TECHNOLOGY

Processing

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District D15

2009

Grade 9

Learner ______________________________

Teacher ______________________________

Date	Contents	LO 1 (S)					LO 2 (K)			LO 3 (V)			Marks LO 1	Marks LO 2	Marks LO 3
		AS 1	AS 2	AS 3	AS 4	AS 5	AS 1	AS 2	AS 3	AS 1	AS 2	AS 3	Skills	Knowledge	Values
PROCESSING															
Investigate:															
	Case Study 1: Nguni grainpit	#				#					#				15
	Case Study 2: Materials for insulation	#					#				#		25		
	Resource Task 1: Evaporation cooler	#					#								10
	Resource Task 2: Test materials	#					#						20		
Design															
	Design Brief		#				#						5		
	Specifications		#				#						5		
	Possible ideas		#			#	#						10		
	Final design		#			#	#						10		
Make:															
	Planning			#		#	#						10		
	Project: Portfolio file			#			#						30		
Evaluation:															
	Strong & weak points				#		#						5		
	Improvements & changes				#		#						5		
Tests															
	Test	#						#						50	
	Total:	#	#	#	#	#		#			#		125	50	25
													÷ 5 x 2	÷2	
													50	**25**	**25**
													Total:		**/100**

CAPABILITY TASK

It is mid-winter and your friend who lives on the other side of town is very sick. You want to take him/her some hot soup. Because of the distance you can only take your friend food again in two days' time, the soup therefore should stay hot for at least 24 hours.

Eskom has reinstated it's loadshedding initiative and your friend has no electricity. Your area has electricity at the moment so you need to heat up the soup and get it to him/her without it cooling down.

You are going to design and make a container in which you can keep 500 ml to 1 liter of soup hot for a period of 24 hours.

Given specifications:

- You may only use found objects and materials to make your insulating container.
- You will be working in groups of 2 or 3.
- The size of your container may not be bigger than 300 x 300 x 300 mm

At the end of your project (in the space after the drawings for your Final Decision) you have to write a very detailed explanation of your choices of materials and how your container will achieve the requirements.

Designing and making a container without expaining what you did, why you did it and why it will fulfill the requirements is UNACCEPTABLE.

Preserving materials

No substance, from metal to wood to food, will last forever. Many things can cuase substances to spoil, degrade or rot. People use their intelligence to find ways to prevent or slow down spoiling. Preserving is a response to the problem of spoiling. Many food preservation techniques were developed in the era before electricity and refrigeration, for example:

Biltong - salted and dried meat first used by the Voortrekkers
Bokkoms - salted and dried fish by the Cape Malay community
Mopane worms - sun-dried by the Venda people

We will deal with several methods of preservation in this module, for example: how can wood, metal and food be preserved.

Wood

Wood is an excellent natural product, but it can easily be damaged if not properly cared for. Trees are vital components of the earth's ecosystem and are primarily responsible for converting carbon dioxide into oxygen during photosynthesis. When wood is burnt or allowed to rot, the process is reversed:

Carbon (from the wood) + oxygen (from the air) = CO_2

Burning a tree undoes the entire life's work of the treesin only a few hours. Whenever a tree is cut down. at least one indigenous tree should be planted as a replacement.

Some exotic (foreign) trees come from wetter climates than ours and are water-wasters. Exotic trees, like the Black Wattle, often invade river and stream banks, reducing the flow of water. They should be removed. The Australian Blue Gum trees tend to be much thirstier than our South African indigenous trees. Such trees should be replaced, especially in sensitive areas - like next to farmlands.
When trees are cut down, the wood should be utilised for furniture, school desks and roof trusses. Only smaller branches and bark should be used as firewood.

Deforestation
The forests of the Amazon River in South America and on the islands of Indonesia are being felled at a mind-boggling rate. The high-quality wood is exported to the richer nations of world, and local inhabitants reap very few benefits. These trees form the green lungs of our planet. Removing them is causing the quantity of carbon dioxide in the atmosphere to rise, and this is a major cause of global warming.

Remember that tropical forests take sixty years or more to mature. Temperate forests in cooler lands grow more slowly and take twice as long. Parts of Africa are also being looted for timber. The wood is exported outside our continent.

