2010 DEEDI Hermitage Research Station Schools' Plant Science Competition

Instructions

Does climate impact crop growth?

Have you ever wondered why certain crops are grown in certain areas of Australia? Why don't farmers grow pineapples and bananas in Tasmania, or grow wheat and barley in the Northern Territory?

In this year's competition students perform a "multi-environment" trial growing soybean and millet plants in at least 2 varying locations at school to help discover how climate affects plant growth.

Participants will:

- Grow soybean and millet plants under different environmental conditions
- Build their own Stevenson Screens (or weather instrument screens)
- Set up a water evaporation container at each of the experiment locations
- Record all weather and environmental conditions
- Observe, measure, record and compare plant growth
- Share data and make comparisons with other schools and climates across the state
- Calculate fresh and dry weights of the plants
- Drawing competition – draw a picture of a "super" field plant, designed to withstand extremely hot and dry conditions (years p-7 only)

✓ open to all schools nation wide | ✓ four year categories (P-3, 4-7, 8-10 & 11-12)
✓ relevant to science curricula essential learnings and Primary Connections 'Plants in Action' unit | ✓ develop skills in scientific method, report writing, maths, english, team work, communication & technology | ✓ great prizes up for grabs!

GRDC Grains Research & Development Corporation | Queensland Government | PIONEER | Grains Research Foundation
Blue Ribbon | HSR seeds | Professor & Mrs Joe Baker | Selected Seeds | The University of Queensland Australia | Queensland Government

Contents

Introduction

The environment that a plant experiences determines how it will grow. Different plants respond to environments in different ways. Some of this we know intuitively, rainforests grow in warm wet environments and not much grows in a desert.

The factors that make up an “environment” are very complex. From the plants point of view things which effect the basics of plant survival: light, water, nutrients, temperature, are the keys to creating a definition of “environment”. These things are greatly influenced by geography, soil type, latitude, altitude, distance from the sea etc, so it is unlikely that a plant in two places will experience the same environment. Given that weather changes, it is unlikely that a crop will experience the same environment from one year to the next.

How a farmer manages a crop partly determines the environment that the crop will encounter e.g. by planting at a certain time a farmer can help ensure that certain rainfall or temperature regimes are likely to be the “environment” the plant grows in. Crops, unlike trees, are usually grown annually at one particular time of the year. This timing is determined by the plants favoured environment, thus we have summer and winter crops.

Biologists have an equation which says P=G*E. Or more fully - phenotype (P), or what a plant or animal looks like is determined by the interaction of genotype (genes) (G) and environment (E). A simple example may be you observe a skinny dog, some dogs are skinny because of there genotype (genes) (e.g. greyhounds), but some are skinny because or their environment (e.g. malnutrition). In crop science this equation is sometimes expanded to say P = G*E*M where management (M) is recognised as those parts of the environment over which a farmer, or researcher can influence control, e.g. row spacing, irrigation, fertilizer application, stubble management.

Changes in weather patterns create new environments and growing conditions and for this reason a lot of concern and research is being targeted toward the issue of climate change. One of the risks associated with climate change is that crops (that may have been grown successfully in a region like southern Qld in the past) may gradually not be as well suited and a new variety may need to be developed or new locations considered for growing the crop. If current food production systems are disrupted there would be serious consequences for the human food supply chain.

So a plant which may grow really well at the Hermitage Research Station in Warwick, may not perform the same at Biloela, or on the Liverpool Plains in NSW. As new crop varieties are being developed plant breeders must test them across a range of climates. When you purchase seed for a crop variety the seed company provides information on the range of locations and climates to which the variety is suited. The testing of plants in lots of places for numerous years is the cornerstone of modern plant breeding. The test we put the plant to is called a multi-environment trial (MET).

This year in the Hermitage Plant Science Competition you will have an opportunity to participate in your own multi-environment trial.

Queensland Government

The big picture

Studying crops and climates intersects a number of themes related to agriculture today, e.g. the global food crisis, the carbon economy and ethanol in fuel. While tackling these large themes is beyond the mandate of the Plant Science Competition it can provide a forum in which some of these issues are raised.

Students may find value in considering which catchments and regions are most impacted by grain cropping in Australia. This would highlight the importance of the Murray Darling Basin to Australian cropping.

Queensland Science Curriculum

The Hermitage Plant Science Competition interacts with the science curriculum in the following levels.

Science as a human endeavour

Science has application to daily life and in this case the science of agriculture is directly related to ensuring supply of our food. Crop research and development and plant breeding seeks to maximise food production, quality and farm efficiency.

Life and Living

Seed germination experiments which introduce the early phases of plant growth show the importance of water to germination. Plant structures, roots and leaves can be introduced in growing the plants or drawing the plants' growth stages. Taxonomy can be introduced in the distinction between monocot and dicot seedlings.

Changes in environment make some areas more suitable for growing certain crops than others. Climate change may have significant effects on crop production and on the incidence of pests and diseases. The crop environment can be considered as an ecosystem.

Natural and Processed Materials

Growing food producing plants is a good introduction to the various plant parts, and products and grain processing to produce flour, cereals, etc.

The germination and growing experiment has been developed with an awareness of the Primary Connections: Plants in action curriculum notes.

Aims of the competition

This year the competition focuses on testing crop lines for production in various climates. The aims of this competition are for students to:

- Become familiar with how new crop varieties are developed to grow and perform well in certain areas under varying climatic conditions.
- Understand the importance of replications in scientific experiments.
- Identify with the relevant plants and crops by growing seeds and considering the growth stages and requirements of the plant and the growing system.
- Consider how climate, weather and environmental conditions affect plant growth.
- Consider the key issues associated with growing crops now and into the future under the pressures of climate change.

