Introducing robotics

Strand	Organiser	Level						
		1	2	3	4	5	6	B6
Technology Practice	*Investigation*						■	
	Ideation						■	
	Production						■	
	Evaluation						■	
Information	*Nature*							
	Techniques						■	
Materials	*Nature*							
	Techniques						■	
Systems	*Nature*						■	
	Techniques						■	

Purpose

The activities in this module are planned to provide students with opportunities to build and program robotic devices using Lego™ Dacta equipment and Robolab™ software. Students work collaboratively with a partner to identify needs and wants and to generate possible design ideas.

Overview

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

Introductory	Developmental	Culminating
Formulate plans for gathering information and acquiring relevant skills. Research and discuss robotics. Follow instructions to build robots and use sample programs.	Analyse the design challenge and prepare project proposals and design briefs. Devise project management plans. Prepare product specifications. Construct and program a robot.	Trial and refine robotic devices. Evaluate robotic devices. Evaluate personal and team performances.

Core learning outcomes

This module focuses on the following core learning outcomes from the *Years 1 to 10 Technology Syllabus*:

Technology Practice

TP 6.1 Students formulate detailed plans for gathering knowledge, ideas and data and validate choices of information, sources and methods.

TP 6.2 Students generate design ideas and communicate these in design proposals that indicate various options and incorporate management strategies.

TP 6.3 Students negotiate and refine production procedures in making quality products that meet detailed specifications.

TP 6.4 Students identify methods for evaluating commercial or industrial products and processes and use these to judge the appropriateness of their own processes and products.

Information

INF 6.2 Students use specialised techniques for managing and organising the presentation of information to meet detailed specifications.

Materials

MAT 6.2 Students use specialised equipment and refined techniques to make quality products to detailed specifications.

Systems

SYS 6.1 Students explain principles underlying complex systems in terms of structures, control and management.

SYS 6.2 Students devise ways to manage and monitor the operation of complex systems.

Core content

The core learning outcomes are the focus for planning learning activities and assessment tasks. Students will engage with core content (see pp. 37–40 of the syllabus) when they are provided with opportunities to demonstrate core learning outcomes. While the content is listed in strands for organisational convenience, no one part of that content is to be viewed as discretely associated with a single strand.

The organisation of content within a strand should not be considered hierarchical. Any of the content can be addressed at any appropriate level; not all of the content need be addressed at every level. Core content should be selected to suit students' needs, interests and abilities and to take account of their prior knowledge and experiences.

The core content should be studied in a range of contexts. These could include personal and global contexts, as well as contexts of agriculture, business, communities, home and family, industry, leisure and recreation, and school.

Using this module

The activities in this module are designed to provide opportunities for students to demonstrate Level 6 core learning outcomes. These activities can also provide opportunities for students to develop and demonstrate the related learning outcomes at other levels. In order to do this, teachers will need to prepare additional sets of anticipated evidence derived from the related learning outcomes at different levels. They may also need to modify aspects of the activities.

This module includes a variety of sequenced activities requiring varying amounts of time. Teachers can modify the design challenge and related activities depending on the local contexts, particular needs and prior knowledge of students and the availability of materials and resources.

Advice to teachers

It is important that the storage and management of the Lego™ Dacta equipment is considered before commencing the project. Efficient and effective routines for setting out and packing up equipment must be developed and communicated to the students.

Ensure an adequate supply of batteries is available for the project. Students need to be reminded that batteries should be removed one at a time so that the firmware on the RCX programmable brick is maintained. Students should notify others in their vicinity when downloading programs using the infrared transmitter (IRT). Other students should ensure their RCX programmable brick is turned off so that programs are not accidentally transferred to their robots.

Resources

Students' creativity in demonstrating core learning outcomes in this module should not be limited by the range and scope of resources and equipment provided by the teacher. A variety of resources should be collected over time and should be safely stored and made available to students as required.

This project is based on the use of Lego™ Mindstorms equipment and Robolab™ Version 2 software. The Robolab™ software is suitable for use on either IBM-compatible or Macintosh computer systems. Robolab™ software includes Pilot and Inventor phases. Robolab™ Inventor includes four levels and is suitable for use by secondary students. More command icons become available at each level.