Trees are vital for the health of the planet and wood is a valuable commodity. Wood should be treated with respect and protected.

Although wood is classified as a renewable resource, trees grow too slowly. Careless or ignorant people are cutting trees down at a faster rate than they can be replaced. We must use our resources in a responsible, intelligent and sustainable way.

There are a number of important points to remember when protecting wood:

The protective material used . . .

- should be easily absorbed by the wood
- must poison organisms that attack the wood, but be safe for humans and animals.
- should be readily obtainable locally
- must be cost effective

The protective material used should not . . .

- reduce the strenth of the wood
- cause metals to corrode (rust) for example nails and screws
- change or affect the surface of the wood
- make the wood more flammable

Preserving metals

Iron is a metal that rusts easily by combining with oxygen in the air to form various iron oxides. Iron is the most widely used metal in industry, especially if it is alloyed to another metal to improve its strength or its resistance to corrosion. In 1889 the Eiffel Tower was built in Paris. This proved the abilities of iron in construction. It has become the most widely used material in high buildings.
Iron can be painted, chromed, tinned, galvanised with zinc or even rubbed with oil. It can be alloyed with chrome, vanadium, tungsten and titanium.

A metal is a substance that conducts electricity and heat well. All metals are shiny - you may have to clean off the oxide coating before you see the shine. They are malleable (can be pressed into shapes) and ductile (can be stretched to form wire). Most metals have high melting points (and even higher boiling points).

Copper is used for most electric wire because it is an excellent conductor, and it does not rust (corrode) easily. It is also used for household objects.

Gold and platinum are used in industry and jewellery because they do not rust at all. Platinum is used for jewellery and chemical catalysts. Gold is used for jewellery and very thin wires.

Other useful metals are aluminium (for cans, aeroplane bodies, cooking foil, pots), iron (for cans, construction, tools, cutlery, steel wire, steel springs, cars, ships, and so on.) and lead (for plumbing).

Some metals are alloyed (mixed) with the above-mentioned metals to improve their properties. For example:

- stainless steel is an alloy of chrome and iron
- tool steel is an alloy of vanadium and iron
- tungsten and iron gives a very hard steel for cutting tools and electric light bulb filaments
- brass is an alloy of copper and zinc (used for brass door handles, hinges)
- bronze is an alloy of tin and copper (used for bronze for statues, machines parts and bearings).

We saw earlier that iron rusts easily. Iron can be protected by coating it with paint, or with another metal that does not rust as easily: tin on iron (tin cans), zinc on iron (galvanised iron roofing sheets, fencing wire, pipes). The protection is very effective if undamaged. Once the metal coating has been damaged, the iron will begin to rust. The rate of the corrosion now will actually be faster than normal for uncoated iron.

Galvanised iron

The main method of protecting iron from rusting is to coat it with zinc. This is so common that corrugated galvanised iron roofing sheets are often called zinc roofing sheets - this is not accurate since the main metal is iron.

There are different methods of coating iron with zinc:

Galvanising can be done in several ways:
- Electroplating - using electric current to deposit zinc atom by atom.
- Hot dip coating - dipping iron into molten zinc.
- Sherardizing - covering the iron in zinc dust and baking it on in an oven.
- Spraying - applying molten zinc using a fine spray.

Zinc is easier and cheaper to apply than chrome, nickel or tin.

Electroplating

The piece of iron to be coated is placed in a bath containing a zinc salt solution - let us say zinc chloride. The iron is connected to the negative pole of the battery. Another piece of pure zinc is connected to the positive terminal of the battery and placed in the other end of the bath.

We need a steady direct current (d.c.) with a low voltage. You will not need more than 6 V to get satisfactory results. When the current flows through the solution, ions of zinc deposit out of the solution onto the iron at the `cathode' (the negative electrode).
Electrolytic plating can be done with several metals. The shiny chrome on a motorcycle is fixed to the underlying metal using electrolysis.

Before you can electroplate it, the object must be cleaned thoroughly. Wash the object thoroughly, using an old toothbrush if it has a rough surface. Dip it into an acid solution - vinegar will do if you leave it long enough. A smooth, polished object will give the best results.