Timetable

Competition timetable

Competition begins:	Term 1, January 2010
Experiment duration:	11 weeks for planting experiment (10 weeks growing, 1 week drying)
Share data with other school/s:	- 31 March 2010 (deadline for submission of datasheets)
	- combined schools database available after Easter break 2010
School visits from DEEDI staff:	After Easter break 2010 (upon request)
Closing date:	Friday 21 May 2010 (all entries to be submitted by this date)
Winners notified:	Beginning of June
Presentation day:	End of July 2010 – date to be advised

Setting up the class

Arranging the class and ordering kits:

To keep things uniform within a replicate it is best to let one student, or a group of students look after one entire replicate. If your resources and class sizes allow it, you can add as many replicates as you like by adding extra students or groups of students who are responsible for an entire replicate.

The following are some suggestions on how you might like to arrange your class to work on the experiment and tasks:

1. Whole class – a class may work on the experiment/tasks as one large group with each student contributing to the project in some way (order 1 kit per class).
2. Small groups within a class – a class can be broken into smaller groups of 4-5 students to work on the experiment/tasks (order 1 kit per group).
3. Home students or small classes (less than 10 students) may order single kits (as long as you have enough space and resources to run each experiment).

What you need for the experiment

Free experiment kits provided contain

- 1 x packet of millet seed (variety: French White Millet)
- 1 x packet of soybean seeds (variety: Leichardt)
- 1 x packet of soybean seeds (variety: Djakal)
- 12 planter bags (pots)
- 12 x paper packets

You will need to supply

- **Extra pots** if you wish to do more replicates or treatments
- **Sand** (from the school sand pit will be fine) – to fill each 10 litre pot (12 pots)
- **Water crystals** (you can buy these from hardware stores or plant nurseries) – 1 tablespoon per pot
- **Fertiliser** (Thrive or Miracle Grow solution) – enough for each of your 12 pots, using once per week for approx 10 weeks

Queensland Government

- **Bucket** (to mix sand and water)
- **Newspaper** (to line each pot before adding sand mix)
- **Masking tape and permanent marker** (for labelling pots and packets)
- **A set of scales** (that give readings in grams would be ideal – for measuring the weight of your plants at the end of your experiment)
- **A 30cm ruler, preferably plastic** (to measure the water level in your evaporation containers)
- **4 x 4 litre, empty, white, ice cream containers (approx 20cm square x 11cm deep)** – not coloured ones as they may affect your readings (2 for making your evaporation containers and 2 for creating your Stevenson Screens)
- **2 x pieces of chicken wire/netting** (an old piece from home would be fine – to make a cover for the evaporation containers)
- **Rain gauge** (if your school doesn't already have one)
- **2 x maximum/minimum thermometers** (one for each treatment – full sun & part shade). If you don't have any thermometers and can't source any, you may need to contact the weather bureau for daily temperature readings throughout your experiment
- **2 x garden stakes** (to assemble Stevenson Screens (you should be able to purchase 1.2m garden stakes from your local hardware store)
- **Pair of scissors or knife** (to cut slots in 3 sides of each ice cream container (for air flow into Stevenson Screen)
- **Hammer and nails or strong hold glue** (to secure your Stevenson Screen to each garden stake)
- **Length of string** (cut into 2 pieces to suspend your thermometers in the Stevenson Screens)

Files for downloading (or available via email kerrie.rubie@deedi.qld.gov.au)

- **Competition instructions** (hard copies of instructions will not be provided in free experiment kits)
- **Data record sheet** (for recording experiment data and submitting to the combined schools database)
- **"What does a Plant Breeder do?"** (information flyer)
- **Entry submission form** (to be completed when submitting your entry)
- **Queensland Government Consent Form** (to be completed and returned to the Hermitage Research Station ASAP).

Please click here to find links to the downloadable files: http://www.dpi.qld.gov.au/4791_4235.htm

Putting your project entry together

Students are asked to complete the given experiments and tasks and do some extra research into cropping in variable climates within Australia. Your experiment report should be presented as scientifically as possible, using a layout such as:

- **Introduction** (predictions/hypothesis, aims of the project, summary of your findings, background information on topic)
- **Materials & Methods** (how you set up your experiments and the materials used)
- **Results** (observations taken, journals/notebooks, data and measurements recorded in data sheet and also displayed in tables/graphs, photos of the experiment and activities undertaken plus labelled drawings of plants and plant samples)
- **Discussion** (group discussions or further research about the experiments and topic, answers to provided questions, case studies and other activities, snippets/quotes from reference materials (e.g. magazines, newspapers, websites) and any statements from interviewees)
- **Conclusion** (summary of your experiment results, research findings and conclusions made)
- **References** (list of books, magazines, journals, websites, interviews which were used to help provide information for your report)

Research options:

- Searching the world wide web – try typing “climate change crops” in a search engine (see the section “Useful websites” in this instruction booklet for some suggested links)
- Searching your school/town library for suitable reference materials
- Interviewing local farmers or other professional people associated with the topic, for example DEEDI plant breeders, weather bureau, etc

Report format

You can present your competition report/project in any of the following methods:

- Poster (ideal for young children)
- Written or word processed document (printed and bound or placed in a display folder)
- PowerPoint presentation saved on a CD or USB stick (one electronic file per student please. One hard copy of each report is also required)
- Video/DVD (please ensure the sound quality is clear)
- any combination of the above

Preparing reports and entries

Students can then prepare their entries in the following ways:

1. One entry on behalf of the whole class (all participating students contribute to the information provided in one entry). One score is awarded for the class.
2. A number of individual or small team entries, representing a class (each student can write and send in their own report or each small team can submit a “team” report). Each report will be judged individually (for consideration for individual prizes) and then an overall average score will be awarded for the class.
3. Individual or small team entries submitted by students working on the project at home or school, but they are not representing a class (relevant to home schooled students or students working on the project in their own time as the competition has not been taken on as a class activity). Each report will be judged individually (for consideration for individual prizes).