Evaluation of a unit of work

After completion of a unit (or units) of work developed from this module, teachers collect information and make judgments about:

- teaching strategies and activities planned or selected to allow students to demonstrate the core learning outcomes
- future learning opportunities for students who have not yet demonstrated the core learning outcomes and to challenge and extend those students who have already demonstrated the core learning outcomes
- the extent to which activities matched needs of particular groups of students and reflected equity considerations
- the appropriateness of time allocations for particular activities
- the appropriateness of resources used.

Information from this evaluation process can be used to plan subsequent units of work to support future student learning. The evaluated units of work may also be adapted prior to their reuse. For further information, refer to the 'Curriculum evaluation' section of the sourcebook guidelines.

Links

Links to other key learning areas

Activities from this module can be used as part of an integrated unit that makes links to other key learning areas. When incorporating this module into an integrated unit of work, teachers can select activities that provide opportunities for students to demonstrate learning outcomes from other key learning areas and identify anticipated evidence of students' demonstrations of these learning outcomes. It is important, however, that the integrity of the processes and concepts within key learning areas is maintained.

This module has links to the Science key learning area.

Contributions to the cross-curricular priorities

This module contributes to students' development of the cross-curricular priorities:

- **literacy**, as students present investigation plans, conduct research, develop and present design proposals, design briefs, product specifications and project management plans
- **numeracy**, as students experiment with shapes and forms in developing robot designs
- **lifeskills**, as students work cooperatively to manage a research and development project
- **a futures perspective**, as students envision, produce and trial a robot to undertake specific tasks.

The valued attributes of a lifelong learner

The overall learning outcomes of the Queensland Years 1 to 10 curriculum contain elements common to all key learning areas and collectively describe the valued attributes of the lifelong learner. The following points indicate how various activities in this module might contribute towards the development of these attributes.

Knowledgeable person with deep understanding

- extends knowledge and conceptual understandings of technology practice, information, materials and systems as robotic devices are designed, developed and evaluated
- considers aspects of appropriateness when designing and developing robots.

Complex thinker

- uses programming software to develop programs to control robots
- incorporates the programming constructs of sequence, selection and iteration in these programs.

Active investigator

- uses research skills to develop a basic understanding of robots, their uses and the advantages and disadvantages that arise from this use
- uses a variety of resources to gather ideas for the development of robotic device.

Responsive creator

- designs and creates robots and programs to control them.

Effective communicator

- communicates design ideas both verbally to team members and in written proposals that include annotated drawings and appropriate terminology
- provides a written evaluation of products and the processes used in the development of robots.

Participant in an interdependent world

- works independently and collaboratively
- acknowledges the design ideas of others
- negotiates with others to share equipment and resources.

Reflective and self-directed learner

- evaluates robots and their performances and considers ways in which these products can be improved
- reflects on technological processes and practices by considering the management of people, time and resources during the project.

Assessment strategies

The assessment opportunities outlined are examples of how to assess students' demonstrations of the identified learning outcomes. As often as possible, negotiate assessment with students and support a variety of ways of demonstrating the learning outcomes. Reflect with students on evidence gathered when making judgments about their demonstrations of learning outcomes. Some students may require more time and/or other contexts in which to demonstrate these learning outcomes. Other modules may provide such time and/or contexts.

Suggestions for gathering information about student learning are provided in the activities section of this module. The table below provides descriptions of anticipated evidence that teachers might gather to support their judgments about students' demonstrations of learning outcomes and suggests sources of evidence. The table is neither exhaustive nor mandatory. Once sufficient evidence has been collected, judgments can be made about students' demonstrations of learning outcomes. *[This table spreads over two pages.]*

