How to succeed in the Student Research Project

2001 edition

A guide for students ... (and teachers)

A booklet developed by the Science Teachers' Association of NSW, with the support of the Science Unit, Curriculum Support Directorate, NSW Department of Education and Training.

NEW SOUTH WALES DEPARTMENT OF EDUCATION AND TRAINING

How to succeed in the *Student Research Project*

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This booklet is designed for students to assist them with their Student Research Project. Teachers may photocopy it for use in their classrooms. Teachers are reminded that all Student Research Projects are eligible as entries in the *Intel® Young Scientist Awards.* All students will receive a Certificate of Participation. Only the best school entries are sent for state judging. See *Intel Young Scientist* brochure for more details on entry criteria.

More Information

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Information for Teachers

The NSW Stages 4-5 Science Syllabus requires students to complete at least one **Student Research Project (SRP)** in each of Stages 4 and 5.

Below are suggested roles to support both the teacher and student in managing the project. It is not the only approach you can take, but it may suggest ideas for the involvement during the project.

Role of Teacher	***Role of Student***
Prepare for the SRP by: • conducting simple problem solving activities • teaching investiagtion skills • displaying a range of common and topical problems and possible solutions. Introduce the task by providing written and oral instructions, stimulus material, models of projects and time lines.	Develop knowledge and skills in problem solving and in conducting fair tests. *Refer to pages 9, 10, 11 & 12 for more details on the skills.* Think about the project. Start a log book or process diary. Express areas of interest and potential problems or issues.
Provide support as students decide on a problem or area to investigate.	Ask questions to clarify the task. Discuss the project with friends and family.
Explain criteria used to assess work.	Research ideas.
Approve student problems/research topics.	Refine a statement to describe a problem and negotiate approval of teacher.
Provide support and resources. Suggest areas for background research.	Develop a plan for the project.
Approve student plans.	Refine the plan and negotiate approval of teacher.
Provide processes for ordering of equipment and completing experiments.	Negotiate time and resources to run experiments.
Assess progress and provide constructive feedback.	Provide a progress report to your teacher. Refine project from feedback.
Provide support for analysis of results.	Analyse data collected.
Provide models of presentation.	Write a report.
Establish a conducive environment for the evaluation and editing of reports.	Seek peer review of your draft report.
	Submit your final report.
Assess and provide feedback.	
Use results at school level. Select and submit best 10 projects for Intel® Young Scientist Awards. Have a school award ceremony.	Refine your project as required for inclusion in other award schemes.

Where do I start?

First of all, **don't panic**!

The Student Research Project **(**SRP**)** is an investigation that needs to be carried out as part of your science course. It has been designed so you can demonstrate to your teacher and to your fellow students your skills in planning and carrying out investigations, solving problems, communicating ideas and how you respond to constructive evaluation from your peers. Once you have completed your project you will be an expert in your chosen area. By sharing your findings with the rest of your class, you will be able to pass on the valuable information you have discovered.

During Stage 4 (Years 7&8), your teacher may allow you to work on a project with fellow students. However, during Stage 5 (Years 9&10) your investigation must be completed on your own. By this stage, it should be easier as you have already had practice! The project is to allow you to show how your investigation skills have developed.

This booklet has been developed to guide you through completing an investigation, in an easy to follow format. The project you complete belongs to you, and you should be proud of your achievements, regardless of the final assessment you receive. With practice you will become better at choosing topics and completing tasks. Some project ideas have been provided, but there are many others. Don't forget to use the Internet and the library. Also, visit or contact local scientific or technological organisations as they may have promotional material to guide you in your investigations. Most companies are only too happy to assist with genuine enquiries related to their products. Start by talking to their public relations department, but as your questions get more technical, you may need to speak to a research scientist, or a member of the laboratory staff. Don't forget to check the company websites first!

Consider safety when choosing your project. You may have to carry out a risk assessment. Remember . . .