See the ‘Entry Submission Form’ for further information on entry classifications and the prizes allocated per classification.

Entries need to be submitted by the due date. (*Occasionally, a one week extension is granted if we are given prior notice).*

*The **Entry Submission Form** and the **Queensland Government Consent Form** need to be completed and attached with your entry. These forms can be downloaded from the competition website, or sent to you via email.*

Experiment information

Aim: To make careful observations of how your plants grow and about the environmental conditions the plants will be experiencing.

You will be supplied with seeds of 2 varieties of soybean and 1 variety of millet and will be asked to grow them in at least 2 environments, one is a warmer place in full sun and the other is a cooler place in partial shade (e.g. beside a building or under a shady tree).

Depending on when you begin your planting experiment, you may need to organise watering of your plants and weather recording during the Easter break. Perhaps the school gardener or a teacher might like to look after the experiments during this time. If this is difficult to organise, you may be able to gather some weather data from the Weather Bureau and make sure your plants get a good watering before the break!

Find positions that are as variable as you can to grow your experiment.

- Record and define each environment.
- Observe agronomic differences
- Each location will have unique issues, what are they, what needs changing to maximise sustainable production in each?

You will then measure and record plant growth and weather data. There will then be an opportunity to share your data with other participating schools via a combined schools database.

The experiment will consist of 3 plant types in 2 environments with a minimum of 2 replicates. So each experiment will have at least 12 plants to observe (3x2x2). Replication is an important way whereby scientists increase the confidence they have that the observations they are making are not random observations but genuine trends in the data.

A replicate in this experiment consists of 3 plant types grown in two different environments, therefore 6 pots. To keep things uniform within a replicate it is best to let one student, or a group of students look after one entire replicate. If your resources and class sizes allow it, you can add as many replicates as you like by adding extra students or groups of students who are responsible for an entire replicate.

As a special potting media is being used for this year's competition, please grow your plants in the planter bags provided (or pots of similar size), not the school garden.

Experiment Instructions (all year levels)

Including: Planting Experiment | Building a Stevenson Screen | Making an Evaporation Container

Step 1: Select your experiment locations:

Select the 2 (or more if desired) areas in your school grounds that will be ideal for this experiment (e.g. a full sun position and a part shade position - along a building wall or under a tree).

Step 2: Build your own Stevenson Screens (weather instrument screens) (x 2) one for the full sun position and one for the part shade position)

*** TEACHER ASSISTANCE REQUIRED FOR YOUNG STUDENTS! ***

You will need: ***2 x garden stakes, 2 x 4 litre, white ice cream containers, 2 x min/max thermometers, 2 lengths of string, scissors, hammer and nails or glue***

To save some time, have your Stevenson Screen partly constructed (steps 1 to 3) before you begin setting up your planting experiments. Alternatively, build your screen on the same day as you set up your plant experiments. It is important that you are ready to record daily temperatures on the same day you begin planting your seeds.

a) Make a small hole or slit in the bottom centre of a white, 4 litre, ice cream container (small enough to place string through for suspending your thermometer).

b) With scissors or a knife, carefully cut 5mm slots in 3 sides of your ice cream container (to allow for air flow).

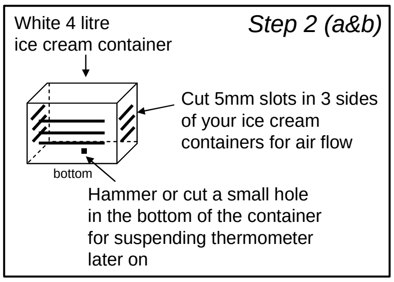
c) Nail the side (without the air slots) of your container to the top of the stake, so that the bottom of the container is now facing the sky. Leave an inch or so of the stake above the top of your container so you can easily hammer the stake into the ground.

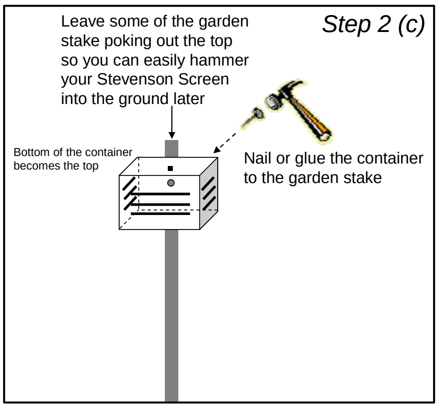
d) At your chosen "full sun" experiment location (beside where your pots will be), hammer your garden stake into the ground, leaving it sticking out around 1m above ground level if at all possible. Be careful not to hit and crack the container when doing this!

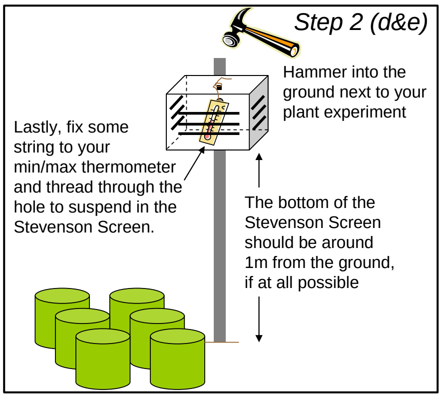
e) Secure a piece of string to your minimum/maximum thermometer and thread through the hole made in the ice cream container (you may need to stick this down with some tape, or tie a knot so the string doesn't come back through). Allow the thermometer to dangle around 5cms (2 inches) from the top of the container. It is ideal that bottom of the thermometer doesn't dangle too far underneath the bottom of the container too.

f) Repeat this process to build your second Stevenson Screen for the "part shade" experiment.

Note: if a garden stake will be impractical to use (e.g. your experiment is set out on a cement area and you can't dig it into the ground) you might like to suspend your screen from an awning or tree using weather proof string. Just make sure it is suspended approx 1m from ground level over your experiment site.