Core learning outcomes	Anticipated evidence	Sources of evidence
TP 6.1 Students formulate detailed plans for gathering knowledge, ideas and data and validate choices of information, sources and methods.	Plan and undertake research (using a variety of resources) to develop understandings about robotic devices, their uses and impacts. Use a range of sources to investigate robotic models and use the information to inform design ideas.	Technology project folios: • investigation plans. • project introductions on robotics. Anecdotal records: • observations of the students' participation in discussions.
TP 6.2 Students generate design ideas and communicate these in design proposals that indicate various options and incorporate management strategies.	Work collaboratively to generate design ideas for their robot. Present their selected design as a labelled diagram that incorporates the use of appropriate technical terms. Produce a project management plan that incorporates key project tasks and reflects consideration of people and resource and time constraints.	Technology project folio: • design proposals. • design briefs. • product specification sheets. • project management plans. Anecdotal records: • observations of the students' participation in discussions. • individual and team interview records.
TP 6.3 Students negotiate and refine production procedures in making quality products that meet detailed specifications.	Negotiate production procedures through effective communication. Monitor the quality of the robot and the effectiveness of the control programs to inform refinements to production procedures.	Anecdotal records: • observations of students communicating, collaborating and negotiating as they develop production procedures.
TP 6.4 Students identify methods for evaluating commercial or industrial products and processes and use these to judge the appropriateness of their own processes and products.	Identify the features of an effective robotic device. Specify performance criteria. Provide a comprehensive evaluation of their robotic device and its performance. Evaluate personal and team performance in terms of communication, problem solving, management and use of time and resources.	Technology project folios: • product evaluations. • personal and team performance evaluations.
INF 6.2 Students use specialised techniques for managing and organising the presentation of information to meet detailed specifications.	Gather, select, organise and present information relevant to the robotics project. Use, for example, project management, CAD and flowchart software and digital cameras to present ideas.	Technology project folios: • project introduction on robotics. • appropriate use of digital photographs, flowcharts, diagrams and technical language in product specifications.

MAT 6.2 Students use specialised equipment and refined techniques to make quality products to detailed specifications.	Use specialised materials and equipment to build robotic devices to their design specifications.	Technology project folios: • detailed lists of the parts used to make their robotic devices. • rationales for selection of materials. Anecdotal records: • observations of the students' participation in discussions.
SYS 6.1 Students explain principles underlying complex systems in terms of structures, control and management.	Include a general explanation of robotic devices and their common features in their research report on robotics. Provide a step-by-step description of the proposed programs, including inputs used, processing and outputs produced.	Technology project folio: • project introductions on robotics. • descriptions and flowcharts of control programs.
SYS 6.2 Students devise ways to manage and monitor the operation of complex systems.	Plan and implement programs to control their robotic device. Coordinate the operation of the computer system and the robotic system to allow successful download of programs to the RCX brick in the robot via the infrared transmitter.	Technology project folio: • descriptions and flowcharts of control programs. • control program printouts. • annotations about refinements to the control programs. Anecdotal records: • observations of trials of the robotic devices. • demonstrations of the robotic devices.

Background information

Terminology

In this module, students have opportunities to become familiar with and use the following terminology:

command	input ports	robot
downloading	investigation	robotic device
effectors	modifiers	sensor sequence
evaluation	multitasking	software development cycle
firmware	output	string
icons	output ports	stringing
ideation	processing	structures
infrared transmitter (IRT)	production	system
input	RCX programmable brick	task

School authority policies

Teachers need to be aware of and observe school authority policies that may be relevant to this module.

Safety policies will be of particular relevance to some of the activities that follow. It is essential that teacher demonstrations and student activities are conducted according to procedures developed through appropriate risk assessments at the school.

In this module teachers may need to consider safety issues relating to:

- computers and electrical safety procedures — for example, connecting and disconnecting peripheral devices such as infrared transmitters and digital cameras
- searching the Internet.

Equity considerations

This module provides opportunities for students to increase their understanding and appreciation of equity and diversity within a supportive environment. It includes activities that encourage students to:

- be involved in the investigation of robotic devices
- work individually or in groups to design, construct and program a robotic device
- value diversity of ability, opinion and experience in selection options and envisioning designs for robotic devices
- value diversity of language and cultural beliefs in assessing appropriateness of robotic applications
- support one another in their efforts
- become empowered to communicate freely
- negotiate and accept changes to designs, robotic devices and control programs.