Hot dip galvanising

This fast and effective method is widely used to galvanise iron on a large scale. The key to a good bond between the iron and the zinc is cleanliness. The process is as follows:

- Step 1: Degreasing - the iron is dipped into a hot caustic soda bath. This removes oil, organic materials and paint.
- Step 2: Pickling - the iron is immersed in acid to remove rust and dirt.
- Step 3: Rinsing - the iron is then washed to remove all traces of acid.
- Step 4: Heating - the iron is heated to a temperature of 455 °C to 460 °C.
- Step 5: Prefluxing - the hot iron is dipped into a solution of zinc ammonium chloride for final surface preparation.
- Step 6: Spelting - the hot iron is dipped into a bath of molten zinc.
- Step 7: Quenching - the hot coated iron is dipped into a zinc chromate solution to cool and to stabilise the surface to prevent early rusting.

Preserving foods

From the moment a ripe fruit or vegetable is pickled, or an animal is slaughtered for the meat, the food begins to spoil. So we must either use foods that are as fresh as possible, or we msut use some form of food technology to keep it as fresh as we can, for as long as possible.

Why does food degrade?

Bacteria, yeasts, moulds and fungi are tiney living 'micro-organisms' that can spoil food very quickly. Chemical changes caused by enzymes (organic catalysts) soon affect the taste, texture and look of foods. Oxygen from the air may react with chemicals in the food leading to changes of colour, smell and flavour. Animals like insects and rodents cause huge losses in stored foods.

Food poisoning is most often caused by bacteria like salmonella, botulinum, and Staphylococcus. Food poisoning may occur from one hour or even up to three days after eating contaminated food. Symptoms include diarrhoea, nausea and vomiting, pains in the abdomen and fever.

The deterioration can be slowed if we create conditions that the causes of degradation do not like. Fungi and bacteria do like warm, moist conditions which make them grow. Heat also speeds up chemical processes. To fight them we just need to provide the cold and dry conditions that they do not like. In this way we are able to extend the shelf life of many foods.
If we cut off the oxygen supply by vacuum packaging or by storing in a sealed container we reduce the bad effects of oxidation. Using insect-proof containers stops the destruction of stored foods by animals.

Food spoilage can be slowed or prevented using physical and/or biological processes:

- Physical processes: heating, refrigeration, freezing, drying, curing, canning.
- Biological processes: fermenting for example yoghurt, cheese and so on.

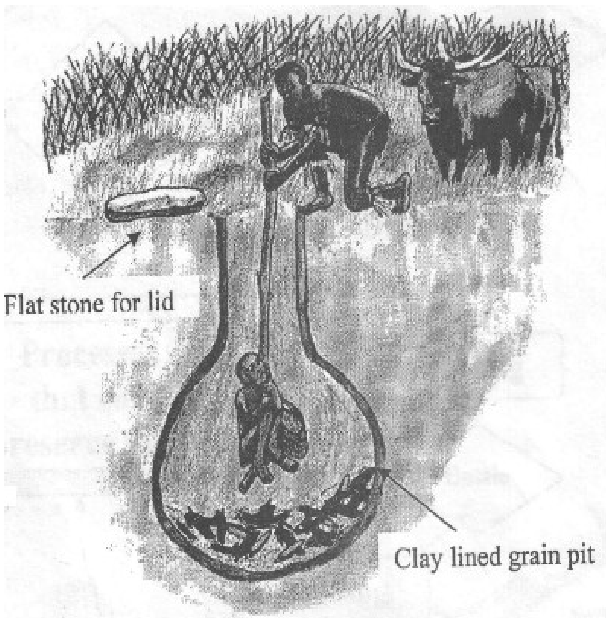
Using these techniques stops deteriorating caused by bacteria, yeasts, moulds and fungi.

In some cases, the preservation is only partially effective. We may need to add chemicals to help extend the lifespan. Additives that help preserve foods include salt, benzoates and propionic acid. Another approach is to use antioxidants to prevent undesirable changes in colour or flavour caused by oxygen in the air.