Did you know?…

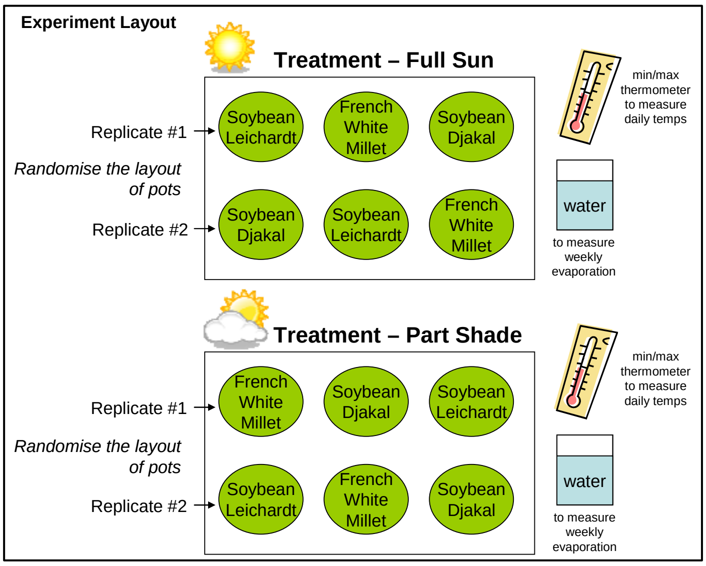
Galileo invented the thermometer! Galileo was a scientist who lived in Italy about four hundred years ago. The thermometer did not look like the ones we use today and it was not accurate. Galileo's thermometer had a glass bulb the size of a hen's egg. There was a glass tube connected to the bottom of the bulb. The tube was as thick as a straw and pointed downwards from the bulb into a bowl of water. When the temperature of the air around the bulb rose, so the level of the water in the straw also rose. When the temperature of the air fell, so did the level of water in the tube. The main problem was that as the air pressure changed, owing to the weather, the water level also went up or down even if the temperature did not change.

http://www.science-at-school.com/4C/06folder/mainText.html

Step 3: Prepare your planter bags (pots):

Gather all 12 pots (and extra pots if doing more treatments or replicates) and label each pot (using masking tape and a permanent marker) with the replicate number and crop type (as shown).

Place the 6 pots for the "Full Sun" treatment in your pre-selected sunny position and place the other 6 pots for the "Part Shade" treatment in your pre-selected shady spot. Make sure you randomise the placement of each pot within a treatment.



Potting media:

You now need to fill your pots with a special potting medium. For these experiments, we are asking you to create a mix of sand, water crystals and fertiliser. Follow the recipe below carefully and then we have confidence that when you compare your plants to plants in other schools it is not the potting media that has created the differences. Be careful to use the same ratios of mix for each pot.

Recipe:

a) Add one tablespoon of water crystals to a plastic cup of water.

b) Line bottom of planter bag/pot with old newspaper to stop sand leakage.

c) Place sand in a bucket and top up with water to ensure sand is all wet.

d) Fill each pot 3/4 full with the damp sand.

e) Add the water crystal mix as a layer at the 3/4 mark.

f) Fill remainder of each pot with sand.

g) Plant five seeds in each pot (as directed in Step 4 below).

h) Once the plants have emerged then ensure one of the weekly waterings is with a Thrive or Miracle Grow solution (made up as per the instructions on the packet).

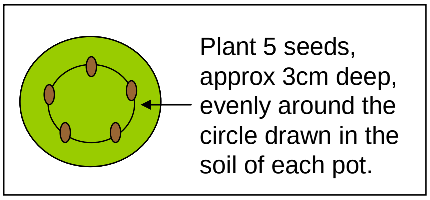
i) Ensure you record the fertiliser mix and concentration in your notes/journal.

Step 4: **Planting your seeds:**

Ensure the sand mix is moist before planting your seeds.

With your finger, draw a circle around the top of the sand mix in each pot as shown. Around this circle, evenly poke 5 holes about 3 cm deep.

Take 5 seeds from the 'Soybean Variety Leichardt' packet, 5 from the 'French White Millet' packet and 5 from the 'Soybean Variety Djakal' packet (being careful not to mix them up) and plant into your corresponding labelled pots (5 seeds in each pot). Be careful with the millet seeds as they are very small and might be easily dropped and lost.



Repeat for the 2nd treatment.

<u>**Note**</u>: Once your plants have grown for 3 weeks, you should thin your soybean pots down to only 1 healthy plant per pot. Be careful not to damage the plant you want to keep. There is no need to thin the millet plants, as they will have enough room to grow in each pot.

Step 5: Hammer your partly assembled Stevenson Screen into the ground beside your pots and finish assembling the Stevenson Screen as outlined in Step 2 (d&e) above.

Step 6: **Prepare your evaporation containers (x2):**

You will need: ***a plastic ruler, 2 x 4 litre, white ice cream containers (approx 20cm square x 11cm deep), chicken wire/netting, water***

a) Place the 4 litre, square, white, ice cream container beside your full sun experiment. If possible, make sure it is in a position where no shade will fall over it.

b) Fill your container with 70mm (7cms) of water – while you are filling the container with water, have a team mate hold the plastic ruler straight up and down in the inside bottom the container. Precisely fill the container to 70mm.

c) Cover your container with chicken wire (e.g. at least 10mm gauge netting), folding it down over the sides so that animals wont be able to knock it off and drink your water. Note: make sure the cover is easily removable so you can take your measurements each day.

d) Repeat the steps above to make a second evaporation container for the "part shade" experiment.

Taking daily evaporation readings:

At the same time each day, check your evaporation container. Carefully record what the water level is by placing your ruler straight up and down inside the bottom of the container. Make note of the new measurement and write this in your notes/journal.