It is important that these equity considerations inform decision making about teaching strategies, classroom organisation and assessment.

Some students with disabilities may need assistance with some activities. Advice should be sought from their support teachers.

Activities

Introductory activities

Focus

The introductory activities focus on introducing the design challenge, and providing opportunities for students to develop information and skills that are relevant to the task. Students prepare a design brief that describes the parameters of the project.

Design challenge

Work collaboratively to design and build a robotic device based upon a programmable RCX brick and using Lego™ Dacta construction pieces.

Use touch and/or light sensors to provide inputs, and motors, lights and/or built-in sounds to provide outputs.

Use Robolab™ software to devise two programs to control your robot. The first program should include a sequence of events and the use of timing. The second program must be more complex and should include structures such as forks, task splits, loops and jump/land icons.

Teaching considerations

Activities 1 to 3 are intended to provide opportunities for students to develop understandings about current uses and future potential of robotics. Students are introduced to robotics through:

- class discussion about, and research into, the nature of robotic systems
- experimenting with Lego™ Dacta and Robolab™ Inventor or similar materials and software.

Resources

Student resource 1 and Technology project folios.

Articles, books or videos about robotics.

Lego™ Dacta or similar materials, including the programmable brick, touch and light sensors, motors and micro-motors, lights, built-in sound capability and general construction pieces and the Lego™ Dacta introductory video.

Access to computers with Robolab™ Inventor or similar software and word processing software.

Activity 1

Formulate plans for gathering information and acquiring relevant skills

Technology Practice (Investigation), Information, Systems

Provide students with Student resources 1 and 2 and explain the requirements of the project. Remind students to maintain a project log in their Technology project folios.

Provide time for students to form teams and discuss the project. Encourage students to discuss what they already know and can do, and what they need to know and be able to do to complete the project. Students consider how they might obtain useful information and skills.

Ask the teams to draft plans for gathering information and developing skills that are relevant to the project. Encourage them to investigate applications of robotics in various settings — for example, agricultural, industrial, medical, scientific and household applications. Interview each team and provide advice about including, for example, justifications for their selection of sources and forms of information and details of their proposed methods of investigation.

Activity 2

Research and discuss robotics

Technology Practice (Investigation), Information, Systems

Show students photographs of robotic devices and relevant material produced by other students. Discuss the inputs, processes and outputs of the examples.

Provide students with sources of information they can use to begin their research — for example, introductory reading on robotics and the URLs of some suitable websites. Draw attention to the questions provided on Student resource 1 to guide their research.

Explain that the information gathered will be used to prepare a one-page, word-processed introduction for their project. Remind students to keep their research notes and supporting illustrations in their Technology project folios.

[Introductory activities continues on the next page.]

Activity 3

Follow instructions to build robots and use sample programs

Technology Practice (Investigation), Production, Systems

Show students a video that demonstrates how to prepare the RCX for use. Discuss class management of equipment. Change the RCX batteries if necessary. Provide time for the students to build standard models using the instructions provided with the Lego™ kits.

Introduce the basic skills required to use Robolab™ Inventor software. Demonstrate and/or discuss a range of the Robolab™ sample programs. Provide time for students to work through a selection of exercises from the Robolab™ 'Getting Started' guide. Demonstrate how to download a program from the computer to the RCX programmable brick using the IRT and allow students to download and use programs. Encourage students to record notes in their Technology project folios.

Activity 4

Analyse the design challenge and prepare project proposals and design briefs

Technology Practice (Investigation)

Outline the requirements of the design challenge and ask teams to prepare a draft project proposal. Explain that the proposal must identify the type of robotic device that will be produced and describe the two tasks the robot will be programmed to perform. Provide time for groups to:

- re-examine sample projects and use the Internet or other sources to gather ideas
- negotiate the purpose and proposed users of the robotic device
- discuss and develop their draft project proposals.

Meet with each team to discuss and provide feedback on their draft proposal.

Students work individually to prepare a formal design brief. Explain that the design brief should define the challenge. Each brief should:

- identify the product's purpose and proposed users
- provide a rationale for, and description of, a proposed solution
- specify possible criteria for evaluating the product and its performance.