- Your project **cannot** involve explosions or poisonous or flammable substances.
- **You must not** use domestic supply (240 Volt) electricity when constructing circuits.
- You **must not** be cruel to animals. Studies of vertebrate animals need approval of the School's Animal Care and Ethics Committee (get details from your teacher) and; lastly
- **Do not** damage the environment.

The time factor . . . don't run out of it

Time is one of the most critical factors when trying to complete a project such as the **Student Research Project**. Once you have been given details from your science teacher about your **SRP** and decided on a suitable topic, you should sit down and work out how to ensure you complete the project on time. You will have at least 4 weeks to complete your project, but you will find that the time goes by quickly. A timeline of events allows you to plan the time required for each component of the project. Set realistic goals for this aspect, mega-crystals don't grow overnight!

Remember to allow extra time for *disasters*! A good example is Fido the dog digging up your strips of carefully buried plastic you are waiting for to decompose. Or how about Fluffy your pet chicken scratching around the carefully placed seeds that you are waiting for to germinate (because she thought they were food!).

The timeline below is one suggestion. Of course, it will have to be modified to suit your needs. Talk to your teacher. You may find a better plan that will be more suitable for your specific project.

Sample timeline

Week 1	Choose your topic. Think about an aim. Discuss it with your teacher.
Week 2	Carry out library research, make phone calls, write letters.
Week 3	Design experiment(s), discuss them with your teacher. Allow time for repetition.
Week 4	Organise the equipment you require, refine your experiment, and discuss the details with your teacher and the school laboratory assistants.
Week 5	Identify the dependent and independent variables. Set controls. Select the method you will use to collect results. Carry out the experiments. Analyse the results. Calculate sources of error such as sample size & selection, measurements or poor control of variables. Discuss these with your teacher.
Week 6	Write a draft report and obtain feedback from your teacher, parents and friends.
Week 7	Edit the draft report.
Week 8	Submit your completed project.
	Take a deep breath ... it is over (until next time!)
Later ...	*Refine your marked project and submit it in a local, state or national science award and competition.*

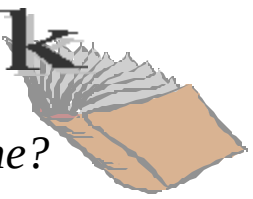
Project Ideas

Other ideas you might consider:

- The impact of introduced species in your local area. Examples of introduced species: Indian myna, tradescantia (wandering dew), pigeons, rabbits, foxes, lantana, balloon vine, cane toad.
- Lifecycle observations of a particular plant or animal species in your backyard, school grounds or local environment.
- Do all cereals absorb the same amount of milk?
- What effect does toothpaste have on bacteria?
- Which brand of shoe provides the most cushioning while playing sport?
- Does white chalk last longer than coloured chalk?
- What is the best (and safest way) to remove moss from paving in the shady areas of your backyard?
- Do all plastic shopping bags carry the same weight without breaking?
- Do professionally developed photographs fade as quickly as those printed from your home PC (on photograph quality paper)?
- Which plastics are biodegradable? (This might be a longer term project)

For even more ideas check the Science Stages 4-5, Syllabus Support Document.