To calculate the evaporation, subtract your daily measurement from your original water level:

(e.g. 70mm (original water level) – 65mm (the next day's water level) = 5mm (evaporation for the day).

Carefully fill your container with water to exactly where your original water level was (70mm) and repeat this process each day during the week.

What if it rains?

Check your schools' rain gauge each day. If you have had some rain since the last time you did your evaporation reading (e.g. 25mm rainfall), record your rainfall total and add this to your 70mm original water level:

(e.g. 25mm (rainfall) + 70mm (original water level) = 95mm).

Queensland Government

This 95mm is what your evaporation container would read if you had no evaporation. However, it is possible that some evaporation has still occurred. When you measure your new water level it may read, for example, 80mm which is obviously different to your 95mm total (original water level + rainfall). You will need to subtract the amount of 80mm from the 95mm to get your evaporation

(e.g. 95mm (original water level of 70mm + rainfall of 25mm) – 80mm (new water level) = 15mm evaporation).

If the water has overflowed, note this in your diary and still calculate your evaporation by taking the reading of the water level (which will most likely be close to the top of the container).

Remember to remove the extra water (tip it all out of your container if you like) and carefully refill to 70mm.

Step 7: Watering your plants:

You will need to water your plants every second day – ideally Monday, Wednesday and Friday each week. Your watering regime may vary with temperature, as higher temperatures and greater sunlight will lead to higher water use. If need be, make arrangements for someone (e.g. school gardener) to water your plants during the Easter holidays.

Step 8: Observations and data recording:

Weather:

Monitor the weather conditions each day (e.g., hot, cloudy, rainfall, minimum and maximum temperature, when the sun rises and sets, daylight hours, daily evaporation, etc) and keep a good record of these in your notes and on your data sheet (provided). You will also need to record your site data (e.g. your school's name, address, latitude, longitude, altitude, nearest weather station and distance to this weather station).

Plant observations:

Take note of when your plants first appear. Continue to inspect them each day and count the number of leaves, plant height, nodes, flowers, pods, colour/appearance/health of the plants, diseases/pests/plant death, etc. Remember to record certain plant observations in the data sheet provided (see data sheet for further details). It is a good idea to take photos of your experiments and/or sketch your plants at various stages, so you can include them in your report/s.

*Note: only information from the **full sun treatment**, for a 30 day period from day of planting, is required for the combined schools database.*

You can download a datasheet from the competition website or have one emailed to you by contacting Kerrie Rubie at the Hermitage Research Station.

Time to do some research!

While your plants are growing for the 10 week period, you may like to do some extra research into crops and the areas and climates in which they are grown throughout Australia.

- Why are they grown there?
- Will climate change affect the types of crops we grow in the years to come?
- What research are Plant Breeders doing to help crops adapt to changing climates?

Step 9: Calculate "Plant Mass" (harvest, weigh and dry your plants):

You will need: Set of scales, scissors or knife, 12 paper packets

a) At the end of your experiment (10 weeks) you can cut each plant off and weigh them. Weigh each soybean plant from each pot. Gather each millet plant from a pot and weigh them together (repeat for each pot of millet). Note: for the millet plants, you might like to record an average weight for each plant:

(e.g. total weight of all plants from one pot ÷ number of plants from that pot = average weight per plant)

Record these original weights, which is called "fresh weight".

b) Place each soybean plant, and group of millet plants from each pot, in the paper packets provided in your kit and leave out to dry for at least another week (you can chop them up or bend them over, if they wont easily fit in the packets).

If you like you can periodically re-weigh the packets to see when the plants are not losing any more weight. That means that the plant is now totally dry and you can now record its so-called "dry weight".

- How did the full sun plants compare with the part shade plants?

Data recording

Recording the data for your experiment

The foundation of good science is good record keeping. Given that time of year has an effect on the way the plant behaves it is important to record the date. Record the name of the person making the observation, so you know who to ask questions of if the data collected seems a bit strange.

Optional combined schools database

The aim of the "combined schools database" is to allow students from one school to compare notes with students from another school or schools across the state, or even interstate! By doing this data comparison, you will hopefully see some differences in the data collected from schools who are located in different climatic areas than yourself.

It is not compulsory to participate in the combined schools database, but it could be an interesting way to compare notes and communicate with students from other schools. The ideal would be to compare data with schools who are located furthest away from you (e.g. a school in Cairns (far north Qld) may like to compare data with a school in Warwick (SE Qld), or with a school even further south.

A data sheet has been prepared by Hermitage Research Station staff in the Microsoft Excel program and can be downloaded from the competition website or emailed to you (see example on following page). These data sheets will need to be completed electronically (on your computer) and emailed to the Hermitage Research Station when complete.

Please note that you need to record information for the combined schools database from the FULL SUN treatment only, for a specific 30 day period (starting from the day you begin your experiment or "Days After Planting" in scientific terms). However, you may like to print out more of these data sheets and use them to continue recording your observations for the remaining weeks of your full sun experiment and for the entire 10 weeks of the part shade experiment (and include all data sheets in your report). This may be easier than designing your own data sheets!