Provide time for the team to discuss and define the challenge and for each student to prepare a formal design brief.

Provide feedback on each design brief and ask students to refine their work based on this feedback. Remind students that their final copy of the design brief must be word processed and kept in their Technology project folios.

Assessment

Sources of evidence could include:

- observations of students' participation in discussions and activities
- investigation plans and research reports on robotics in Technology project folios
- design briefs.

Developmental activities

Focus

The design challenge is the focus of the developmental activities. Students work in project teams to prepare a project proposal and undertake the design challenge.

Teaching considerations

This project provides opportunities for students to use a range of software applications, including project management, CAD and flowchart software. If the students are unfamiliar with these applications, additional time will need to be spent demonstrating the programs and allowing students to become familiar with them.

Resources

Student resources 1 and 2 and Technology project folios.

Lego™ Dacta or similar materials, including the programmable brick, touch and light sensors, motors and micro-motors, lights, built-in sound capability and general construction pieces and the Lego™ Dacta introductory video.

Access to computers with Robolab™ Inventor or similar software and word-processing software, CAD, flowchart and project management software.

Activity 5

Devise project management plans

Technology Practice (Ideation, Production)

Provide students with copies of Student resource 2. Ask teams to prepare project management plans that reflect consideration of time and resource constraints. Encourage students to use project management software if it is available.

Students should include a copy of their management plan in their Technology project folios. Remind them that they will need to revise their plan at strategic points in the project, and annotate the plan with changes.

Activity 6

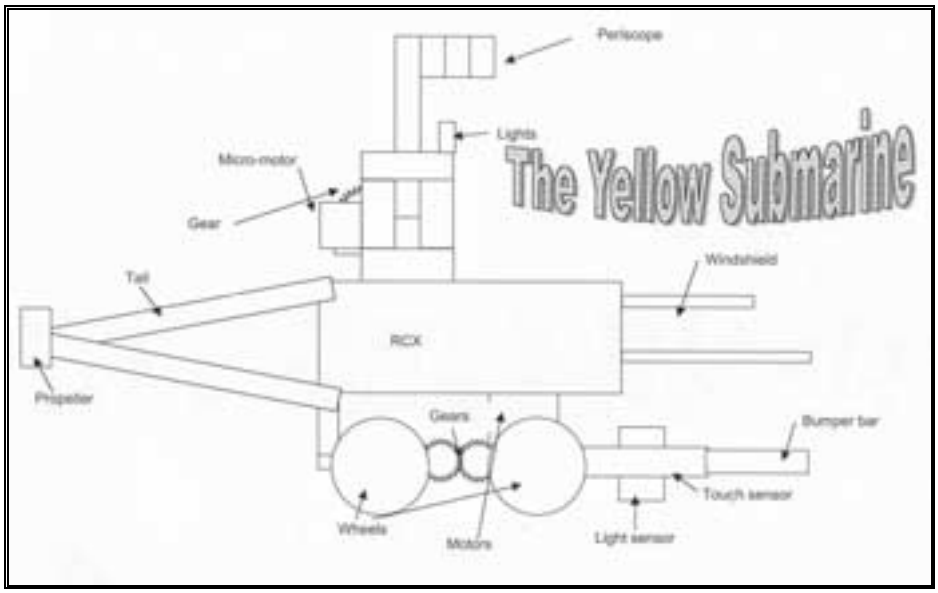
Prepare product specifications

Technology Practice (Ideation), Information

Students work individually or in pairs to generate a range of ideas for robotic devices that meet the requirements of the design brief. Further research or experimentation might be required.

Students meet with their teams to discuss the range of ideas generated, select a preferred option or options and prepare a product specification. Refer students to Student resource 1 for information to guide their preparations of the product specification sheet.

The product specifications should included labelled drawings or diagrams. Where possible, encourage students to use a CAD package to prepare their designs. Add the product specifications to the Technology project folios.



In their product specifications, students should describe the intended purposes of their control programs and prepare flowcharts to represent them.