CASE STUDY 1

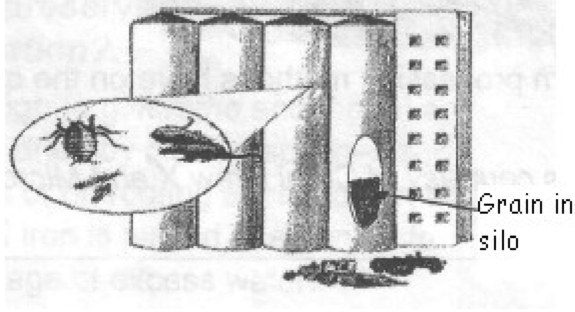
Date:______________________

The Nguni grainpit



After opening the Pit and Ieaving it open long enough a father lowers his son in to the pit to collect stored grain for use by the family.
The Nguni people of South Africa have long had an effective solution to the problem of storing grain. The sorghum grown in past centuries and the more recent use of maize, is threatened by rats, insects fungi and mould. The Nguni tradition of storing grain in claylined grainpits is remarkably effective. The grain remains in near-perfect condition
for many months.

So, how does it work?
The rural people dig a hole, usually in the cattle kraal. The hole is lined with moist clay. When the grainpit is ready, the sorghum or maize kernels are poured into the pit. A large, f lat stone is placed on top as a lid, and sealed with cow dung mixed with clay. The pit is left undisturbed until the grain is needed. When the pit is opened, it must be left open for some hours because it is not safe to enter at first. The grain is in near perfect condition, except for the kernels that were touching the clay sides of the pit. These kernels show signs of having started to ferment but then the fermentation has stopped.



What is the secret science that makes this preservation process successful?
When the pit is completed the clay sides are still

slightly damp. Grain kernels in contact with the damp clay begin to ferment. The fermentation process releases carbon dioxide gas(co$_2$), a heavy gas that soon fills the sealed grainpit. The grain is thus completely surrounded by the CO_2 gas. Without oxygen the fermentation process stops. No insects or rats are able to invade the protective environment of the pit. No aerobic bacteria moulds or fungi can survive in
this CO_2 only atmosphere.
Modern grain silos are also at risk from attack by insects, rodents, moulds and fungi. CO_2 gas can be used to replace the air simply by placing a block of dry ice in the top of each silo, and sealing the bottom. Dry ice soon sublimes to form CO_2 gas.

Answer the following questions:

1. Explain the role of CO_2 gas against insect and rodent attack. (2)

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2. Why is it dangerous to lower a child into the pit to retrieve grain as soon as it is opened? (2)

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3. Why did the grain kernels against the sides of the pit start to ferment? (3)

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4. This indigenous technology is very appropriate for small subsistence storage systems. How can CO_2 be introduced to prevent damage in modern commercial grain silo as the one pictured above? (2)

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5. Present systems diagrams
 a. To represent the indigenous preservation system used by the Nguni people. (3)

 b. To represent the more modern preservation system suggested. (3)

Assessment					
Aspect	**Level 7** **(Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Case Study 1	Answers were logically planned and well structured and provide in-depth information	Answers planned that provide information to suit the aim of the task	Some answers were given but not all are applicable to the aim of the task	Incomplete or could not answer questions	___ **15**

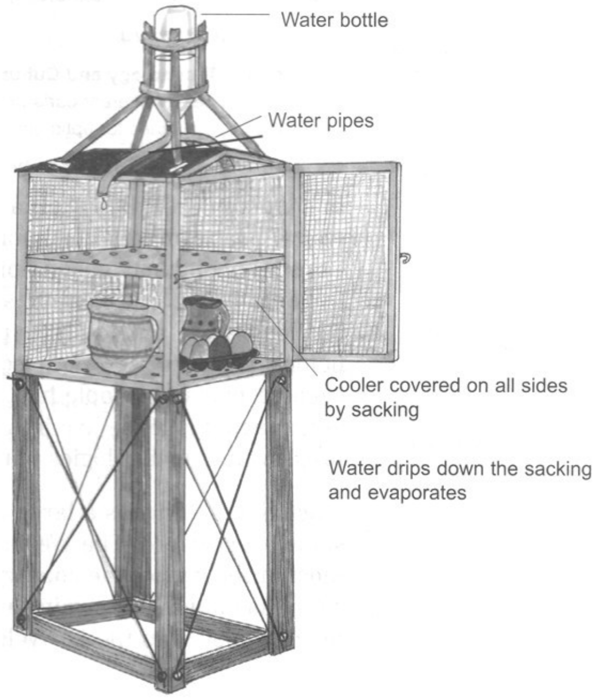
Freezing foods
The Eskimos have been using the natural winter freezing to preserve food for centuries. Most meat, fish, vegetables and fruits can be preserved by freezing, but some foods freeze better than others. Preserving food by freezing makes it too cold for moulds and bacteria to reproduce, and this makes it impossible for them to function.