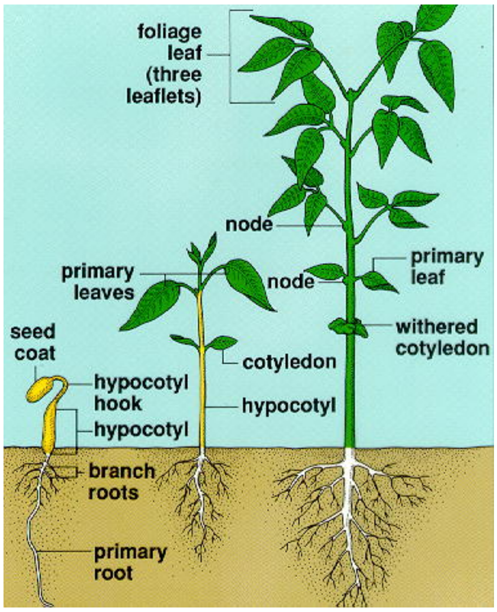
Plant description data - full sun treatment - soybean (Leichardt)

	Replicate #1							Replicate #2					
	Date	# all leaves	# fully emerged leaves	# nodes	# flowers	# pods	Overall plant health / comments	# all leaves	# fully emerged leaves	# nodes	# flowers	# pods	Overall plant health / comments
Day 1													
Day 2													
Day 3													
Day 4													
Day 5													
Day 6													
Day 7													
Day 8													
Day 9													
Day 10													
Day 11													
Day 12													
Day 13													
Day 14													
Day 15													
Day 16													
Day 17													
Day 18													
Day 19													
Day 20													
Day 21													
Day 22													
Day 23													
Day 24													
Day 25													
Day 26													
Day 27													
Day 28													
Day 29													
Day 30													

example

An example of what the plant description data sheets look like

The table below shows the types of observations we would like you to make and record about your plants. In the appropriate columns of the data sheet (as shown in the example above), record the number of each organ for each plant. You will also be recording weather data including daily minimum and maximum temperatures, rainfall, daily evaporation, time of sunrise and sunset and daily sunshine hours.

Organ	Description	Developmental stages of soybeans
All leaves	Flat leaves - note that for Soybean, except for the first four leaves, one leaf looks like 3 leaves, i.e. a leaf is made up of three leaflets. These leaflets are on there own "branch' attached to the node.	
Fully Emerged Leaves	Only record a flat leaf with no roll in it.	
Nodes		
Flowers		
Pods	Depending on the amount of time that you run your experiment for you may or may not get to see any pods in this experiment.	

Queensland Government

Data sheets, for inclusion in the combined schools database, will need to be submitted by 31 March 2010. You will need to email your excel datasheet file to Kerrie Rubie at the Hermitage Research Station. All submitted data sheets, from each participating school, will then be compiled into one large database. This "combined schools database" will then be emailed back to all schools after the Easter Holidays and also uploaded on the website. You will then be able to access information from another school/s by selecting the worksheet that relates to the school of your choice.

From the data you receive in the combined schools database, you might like to note the following:

- Are there any differences in data? If so, why might this be so?
- Did the plants at other schools grow differently to yours? If so, why might this be so?
- Plot the data from your experiments and the experiments from other schools in tables or graphs.

Did you know?...

The concept of Thermal Time: People have observed that the same type of plants do not grow at the same rate if the temperatures are different. So how do you 'clock' the progress of a plant if your normal clock is not up to the task?

Scientists developed the concept of thermal time, which subtracts a base temperature from the average daily temperature to see if the plant experienced enough heat to progress in its development. Below a certain temperature plants will not develop.

Some models for thermal time also recognise that above a certain threshold temperature, plants either slow or stop growing also.

Glossary

Agronomic	All about growing a crop (e.g. planting depth, row spacing, stubble cover, fertiliser and pest management.
Crop line or crop variety	A type of crop (e.g. a type of barley) that has been selected out by plant breeders and named (i.e. a barley variety name). It has particular characteristics (e.g. grows shorter or quicker or produces larger seeds.
Replication	Replications or duplicates of a treatment in an experiment (so the results can be checked to see if they happened in each treatment that was identical).
Randomisation	To make treatments or plant pots random in arrangement so that other factors (other than those being tested) do not impact on the experiment results.
Photoperiod	The duration of an organism's daily exposure to light, considered especially with regard to the effect of the exposure on growth and development.
Thermal Time	Is measured as degree days (the number of days at a particular temperature). A crop may need to grow through a particular number of degree days to fulfil a development phase. The term is used in crop growth modelling.
Planting Window	The calendar period during which a crop can be planted e.g. December – February (depends on climate and therefore varies at each location).

Questions and activities (years P – 7)

Questions

1. What was different about the two (or more) environments?
2. Did the plants perform differently in the two environments? If so, how and why?
3. Which environment did the plants perform best in?
4. What type of climate would best suit the growing of soybeans and millet?
5. How do you think rainfall and temperature might affect the incidence of pests and diseases? Can you give an example?

Drawing competition

Draw a picture of a "super" field plant that will be able survive an extremely hot and dry climate. You might like to label the plant's "super" features that will make it the best crop for farmers to grow.

Questions and activities (years 8 - 12)

Questions

1. What was different about the two (or more) environments?
2. Did the plants perform differently in the two environments? If so, how and why?
3. What type of climate would best suit the growing of soybeans and millet?
4. How do you think the climate might affect the incidence of pests and diseases? Can you give an example?
5. Can you give some examples of how we can manipulate growing environments to suit the requirements of plants?
6. What plant growth characteristics would plant breeders look for when they are developing crop varieties adapted to drier or wetter conditions. (You may need to do some research to help answer this question).

Case study (years 8-12):

Scenario: The Queensland Government has started an incentive scheme to encourage grain growing in northern Queensland to produce more grain in Queensland.

The scheme was started after five years of poor cropping seasons (low rainfall) in southern Queensland combined with the recognition that some of the poorer farming soils that had been farmed for the last 40 - 50 years were now becoming uneconomical to farm as too much expensive fertiliser was required to produce reasonable crops.

What advice could you give farmers, in relation to the questions below, before they try growing crops in northern Queensland?

A. What climate are the farmers likely to experience in the north and how could they decide which grain crops to grow and how to grow them?

B. What information on crop types and climate conditions would be helpful?

Queensland Government

Optional activity (all year levels)

Farming over the years at Hermitage Research Station

Farming our Future

If you look back 50 or 100 years Queensland farmers were very different from today. They used different machinery, grew different crops, farms looked different and climate was probably different.