Remind students to add their drawings, CAD representations and flowcharts and draft code to their Technology project folios. Before trying to prepare flowcharts to represent their own control programs, students should have opportunities to:

- step through the control programs available with Robolab™ Inventors package
- identify steps and subroutines in the programs
- represent the steps and subroutines using flowcharts.

[Developmental activities continues on the next page.]

Activity 7

Construct and program a robot

Technology Practice (Production), Evaluation

Provide lab sessions for students to build their robot using the Lego™ Dacta equipment and develop the control programs using the Robolab™ software.

Before preparing code for their own control programs, students should examine the formatting of the control programs available with Robolab™. Explain that by using consistent formatting, students can improve the readability of their code.

Discuss issues related to management of the materials and equipment and personal safety. Negotiate guidelines for sharing and managing the materials and equipment and ensuring personal safety.

Students record their progress in their Technology project folios. They make notes about the constraints of the materials, equipment and software and how these might be overcome and describe their solutions to problems they encounter. Students might also revise their evaluation criteria as their understanding of robotics develops.

Students review their project management plan at the end of each session to determine if they are on schedule and make adjustments where necessary.

Assessment

Sources of evidence could include:

- team design proposals and individual design briefs
- group project management plans
- product specifications including descriptions and diagrams of the device and its proposed control programs
- anecdotal records — observations of students:
  - communicating, collaborating and negotiating as they work on the project
  - using software and special equipment to create and control robots.

Culminating activities

Focus

During the culminating activities, students trial, evaluate and refine their robotic devices and control programs.

Teaching considerations

If students are unfamiliar with evaluation techniques, provide additional resources and activities to support their understanding. Collect examples of product evaluation reports and performance reports prepared by other students. Discuss these with students and display them for future reference.

Resources

Examples of product evaluation reports and performance reports.

Lego™ Dacta or similar materials, including the RCX programmable brick, touch and light sensors, motors and micro-motors, lights, built-in sound capability and general construction pieces and the Lego™ Dacta introductory video.

Access to computers with Robolab™ Inventor or similar software and word processing software.

Technology project folios.

Activity 8

Trial and refine robotic devices

Technology Practice (Evaluation)

Students:

- download the control programs to the programmable brick and test their robotic device
- modify the robotic device and/or revise the control programs if necessary
- revise their designs to match the modified robotic device
- prepare a detailed list of components used to construct the robot
- print the code for the two control programs
- photograph the robotic device using a digital camera
- add the photographs, program printouts and list of parts to their Technology project folios.

Activity 9

Evaluate robotic devices

Technology Practice (Evaluation), Information

Students:

- refine the evaluation criteria specified in their design briefs
- demonstrate the robot to other class members and gather feedback
- devise ways to evaluate their robotic device based on the evaluation criteria
- undertake a product evaluation of their robotic device
- prepare a product evaluation report and include it in their Technology project folios.

The product evaluation should use specific criteria and should consider the qualities of an effective robot and the aesthetic and functional aspects of appropriateness. Feedback from the demonstration can be used to supplement the evaluation. Product evaluation reports should specify the criteria and methodology used and summarise the results.

Activity 10

Evaluate personal and team performances

Technology Practice (Evaluation)

Students evaluate their personal and team performances. Encourage them to identify both strengths and areas that require improvement.

Students should consider the requirements of effective teamwork and efficient project management. They should devise specific criteria for judging and improving personal and group performances.

Performance reports, including evaluations of personal performance, teamwork and project management, should be included in their Technology project folios.

Assessment

Sources of evidence could include:

- product evaluation reports
- performance reports
- anecdotal records — observations of students as they trial, refine and evaluate their robotic devices.

Robotics project description

Student resource 1

Name:_____ **Class:**_____

Design challenge

Work collaboratively to design and build a robotic device based upon a programmable RCX programmable brick and using Lego™ Dacta construction pieces.

Use touch and/or light sensors to provide inputs, and motors, lights and/or built-in sounds to provide outputs.

Use Robolab™ software to devise two programs to control your robot. The first control program should include a sequence of events and the use of timing. The second control program must be more complex and should include structures such as forks, task splits, loops and jump/land icons.