Large numbers of our country's people live in poor areas, often without electricity. Many of them have no way of cooling their raw foods and because of this, food is often spoiled. This makes their lives even more difficult and hazardous.

RESOURCE TASK 1:

*Date:*_______________________

Here is an idea for a design of an 'evaporation cooler'. It uses a bottle of water which keeps the hessian wet. This simple set-up can lower the temperature inside it by as much as 10°C below the air outside it.



1. Find out how the 'evaporation cooler' works. What is the scientific principle that explains why this simple cooler works. (You must use an example to explain this.)

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2. Look at the picture and make a list of 5 materials you will need to make an evaporation cooler like this. (5)

a. __________________________________ d. __________________________________

b. __________________________________ e. __________________________________

c. __________________________________

Assessment					
Aspect	**Level 7 (Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Resource Task 1	Assignments completed and correct. Obvious effort.	Assignments completed and correct. Some effort.	Assignments completed haphazardly. Hardly any effort.	Assignments incomplete. No effort.	___ **10**

If you have access to the internet you might find these webpages useful:

http://home.howstuffworks.com/thermos.htm
http://en.allexperts.com/q/Science-Kids-3250/insulation-1.htm
http://www.juliantrubin.com/fairprojects/chemistry/insulator.html
http://www.school-for-champions.com/science/thermal_insulation.htm
http://www.gcsescience.com/pen14-cavity-walls.htm
http://home.howstuffworks.com/tips-for-insulating-greenhouses.htm

CASE STUDY 2

*Date:*________________________

Exploring Materials that Minimise Heat Loss

Questions:

1. What materials would let heat pass through them quickly? (3)

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2. What materials would not let heat pass through them very quickly? (3)

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3. Explain what heat insulators and conductors are. Give examples. (6)

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4. Explain the difference between convection and radiation. (6)

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5. How does the thickness of a material affect how quickly heat passes through it? (2)

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6. What materials are used commercially as insulators? (3)

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7. What do you think would be a good material for insulation? Why? (2)

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Assessment					
Aspect	**Level 7 (Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Case Study 2	Answers were logically planned and well structured and provide in-depth information	Answers planned that provide information to suit the aim of the task	Some answers were given but not all are applicable to the aim of the task	Incomplete or could not answer questions	___ **25**

RESOURCE TASK 2:

*Date:*______________________

Homework Activity: Testing Different Insulation Materials

Question 1:

Compare 3 bought coolboxes and discuss briefly how each isulates its contents. (5)

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Question 2: Test the heat insulation qualities of different materials.

Equipment:

- 5 plastic cups of the same size and thickness.
- Ice cubes
- A variety of materials to be tested, for example, different fabrics, cotton wool, egg cartons and other cardboard and paper, bubble wrap (used in packaging), aluminium foil, plastic wrap.
- Polystyrene, for example, cups or offcuts from packaging.
- Scissors and sticky tape.
- watch

What to do:

1. Choose 4 materials to test and insulate your containers with equal thicknesses of each. One is left uninsulated.
2. Put the same amount of ice cubes in each cup.
3. Check the cups every few hours and count how many ice cubes have not melted.
4. Tabulate the results in a graph below. (15)

Assessment					
Aspect	**Level 7 (Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Resource Task 2	Assignments completed and correct. Obvious effort.	Assignments completed and correct. Some effort.	Assignments completed haphazardly. Hardly any effort.	Assignments incomplete. No effort.	___ **20**