The consumers of their produce had different expectations and bought very differently than today.

Look 50 to 100 years into the future and look at similar questions…

- What might farm machinery look like?
- What might crops be?
- What will farms look like?
- How might climate change?
- How will we buy our food?
- Draw the future of farming.

Agricultural scientists at Hermitage Research Station research current problems and try to predict what future issues will be. One area of research is to make crops more able to perform better in drier environments and survive better under disease and pest attack.

Useful websites

Plant Science Competition website
Please go to http://www.dpi.qld.gov.au/4791_4235.htm for a direct link to the DEEDI Hermitage Research Station Schools' Plant Science Competition website. However, you may prefer an easier link to remember: Go to http://www.dpi.qld.gov.au/cropresearch. Once on this page, just scroll down and click on the link to the schools' competition website. All downloads required for the competition will be available here. *If you have any problems accessing the website, please contact Kerrie Rubie on 07 4660 3601*

Other useful sites

What does a Plant Breeder do?

DEEDI Hermitage Research Station Schools' Plant Science Competition
http://www.dpi.qld.gov.au/4791_4235.htm For further information on the role of a Plant Breeder, please download the document titled "What does a Plant Breeder do?"

Weather/Climate

The Bureau of Meteorology www.bom.gov.au While we are encouraging you to make your own observations of the weather as you experience it, you may find value and interest in comparing your data to your nearest weather station.

Australian Government Department of Climate Change: http://www.climatechange.gov.au/

Queensland Government Office of Climate Change: http://www.climatechange.qld.gov.au/

Climate Change in Australia: http://www.climatechangeinaustralia.gov.au/

Thermometer fact sheet: http://www.science-at-school.com/4C/06folder/mainText.html

Crops

DEEDI fact sheet on Millets
http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/26_3519_ENA_HTML.htm

DEEDI soybean sheets
http://www.dpi.qld.gov.au/documents/Newsletters/Future-Grains-Sept-08_Part11.pdf

http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/26_12465_ENA_HTML.htm

http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/26_11723_ENA_HTML.htm

Need some help?

You can contact the DEEDI Hermitage Research Station on 07 4660 3666 or email kerrie.rubie@deedi.qld.gov.au if you are encountering any problems or need some further advice.

School visits from DEEDI staff

- Mid way through the competition, an email is sent to participating schools asking whether any help or assistance is required with the competition experiment or the topic in general.
- DEEDI Hermitage Research Station staff (scientists, agronomists, technicians) will travel to local schools (within an hour or so of Warwick) and visit with the children/teachers involved in the competition to answer questions and have a look at how the experiment is going. This can be arranged by contacting Kerrie Rubie at the Hermitage Research Station.
- If you are situated outside the local area, there are a number of other options to gain assistance with the competition:
    - You can phone the Hermitage Research Station and be connected to the appropriate staff member who will answer your questions.
    - Students/teachers can put a list of questions together and email, post or fax them to Kerrie Rubie and they will be forwarded to the appropriate staff member, answered and returned to you.
    - Hermitage staff can check the availability of another DEEDI staff member, in a town near year, to visit with you.
    - Hermitage Research Station staff are happy to participate in on-line chats with teachers and students to answer any questions. These chats are normally organised by school teachers.

Judging criteria

All year levels will be judged on submitted projects/reports. Marks will be awarded against the content of your project including demonstrated understanding of scientific method, answers to questions and tasks, graphs/tables displaying data, photos, drawings, observations, conclusions, presentation, attention to detail and further research, as relevant to your year category.

We are only looking for the basics from year's p-3 and look for increase in content and research as the year levels increase.

We understand that teachers need to assist young students in putting together a project entry, but it is ideal for younger students (yr p-3) to attempt some of their own work – not an entry completely done by the teacher.

Extra credit is given to students who present a report containing excellent content, extra research into the topic, further experiments and good scientific method and conclusions.

Submitting your entry

You will need to complete the **Entry Submission Form** (which you can download from the competition website) and attach with your entry. The **closing date** for competition entries is **21 May 2010**. Please forward your entry and the competition entry submission form by the closing date to:

Post: Schools' Plant Science Competition
Hermitage Research Station
604 Yangan Road
WARWICK QLD 4370

or Email: kerrie.rubie@deedi.qld.gov.au

All entries will be kept at Hermitage Research Station for a 12 month period, unless you indicate that you want them sent back to your school. Drawings, photos and other material presented in your entry may be used for promotion of the competition.

We request that winning drawing competition entries remain at Hermitage Research Station to be placed on display.

Please ensure that the Queensland Government Consent Forms have been completed so that any submitted photos, student work/drawings and feedback can be used by DEEDI for promotional purposes (e.g. media, websites, posters, displays, reports).

Prizes you can win

Depending on sponsorship money received, we are normally able to provide a great variety of prizes over each year category:

★ Paul Johnston Memorial Senior Science Awards

Awarded to a winner and runner up in the year 11-12 category who submit exceptional project entries demonstrating excellent knowledge of scientific process and research into the competition topic (awarded to individual students only). ***NOTE:* *Students must also submit an accompanying document (no more than 1 A4 page) detailing their interest in agricultural science and plans for tertiary education. Teachers or mentors are required to endorse each application.***

Prize (Winner): handcrafted medallion, certificate and $1000 to go towards books/reference materials for the student's first year of tertiary education.
Prize (Runner up): handcrafted medallion, certificate and a 12 month subscription to a scientific journal of the student's choice to the value of $500.