Technology Practice involves ideating, investigating, producing and evaluating. These processes are also essential to the software development cycle. In this task, you will ideate, investigate, produce and evaluate as you work collaboratively to build and program robotic devices using Lego™ Dacta equipment and Robolab™ software.

You will need to keep aspects of your project submission in a Technology project folio as you work. Assessment will be based on your teacher's observations and analysis of your Technology project folio.

Preparing your submission

Essential items for your submission include:	**Draft**	**Final**
Investigation plan — generated collaboratively		☐
Project introduction about robotics — generated individually		☐
Project proposal — generated collaboratively	☐	☐
Design brief — generated individually	☐	☐
Project management plan — generated collaboratively		☐
Product specifications— generated collaboratively	☐	☐
Project log describing production activities such as building, programming, trialling and refining your device — generated individually		☐
List of materials used — generated individually		☐
Photographs of your device — generated individually		☐
Printouts of control programs — generated individually		☐
Product evaluation — generated individually	☐	☐
Personal and team evaluation — generated individually.	☐	☐

At the end of the project:

Check all your written work for spelling, grammar, punctuation, referencing and accuracy of information.
Your work should be prepared using a word-processing program. Use the spelling and grammar checks. Print a draft copy and proofread it for errors that computer spelling and grammar checks do not pick up and for consistency of style and layout.

☐ *Use the project checklist to ensure your submission is complete.*

Technology practice: Investigation

To help you develop understandings about robotics and prepare for the project task, you will need to develop an investigation plan, research the potential uses of robotic devices, negotiate a project proposal, develop a design brief and experiment with robotic equipment and software.

Developing an investigation plan

In teams, discuss what you already know and can do, and what you need to know and be able to do to complete the project. Consider how you might obtain useful information and skills.

Draft a plan for gathering information and developing skills that are relevant to the project. Present your plan to your teacher and incorporate any suggestions for improvement. Include justifications for your selection of sources and details about the types of information and skills you need and the investigation methods you intend to use. As you work through the project, add information from your research and experimentation to your Technology project folio.

Researching robotics

Use a range of sources to research aspects of robotics. Use the results of your research to write the 'Introduction' section for your project report. A minimum of one word-processed page is required. Use the following questions to guide your research:

- What is a robotic device?
- What features do robotic devices have in common?
- What are some examples of robotic devices (including everyday ones)?
- What are some of the benefits/advantages of using robotic devices? (Think about how and where robots can be used.)
- What are some of the ethical issues related to using robotic devices?

Experimenting with robotic equipment and software

Spend time using the Lego™ Mindstorms set to build standard models. Try some of the sample programs. These experiences should provide ideas about the types of devices you might include in your project. Looking through the Teacher's Guides and visiting the Lego™ website will also help.

Negotiating a project proposal

Hold a team meeting to clarify your project proposal. The proposal should include information about the type of robotic device you intend to build, its inputs and outputs and the kinds of tasks it will perform. Discuss your proposal with your teacher and obtain approval before you begin the project. Add the approved proposal to your Technology project folio.

Developing a design brief

Generate a design brief from your approved proposal. Discuss the design brief as a team, but write it up individually. Team members should not submit identical design briefs. The design brief is a formal document and should be written without the use of personal pronouns such as we, our, I or my. Submit your draft design brief to your teacher for feedback and then prepare a final copy that incorporates any suggestions for improvement. Add your draft and final copies to your Technology project folio.

Your design brief should be three or four paragraphs long and should include:

- information about the intended users — Who will use the device?
- information about the purpose of the robotic device — What need or want will the device meet?
- information about the functions of the robotic device — How will the device be used? What tasks will it perform?
- a rationale for developing the robotic device — Who will benefit? How?
- information about its limitations or constraints.

Technology practice: Ideation

Project management plan

An example of a project management plan has been provided (Student resource 2). Work as team to add details about how you plan to manage your project. As the project progresses, record the activities you undertake each day (both in and out of class) in a daily project log.

