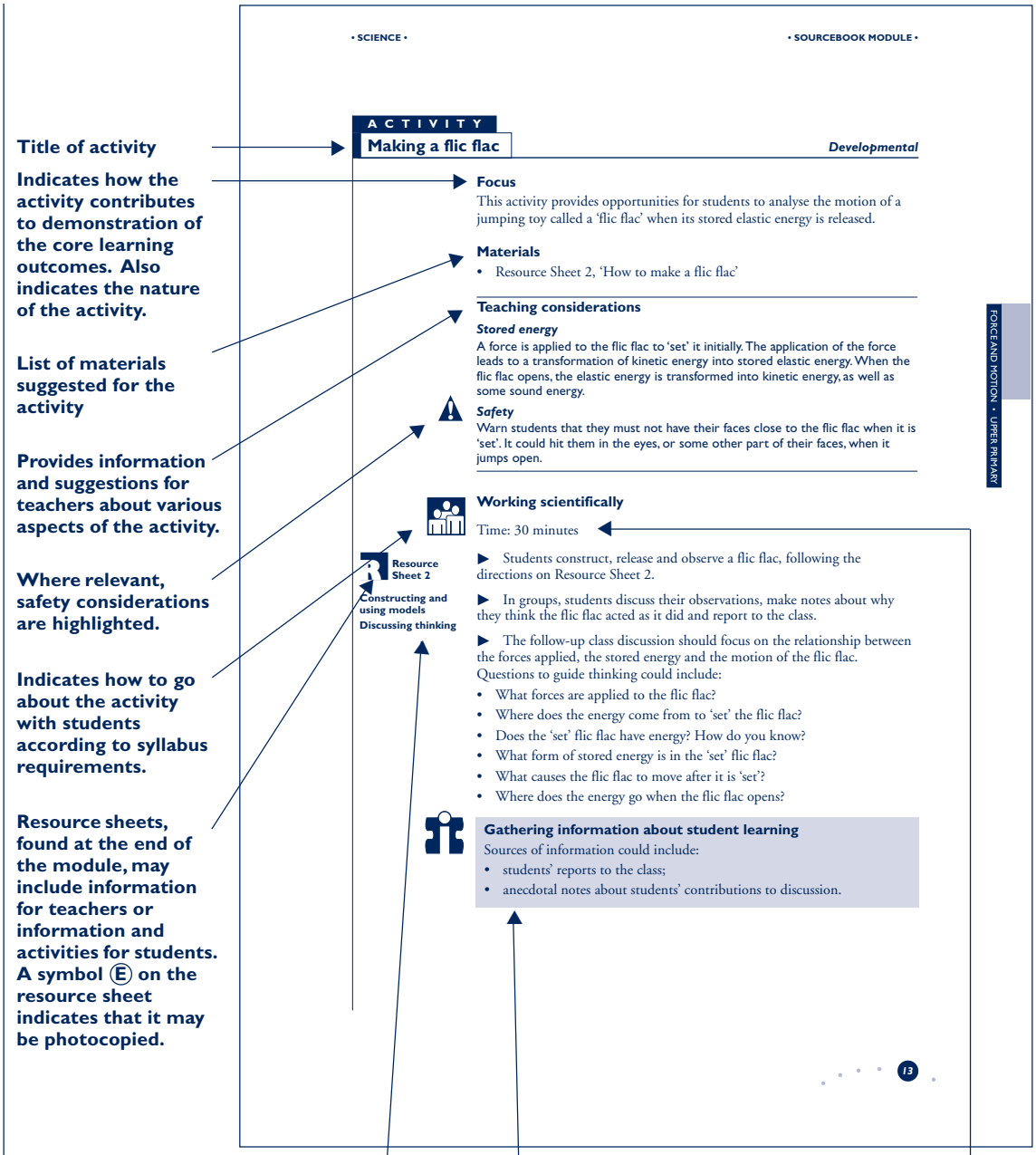
• SCIENCE •
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ACTIVITY
Making a flic flac
Developmental
Focus
This activity provides opportunities for students to analyse the motion of a jumping toy called a 'flic flac' when its stored elastic energy is released.
Materials
• Resource Sheet 2, 'How to make a flic flac'
Teaching considerations
Stored energy
A force is applied to the flic flac to 'set' it initially. The application of the force leads to a transformation of kinetic energy into stored elastic energy. When the flic flac opens, the elastic energy is transformed into kinetic energy, as well as some sound energy.
Safety
Warn students that they must not have their faces close to the flic flac when it is 'set'. It could hit them in the eyes, or some other part of their faces, when it jumps open.
FORCE AND MOTION • UPPER PRIMARY
Working scientifically
Time: 30 minutes
Resource Sheet 2
Constructing and using models
Discussing thinking
▶ Students construct, release and observe a flic flac, following the directions on Resource Sheet 2.
▶ In groups, students discuss their observations, make notes about why they think the flic flac acted as it did and report to the class.
▶ The follow-up class discussion should focus on the relationship between the forces applied, the stored energy and the motion of the flic flac. Questions to guide thinking could include:
• What forces are applied to the flic flac?
• Where does the energy come from to 'set' the flic flac?
• Does the 'set' flic flac have energy? How do you know?
• What form of stored energy is in the 'set' flic flac?
• What causes the flic flac to move after it is 'set'?
• Where does the energy go when the flic flac opens?
Gathering information about student learning
Sources of information could include:
• students' reports to the class;
• anecdotal notes about students' contributions to discussion.
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Title of activity
Indicates how the activity contributes to demonstration of the core learning outcomes. Also indicates the nature of the activity.
List of materials suggested for the activity
Provides information and suggestions for teachers about various aspects of the activity.
Where relevant, safety considerations are highlighted.
Indicates how to go about the activity with students according to syllabus requirements.
Resource sheets, found at the end of the module, may include information for teachers or information and activities for students. A symbol Ⓔ on the resource sheet indicates that it may be photocopied.
Components of 'working scientifically' that contribute to students' demonstrations of outcomes (listed in the order in which they appear in the syllabus)
Indicates the sources of information that could be used to make judgments about students' demonstrations of outcomes.
Time allocations are suggested for each of the activities in modules. Teachers may shorten or lengthen activities as necessary or divide them into smaller parts.