Dr Paul Johnston was a plant breeder based at Hermitage Research Station where he worked on linseed and barley. Paul had a passion for sport, barley and the development of young scientists. He was successful at all three, having represented Queensland Country in cricket, releasing eight varieties of barley and nurturing many promising young scientists to achieve their potential. Paul was a driver and foundation committee member of the inaugural Hermitage Research Station Schools' Plant Science Competition. Paul passed away suddenly in 2001 and a Trust fund was established in recognition of his contribution to Hermitage, to the barley industry and to the community. This Fund is now a major sponsor of the Schools' Plant Science Competition.

Queensland Government

★ Joe Baker Outstanding Achievement Awards

Awarded to students who submit an outstanding entry demonstrating excellent presentation and science communication (usually awarded to one student or small team, in each year category).

Prize: handcrafted medallion and a certificate recognised and signed by Professor Joe Baker (for each recipient). ***Note: Medallions are now awarded, instead of trophies***

Professor Joe Baker is one of Australia's most respected marine scientists and environmental advocates. In his 40 years in science, Prof Baker has been an inspirational leader of the Australian marine science community, mentored many key figures in Australian science, and increased knowledge about the plants and animals living in Australia's marine territory.

Joe Baker has been influential in Earthwatch, the United Nations Convention on the Law of the Sea, the Australian Heritage Committee, World Wildlife Fund Australia and played an important role in gaining World Heritage listing for the Great Barrier Reef.

He was also instrumental in generating awareness and progress in the issues surrounding the ethical utilisation of biodiversity in biotechnology research within the Asian Pacific region. He helped underpin the landmark Manila Declaration in 1992, and the Malacca Accord in 1994, and also in 1994 co-authored the fundamental tome on the Australian regulatory situation. This work laid the foundation for Australian regulatory reform.

From 1993-2004 he was Commissioner for the Environment of the Australian Capital Territory and in 1999 he became Chief Scientific Advisor of Queensland's Department of Primary Industries and Fisheries where he advises government on strategic policy issues related to public research and development.

In 2002, Prof Baker received the Order of Australia for his contribution to environmental studies and chemistry. He is a 'Queensland's Great' awardee and a Centenary Medal recipient.

The Hermitage Research Station Schools' Plant Science Competition organising committee are very proud to have Prof Baker involved as a long-term sponsor and supporter of our competition.

★ AIAST Junior Achievement Awards

Awarded to a winner and runner up in the year 8-10 category who submit an excellent entry demonstrating a good understanding of scientific method (awarded to individual students only).

Prize (Winner): engraved AIAST medallion, certificate and a book prize
Prize (Runner-up): book prize and certificate

★ Highly Commended Awards

Awarded to individuals, small teams or classes that submit a high quality entry worthy of extra credit.

Prize: handcrafted medallion and a certificate (for individual winners) or framed medallion and certificates (for small team/class groups).

★ Overall first, second and third place 'class prizes'

Awarded to a whole class in each year category.

Prize: science based books and/or CD ROM's (for the class to share) and individual certificates.

★ Encouragement prizes

Awarded to classes, individuals or small teams that have demonstrated great effort and enthusiasm.

Prize: science based books and/or posters and certificates.

Queensland Government

★ Drawing competition prizes

Awarded to one student from each of the primary year levels p – 7 (8 prizes in total) with the most popular artwork, as judged by Hermitage Research Station staff.

Prize: science based book and/or poster and certificate.

★ Participation certificates

Awarded to all students who submit an entry but do not receive any of the above prizes.

All prizes are presented to students at the annual Presentation Day held at the DEEDI Hermitage Research Station, Warwick (date to be advised). If you are unable to attend the Presentation Day, prizes are posted to you. Occasionally we can organise for DEEDI staff in a town near you to present prizes at your school.

Presentation day

The annual Presentation Day is held at the Hermitage Research Station, Warwick to formally acknowledge the competition winners (normally held at the end of July).

All students who submit an entry in the competition are invited to attend the Presentation Day. Teachers, school principals and family members are also invited. Other invited guests include the Minister for Primary Industries & Fisheries, Professor Joe Baker (sponsor and visiting Science Fellow DEEDI), DEEDI management staff, competition sponsors, Education Department representatives, Hermitage Research Station staff and the media.

Presentation Day Proceedings

The Presentation Day is normally held between 10:00am and 1:00pm and the agenda includes:

- Welcome and introduction from the Hermitage Research Station Centre Leader
- Speeches by the Minister for Primary Industries and Fisheries and/or Professor Joe Baker (if attending) and/or DEEDI management staff and competition sponsors
- Presentation of a competition entry by a pre-selected school
- Presentation of prizes – Paul Johnston Memorial Senior Science Awards (presented by Mrs Mary Johnston, if able to attend), Joe Baker Outstanding Achievement Awards (presented by Prof Joe Baker, if able to attend), AIAST Junior Achievement Awards (presented by AIAST representatives), Highly Commended Awards, Overall First, Second and Third class prizes, Drawing competition prizes, Encouragement prizes and Participation certificates
- Photo session with DEEDI staff and/or competition sponsors
- Tour of Hermitage Research Station
- Lunch for all attendees

All competition entries are placed on display during the Presentation Day.

If you find the instructions in this handout difficult to follow, or are missing some items from your free kit, please contact Kerrie Rubie at the Hermitage Research Station by phone: 07 4660 3601, or email kerrie.rubie@deedi.qld.gov.au

Queensland Government

Many thanks to the following organisations and people who support and sponsor the competition each year:

Queensland Government

GRDC Grains Research & Development Corporation

1939 ~ 2007
Paul Johnston Memorial Trust

Queensland Government Education Queensland

PIONEER. BRAND • SEEDS

GRAINS RESEARCH FOUNDATION LTD

AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE & TECHNOLOGY
Bringing the Elements Together

BLUE Ribbon SEED & PULSE EXPORTERS

HSR seeds

Professor & Mrs
Joe Baker

SELECTED SEEDS

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Queensland Government