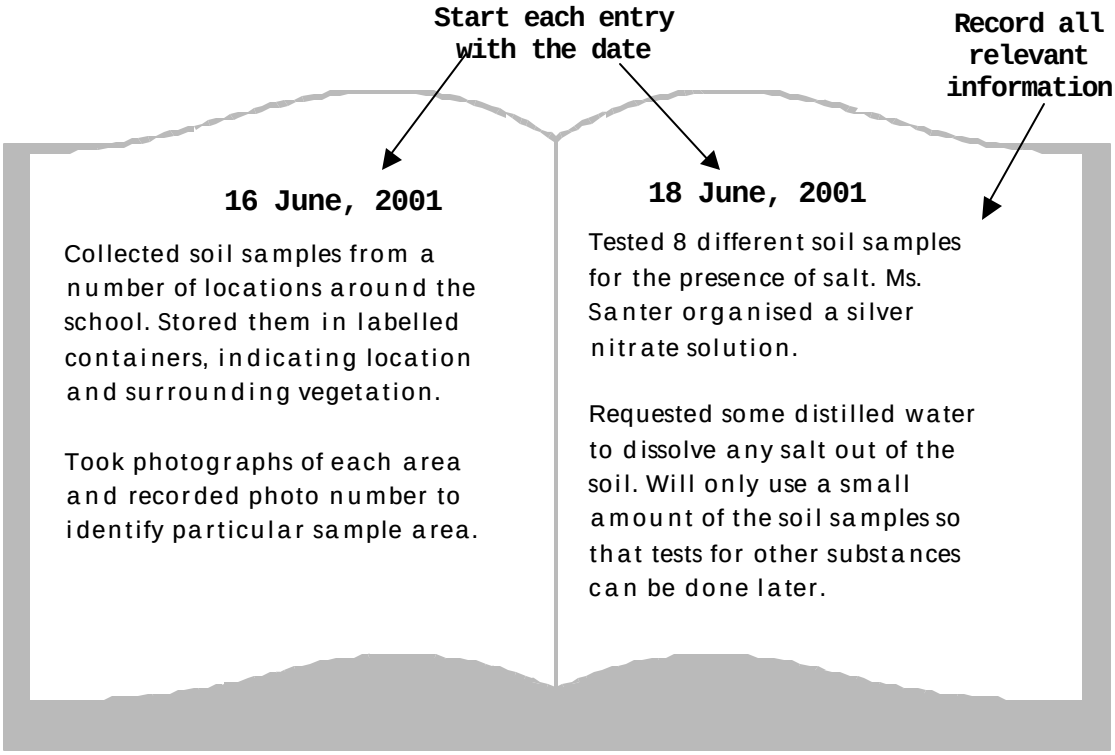
The Log book



What is a log book? Why should I have one?

A log book, or process diary, as some people call it, is a record of the steps involved in completing a **SRP**. The log book can be an exercise book especially designated for your project. Your log book doesn't have to be neat, typed up or lavishly illustrated. It is to be used as a record of how you went about completing your task and what you were thinking. It should include relevant diagrams, sketches, photos and anything else to show your planning and progress through your project. It is also a good indicator of how long you took on each aspect of the project. Its purpose is to record what actually happened through your project. It will also record your thinking and decisions if unexpected things occur. Some projects may involve extensive records, while others may require less detailed information. Your project will determine the extent of the detail supplied in your log book.

Below is a *sample* entry from a log book. Remember to include details of phone calls made, letters sent, discussions with teachers, etc.



Submit your log book to your teacher at regular intervals to obtain valuable feedback on your progress and keep you on the right track. The log book should be used to assist you in the writing up of your final report. Make sure you keep original data and maintain accurate records.

A suggested PLAN of attack!

1. What problem or question are you investigating?
2. What do you know about this problem from personal knowledge and experience? What have other people done in this area or what information is already available about this?
3. Find out about dependent and independent variables and apply the information to your experiment.
4. What hypothesis are you testing?
   State your hypothesis as a relationship between the independent and dependent variables.
6. Predict what you think will happen. Explain why.
7. What must be done to ensure testing is fair?
8. Describe any experimental set-up using a labelled diagram and explain how you will collect your data.
9. Are there any special safety precautions to consider?
10. Carry out some preliminary trials. Were there any problems?
11. How did you modify your experiment to fix the problems?
12. Collect and record the data you need to test your hypothesis. Is a data table appropriate here?
13. How did you make sure your data were accurate?
14. What is the best way to organise and analyse your data? Is it appropriate to draw a graph? What type of graph is most suitable?
15. Are there any patterns or trends in your data? What is the relationship between the variables you have investigated? To what extent is the hypothesis supported by the data?
16. Using science concepts, explain the patterns, trends or relationships you have identified in your data. What is your conclusion?
17. What were the main sources of experimental error?
18. How confident are you with your conclusions?
19. How could the design of the experiment have been improved to reduce error?
20. What have you learned about the topic of your investigation? Was the outcome different from your prediction? Explain.
21. What have you learned about the methods of investigating in science?