DESIGN

Design Brief

Date:________________________

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Assessment					
Aspect	**Level 7 (Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Design Brief	Formulation of problem solving is clear and comprehensible.	Formulation of problem solving is reasonably clear	Formulation of problem solving is vague	Formulation of problem solving is incomplete and not relevant	___ **5**

Spesifications

Date:________________________

Assessment					
Aspect	**Level 7 (Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Specifications	List of specifications complete and relevant.	Specifications complete	A few specifications were given	Specifications incomplete	___ **5**

Possible ideas

Date:________________________

*Make freehand 3-D drawings of **3 possible ideas** and briefly give pros and cons for each idea.*

Pros and cons: ____

Pros and cons: ____

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Pros and cons: ____

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Assessment					
Aspect	**Level 7 (Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Possible ideas	Ideas very neatly drawn, labels added. All pros and cons mentioned. Chosen idea very well motivated.	Ideas reasonably neatly drawn, labels added. Pros and cons mentioned. Chosen idea motivated.	Ideas not neatly drawn labels added. Few pros and cons mentioned. Chosen idea not clearly motivated.	Incomprehensible drawings of ideas. Pros and cons incomplete. Weak motivation of chosen idea.	___ **10**

Final Design

Date: ______________________________

Give final information about your product and make the drawings.

Make a first angle orthographic drawing of your product and indicate dimensions.

Make 3-D drawings of your product. Make use of exploded drawings and labelling to explain your idea in as much detail as possible.

Explanation of my choice of materials and why my container complies with the requirements.

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Assessment					
Aspect	**Level 7** **(Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Final design	Working drawing and 3-D drawing is done and labeled.	Parts of the working drawing and 3-D drawing have been omitted.	Working drawing and 3-D drawing are incomplete.	Working drawing and 3-D drawing are neat and is labeled.	___ **10**

FLOW DIAGRAM

Date:______________________

Make a flow diagram to indicate your work progress, tools, equipment and materials in detail.

Make a list of your tools, equipment and materials.

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Assessment					
Aspect	**Level 7 (Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Flow diagram	List of tools and materials is detailed Flow diagram is logical and comprehensible.	List of tools and materials is complete Flow diagram is logical and but a bit sketchy.	List of tools and materials is not quite complete Flow diagram is not logical or comprehensible.	List of tools and materials is incomplete Flow diagram is incomprehensible.	___ **10**

Project Date: ______________________________

Paste a photograph of your project here.

Assessment

Aspect	Level 7 (Mastered excellently)	Level 6 (Meritoriously mastered)	Level 4 (Adequately mastered)	Level 2 (Elementary mastered)	Mark
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Project	The container can hold 500 ml to 1 liter of soup hot for a period of 24 hours. Only found objects and materials were used. Worked in groups of 2. The size is not bigger than 300 x 300 x 300 mm	The container can hold 500 ml to 1 liter of soup hot for **less** than 24 hours. **Not** only found objects and materials were used. Did **not** work in groups of 2. The size is **too big or too small.**	**Some of these:** The container **cannot** hold 500 ml to 1 liter of soup. Stays hot for **much less** than 24 hours. All objects and materials used were **bought.** Did **not** work in groups of 2. The size is **too big or too small**	**All of these:** The container **cannot** hold 500 ml to 1 liter of soup. Stays hot for **much less** than 24 hours. All objects and materials used were **bought.** Did **not** work in groups of 2. The size is **too big or too small**	**___ / 35**

Evaluation

Date:__________________________

Strong vs Weak points

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Possible changes and improvements

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Assessment					
Aspect	**Level 7 (Mastered excellently)**	**Level 6 (Meritoriously mastered)**	**Level 4 (Adequately mastered)**	**Level 2 (Elementary mastered)**	**Mark**
		Level 5 (Substantially mastered)	**Level 3 (Moderately mastered)**	**Level 1 (Not mastered)**	
Evaluation	Relevant evaluation criteria. Useful ideas to improve product.	Reasonable evaluation criteria and ideas to improve product.	Evaluation criteria unclear. Ideas to improve product irrelevant.	No evaluation criteria. Ideas to improve product incomplete.	___ **10**

Group Evaluation

Write down the name/s of the members of your group in the table below. Give each member a mark out of 10 for cooperation.

Name & Surname	Mark out 10