Product specifications

Prepare detailed product specifications that describe your robotic device and outline the proposed control programs. Submit a draft for feedback before preparing a final copy. Your product specification should include:

- a description of the purpose and functions of the robotic device
- a brief paragraph that describes the equipment that will be used to build the robotic device and the software that will be used to control it
- a diagram of the proposed robot that is labelled using appropriate technical language and depicts features such as the RCX brick, motors, sensors, wheels and gears
- a detailed (step-by-step) description of two or more control programs that you intend to develop for the robotic device. The first should include a sequence of events and the use of timing. The second program must be more complex and should include structures such as forks, task splits, loops and jump/land icons.
- proposed criteria for evaluating the robotic device.

Technology practice: Production

Build and program a robotic device

Now it's time to implement your proposal — to build your robotic device and program it. Make sure you:

- document your progress in your Technology project folio
- list the parts you used to build your robotic device
- print the control programs you have developed
- use the digital camera to photograph your final model from at least two different views.

Technology practice: Evaluation

Product evaluation

Examine your robotic device and refer to your product specifications. Refine the evaluation criteria. Prepare a product evaluation that:

- indicates how well your robotic device and control programs met the evaluation criteria
- describes modifications you have made as you built and programmed your device and provides reasons for the modifications
- lists desirable features of robotic devices and evaluates whether your device has these features
- provides examples to illustrate what you think you did well
- proposes improvements to your robotic device or control programs.

Personal and team performance evaluation

Consider the team performance.

- Were the team member's communication and negotiation strategies effective? Why or why not?
- Was each part of the task completed in the time allocated?
- How was the project management plan modified? Why?
- Consider your personal performance.
- How well did you understand the project?
- Were you always on task?
- How did you solve problems?
- What was your contribution to the team?
- What were your strengths? What were your weaknesses?
- Did you communicate well with other students in your team?
- What would you do differently next time?

Example project management plan

Student resource 2

Student names:

	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Personal time
Week 1	Analyse the project requirements. Form project teams. Formulate plans for gathering information and acquiring skills relevant to the project.	Introduction to Lego™ Dacta. Demonstrate and explain the management and use of Lego™ Dacta equipment.	Build robots from kit instructions and use sample programs.	Build robots from kit instructions and use sample programs.	Research and discuss robotics.
Week 2	Introduction to Robolab™ Inventor software. Discuss examples and demonstrate how to download programs.	Try the programming activities in the 'Getting Started' manual.		Explore programming constructs — sequencing, selection and iteration; insert links to Robolab™ icons and program layout.	
Week 3	Begin work on project.			Submit your project introduction, project proposal, design brief and project management plan.	
Week 4				Submit your product specifications.	
Week 5					
Week 6					
Week 7	Robotics presentations.	Robotics presentations.	Robotics presentations.	Submit your submission (Technology project folio).	

Acknowledgments and support materials

Acknowledgments

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References

Print

Savage, K. 1999, *Applied IT*, 2nd edn, Toowoomba Education Centre, Qld. (This resource has an introduction to robotics on pp. 278–283.)

A variety of print material associated with the Lego™ equipment and Robolab™ software is also available:
The Lego Dacta Robotic Systems Concept Guide
Robolab Getting Started — Teacher's Guide for Robolab Software

See websites below for details.

Websites

(All websites listed below were last accessed in October 2002.)

Information about Lego™ equipment and software including sample designs and programs

Lego Mindstorms,
www.mindstorms.lego.com/

Lego Robolab,
http://www.lego.com/dacta/robolab/default.htm

Educational Experience,
www.edex.com.au/ideas/lego/

Tufts University,
www.ceeo.tufts.edu/graphics/robolab/intro.htm

Information about robotics

Arrick Robotics
www.robotics.com
Extensive information about robotics.

The Tech Museum of Innovation
www.thetech.org/robotics/
On-line museum exhibition of robotics materials.

UWA Robotics Group, Telerobot

http://telerobot.mech.uwa.edu.au/
An Australian-based website that allows users to interact with an online robot.

This sourcebook module should be read in conjunction with the following Queensland Studies Authority materials:

Years 1 to 10 Technology Syllabus

Years 1 to 10 Technology Sourcebook Guidelines

Technology Initial In-service Materials

Technology CD-ROM

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