Adapted from:

Hackling, M. W. (1998). *Working Scientifically: Implementing and assessing open investigation work in science. A resource book for primary and secondary teachers of science*. Perth: Education Department of Western Australia.

How do I present my work?

A scientific investigation can be presented in a number of ways. It could be a written scientific report. Your investigation could include a model or it could be a multimedia presentation. How you present your project depends on the method you choose to communicate your findings. Here are some hints when submitting your final project.

- Is the purpose of your investigation expressed clearly, without being ambiguous.
- If it is handwritten, is it easy to read? If it has been completed on a word processor, make sure all aspects are correct before the final copy is printed and submitted. Use your computer effectively, especially for checking your grammar and spelling.
- Have you written your procedure in a logical sequence, with your audience in mind?
- Have you described the equipment and explained why you are using it?
- Are your results clear and easy to follow? Have you used the correct units?
- The use of graphs in your results may be appropriate. It depends on your investigation. There are many types of graphs that can be selected such as bar graphs, column graphs, line graphs and pie graphs. Choose the type of graphs you will use carefully. Make sure their use is purposeful.
- If photographs are used, they need to be clear (i.e. in focus) and have some important purpose in your project, not just included … "to pad it out".

- A bibliography is a record of any sources from which you have extracted any ideas or information. Use an accepted method of referencing sources. Discuss types with your teacher or librarian. Include internet web sites if you have used information form them. Here are three examples from the bibliographies of some science journals.
  - Haire, M. & Kennedy, E. (1999). *Core Science 1*. Jacaranda Wiley.
  - Hackling, M.W. *Working scientifically: Implementing and* assessing *open investigation work in scienc*e. Education Department of Western Australia, January 1998.
  - Helix. (2000) *Extracting DNA in your kitchen*. http://www.publish.csiro.au/cyberscience/helix/TH70/TH70b4.htm
- Acknowledgements: The recognition of any support you received is a professional courtesy.
- Don't forget your log book. It is a part of your project. It is only authentic if it is used as an ongoing record.
- Has your teacher asked you to present your project to your class? Are there opportunities to present or display your project for the school community?

Syllabus Links ... or why I should complete a SRP?

The NSW Board of Studies has indicated that during years 7-10, two student projects must be completed. You must complete at least one project during Stage 4 (Years 7 & 8) and a completely separate project during Stage 5 (Years 9 & 10). One of the projects you complete during this time must involve a 'hands-on' practical investigation.

The boxes below, and on the pages that follow, outline the ***skills*** you are expected to demonstrate by the time you complete your science course. The **SRP** is an excellent opportunity to practice many of them. You can check to see which of them you have addressed. They have been taken from the Science Stages 4-5 Syllabus.

You are **not** expected to be able to include all of these in one project. However, by the end of your science course in Stage 5, you should have experienced all of these to achieve the related outcomes. This table is here for you to assess your achievement of syllabus outcomes through your **SRP** and allows you to identify your strengths and weaknesses.

SYLLABUS SKILLS CONTENT and OUTCOMES		**Tick the skills you hope to demonstrate by completing your SRP**
4/5.13.1 identify data sources to:		
describe a problem, hypothesis or question that can be tested or researched		
propose possible sources of data and/or information relevant to the investigation		
identify what type of information or data needs to be collected		
justify why particular types of data or information are to be collected		
identify the appropriate units to be used in collecting data		
recommend the use of an appropriate technology or strategy for collecting data or gathering information		
formulate a means of recording the data to be gathered or the information to be collected.		
4/5.13.2 plan first-hand experiences to:		
identify variables that need to be kept the same if first-hand data is to be collected		
specify the dependent and independent variables when planning controlled experiments		
describe a logical procedure for undertaking a simple or controlled experiment		
establish an appropriate timeline for an investigation.		
4/5.13.3 choose equipment or resources to:		
identify advantages and limitations of using particular laboratory equipment for a specific task		
select appropriate equipment (including safety equipment) and/or resources to perform the task		
describe ways to reduce the risk to themselves and others when working in the laboratory or field		
OUTCOMES		How did you go?
4.13 clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem	5.14 identifies a problem and independently produces an appropriate investigation plan	

More skills you'll gain ...

SYLLABUS SKILLS CONTENT and OUTCOMES		Tick the skills you hope to demonstrate by completing your SRP
4/5.14 perform first-hand investigations to:		
follow the planned procedure when performing an investigation		
use time and resources effectively		
safely and efficiently construct, assemble and manipulate identified equipment		
record data using the appropriate units		
evaluate and modify experimental procedures		
demonstrate the use of safe and hygienic work practices including the correct use of safety equipment		
OUTCOMES		How did you go?
4.14 follows a sequence of instructions to undertake a first-hand investigation	5.14 undertakes first-hand investigations independently with safety and competence	

4/5.15 gather first-hand information to:		
make and record observations and measurements accurately over a number of trials		
use a range of data collection technologies and strategies independently		
OUTCOMES		How did you go?
4.15 uses given criteria to gather first-hand data	5.15 gathers first-hand data accurately	

4/5.16 gather information from secondary sources to:		
use a range of sources, including CD-ROMs and the Internet, to access information		
use key words, skimming and scanning techniques to identify appropriate information		
extract information from column graphs, histograms, divided bar and sector graphs, line graphs, composite graphs, flow diagrams, other texts and audio/visual resources		
summarise information from identified oral and written secondary sources.		
OUTCOMES		How did you go?
4.16 access information from identified secondary sources	5.16 access information from a wide variety of secondary sources	

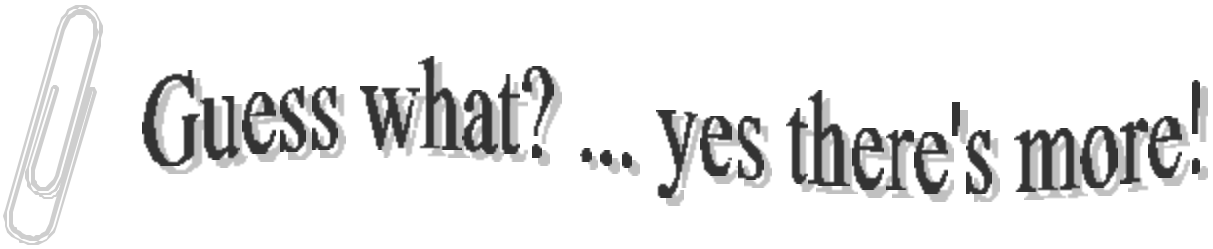
4/5.17 process information to:		
collate information from a number of sources		
distinguish between relevant and irrelevant information		
check the reliability of gathered data and information by comparing them with observations or information from other sources		
organise data using a variety of methods including diagrams, tables, spreadsheets and databases		
critically analyse the accuracy of scientific information presented in mass media		
identify trends, patterns, relationships and contradictions in data and information		
apply mathematical concepts to assist analysis of data and information		
OUTCOMES		How did you go?
4.17 evaluates the relevance of data and information	5.17 explains trends, patterns and relationships in data and/or information from a variety of sources	

Even more skills you'll gain !

SYLLABUS SKILLS CONTENT and OUTCOMES		Tick the skills you hope to demonstrate by completing your SRP
4/5.18 present information to:		
select, and use appropriately, a discussion, explanation, procedure, exposition, recount, report, response or experimental record for oral or written presentation		
select and use an appropriate medium to present data and information		
select and use an appropriate method to acknowledge sources of information		
use symbols to express relationships, including mathematical ones, and appropriate units for physical quantities		
use drawings, diagrams, graphs, tables and flow charts to show relationships and present information clearly and/or succinctly		
select and draw the appropriate type of graph (from column graph, histogram, divided bar, sector or line graph) or diagram to convey information and relationships clearly and accurately.		
OUTCOMES		How did you go?
4.18 with guidance, presents information to an audience to achieve a particular outcome.	5.18 selects and uses appropriate forms of communication to present information to an audience.	

4/5.19 think critically to:		
justify inferences in light of gathered information		
identify data which support or discount a hypothesis, a question being investigated		
make generalisations in relation to a relevant set of observations or experimental results		
anticipate and/or respond to problems as they arise in practical situations		
use models, including mathematical ones, to explain phenomena or make predictions		
use cause and effect relationships to explain ideas		
OUTCOMES		How did you go?
4.19 draws conclusions based on information available	5.19 uses critical thinking skills in evaluating information and drawing conclusions	

4/5.20 solve problems to:		
identify the nature of a presented problem		
describe different strategies that could be employed to solve an identified problem		
use identified strategies to develop a range of possible solutions to a particular problem		
evaluate the appropriateness of different strategies for solving an identified problem		
OUTCOMES		How did you go?
4.20 uses an identified strategy to solve problems	5.20 selects and uses appropriate strategies to solve problems	

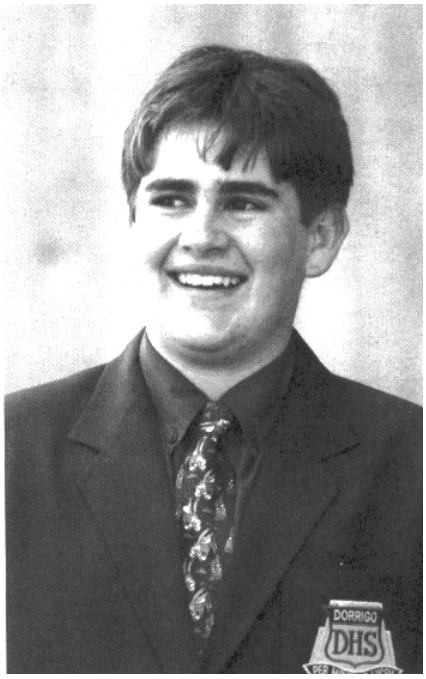


SYLLABUS SKILLS CONTENT and OUTCOMES		Tick the skills you hope to demonstrate by completing your SRP
4/5.21 use creativity and imagination to:		
seek evidence to support claims		
evaluate evidence for reliability and validity		
produce creative solutions for problems		
propose ideas that demonstrate coherence and logical progression		
apply critical thinking in the consideration of proposals		
formulate cause and effect relationships.		
OUTCOMES		How did you go?
4.21 uses creativity and imagination to suggest plausible solutions to familiar problems.	5.21 uses creativity and imagination in the analysis of problems and the development of possible solutions.	

4/5.22.1 work individually to:		
independently plan and conduct investigations, communicate information and understanding and solve problems		
set and work to realistic timelines and goals		
accept responsibility for maintenance of a safe working environment for themselves and others		
evaluate the effectiveness of their performance in completing tasks		
OUTCOMES		How did you go?
4.22 complete a variety of individual and team tasks with guidance.	5.22 independently plans, implements and evaluates the effectiveness of a variety of tasks as an individual and as a team member.	

When you submit your **Student Research Project**, your teacher will be checking for evidence that you are able to demonstrate achievement of the outcomes.

A case study ... to inspire you



Trevor Francis from Dorrigo High School is a former Young Scientist of the Year. His project was selected out of over 4000 others to illustrate the best science and most original concept seen that year.

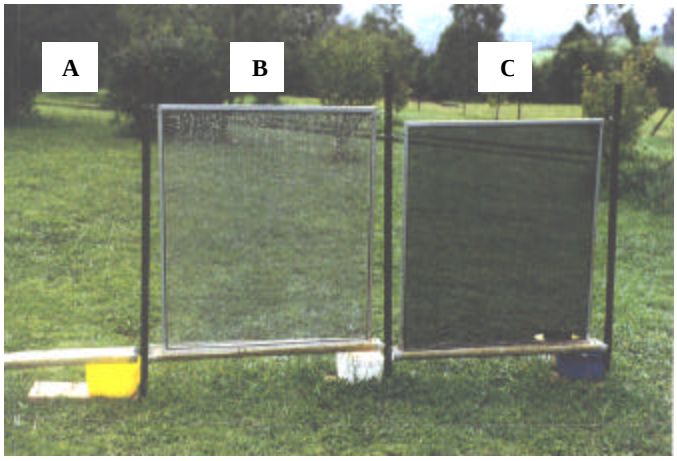
His project idea started when he noticed that fog, which often smothers the Dorrigo hills, condensing as water on his father's car windscreen and also on the stoneguard mesh on the front of the car. This was happening even though the area was in drought. Trevor then wondered if he could use screens to collect water from the fog.

Trevor designed experiments to test different mesh sizes and carefully measured the amount of water each produced. He did this by firstly constructing three troughs to collect any water. Above two of these he attached metal frames (1 m^2), one with regular metal fly screen, the other with shadecloth. (The trough without any frame attached above, was used as Trevor's control).

The project was carried out over a period of three weeks. Each morning he measured the amount of water that was collected. A summary follows:

A	**Control**	**13 145 mL**
B	**Shadecloth**	**44 765 mL**
C	**Metal Flyscreen**	**32 365 mL**

To Trevor's surprise the shadecloth collected the most condensed water (from the overnight fog). He anticipated the metal flyscreen would be the most successful.



Trevor also realised his experiment had some flaws in the design. The control lacked a frame (without any form of screening) and surrounding trees may have affected the total amount water collected as they formed an area of protection.

A conclusion to Trevor's Experiment.

He designed a way of installing similar screens on the roof of his house and shed, so that water could be collected and used appropriately on his family's property.

Intel® Young Scientist Awards

Each year the Science Teachers' Association of New South Wales offers a competition for science students to present their projects to a wider audience. These projects are generally of an outstanding nature and represent the school's best efforts in each of the defined categories. Information booklets are supplied to ALL schools early in Term 1 so that students can commence their projects early. Now that it is a requirement in Stages 4 & 5 to complete at least one project in each stage, this competition is something that may be of benefit to students. There are numerous prizes awarded each year. Check with your teacher to obtain information regarding the judging criteria. ALL students who complete a project at school level are entitled to receive a *Certificate of Participation* if the competition organisers are notified by the closing dates. Students whose entries are submitted for state judging and are successful in reaching the top 10 in the State will receive a *Certificate of Excellence*. The top 3 students in the state will receive money prizes and could be in the running for a major prize. Such major prizes are Young Scientist of the Year, Intel Prize, Powerhouse Experimentation Prize, Special School Prizes and other prizes that change on a yearly basis.

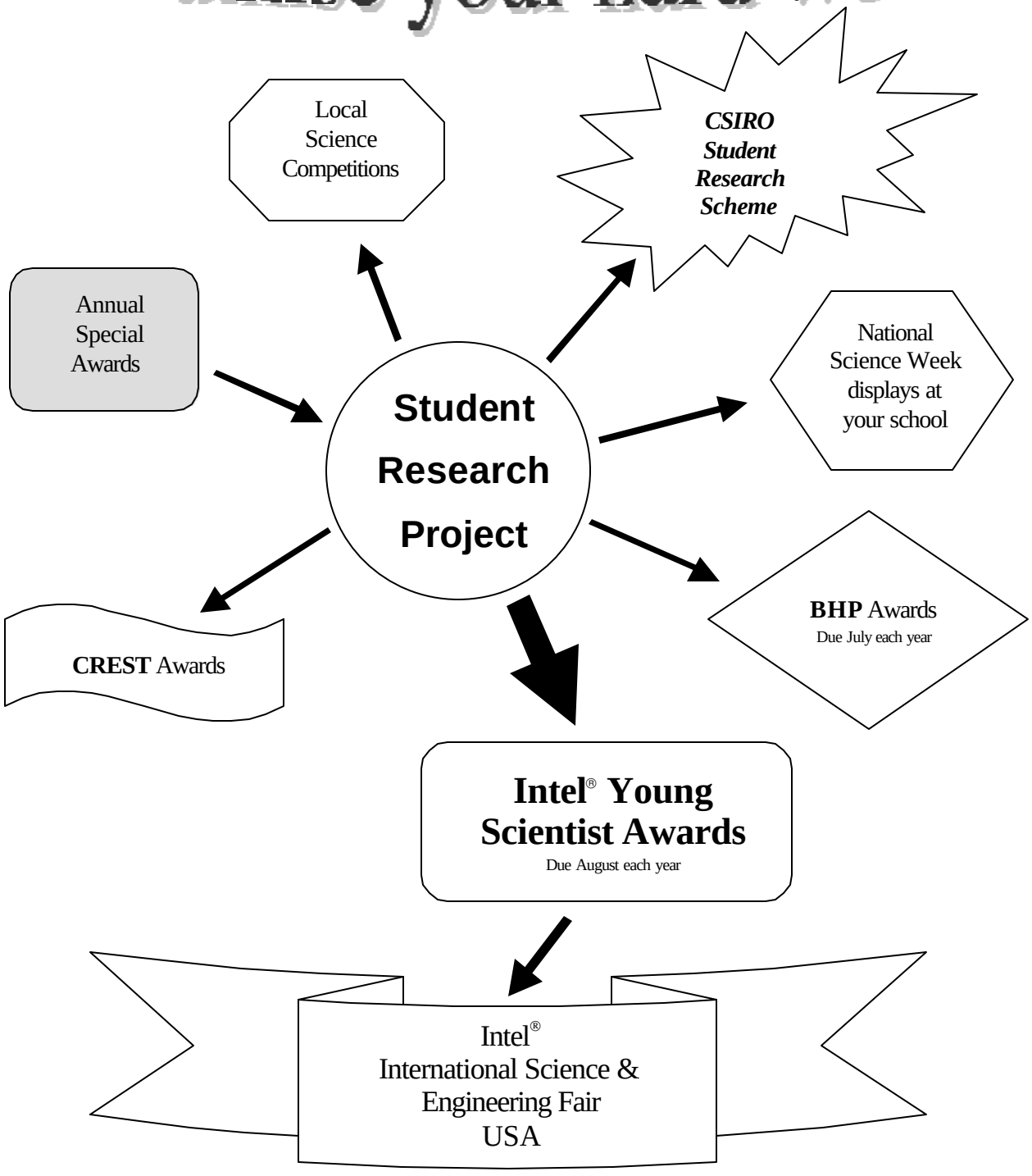
You may present your scientific investigation in one of the following categories:

- **Scientific Research**, one of the most popular areas entered, where students investigate a problem, and present their investigation in a formal written scientific report.
- **Multimedia** allows you to present your investigation in a creative way. Science can be communicated in many ways. Are you good at taking photos? Or using a video camera? What about using a program like "PowerPoint"? Use one or more of these methods to pass on your scientific message.
- **Working Models** allow you to present your scientific investigation as a product. It could be an invention or something which solves a problem.
- **Creative Writing** is an interesting way of presenting an aspect of your investigation. Your imagination and scientific ideas can be portrayed for a particular audience.

THE SCIENCE MUST BE CORRECT IN ALL CATEGORIES.

The Intel® Young Scientist Awards are organised by the Science Teachers' Association of NSW with support from Intel® Australia, the NSW Department of Education and Training, and The Powerhouse Museum, Sydney.

The SRP and other avenues to utilise your hard work



Ask your teacher for details regarding information about these activities or go to http://www.stansw.asn.au/ys/ys20res1.htm *to see what other student have researched.*