Extended practical investigation — Brewing

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About this task

This sample demonstrates:

- the integration of at least two focus areas
- strategies for scaffolding student development of research questions and investigations.

This sample is intended to be a guide to help teachers plan and develop assessment tasks for individual school settings.

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Purposes of assessment

The purposes of assessment are to provide feedback to students and parents about the learning that has occurred and to provide feedback to teachers about the teaching and learning processes. Assessment also provides information on which to base judgments about how well students meet the general objectives of the course.

In designing an assessment program, it is important that the assessment tasks, conditions and criteria be compatible with the general objectives and the learning experiences. Assessment then becomes an integral aspect of a course of study. More information on school-based assessment is available from the QSA website.

Developing assessment tasks

An assessment task is work undertaken by a student in response to an assessment instrument and learning experiences and is outlined in a task sheet. In describing assessment tasks to students, teachers need to ensure the following.

- The techniques and instruments chosen allow students to demonstrate achievement in the particular objective or objectives.
- The tasks are written in clear, unambiguous language, thereby ensuring that both the teacher and the student have the same understanding.
- The criteria for both formative and summative assessment always refer to the individual's achievement, even if assessment has involved group work.
- In the assessment of students, the guidelines for quality and equity apply. These are available from the QSA website.
- Task conditions, which are to be consistent with the conditions described in the syllabus, are stated on task sheets.

Subject: Science21

Date: Term 3, 2008

Task Number: 4

Place of task in school work program is clearly identified.

Unit: Biotech in the Kitchen **Task Type:** EPI **Task Name:** Brewing

NAME: _____ CLASS: _____TEACHER: _____

Background research and topic selection	Research proposal	Practical work completed	Draft report	Final due date

Introduction

Ethanol has been known to humans in the form of alcoholic drinks for many thousands of years. If ripe fruit is harvested and left, fermentation of the sugar in the fruit will soon commence, producing ethanol and other compounds.

Fermentation involves yeasts, which occur naturally on the skins of many ripening fruits such as grapes. It is quite probable that early humans, as hunters and gatherers, consumed alcohol by consuming partially fermented fruit. It would have been quite a small step forward to allowing fruit (or partially germinated grain) to ferment in a container to form an alcoholic liquor. Such liquors would have a wide range of compounds present.

Fermenting has become increasingly sophisticated. The process is an exothermic reaction which provides yeast with energy for its metabolism. Glucose is converted to ethanol and carbon dioxide by enzymes in the yeast.

$$C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(aq) + 2CO_2(g)$$

The reaction is anaerobic (does not require oxygen), so fermentation is carried out with air excluded to prevent the oxidation of the ethanol to undesirable compounds such as aldehydes, which affect the flavour of the product and may cause headaches.

Fermentation stops when the ethanol gets too high. Figure 1 below outlines other stressors.

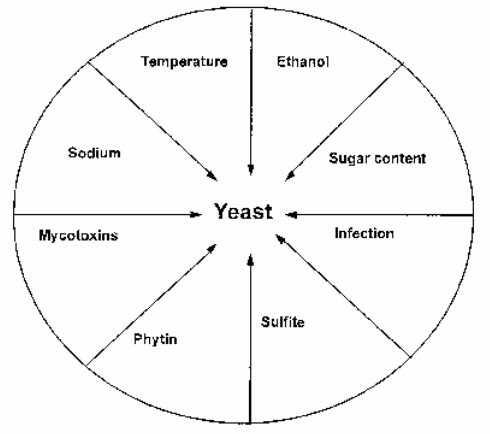

Figure 1. Summary of stressors affecting yeast

Brief stimulus material provides some scaffolding to initial student engagement with this extended practical investigation (EPI).

Students should also have undertaken a range of learning experiences related to each of the general objectives and relevant key concepts. These might have included:

- Direct teaching and investigation of biology and of micro-organisms, chemistry of fermentation etc.
- Analysis of directed investigations of biotic and abiotic conditions favourable to yeast growth.
- Analysis of data and evaluation of relationships between alcohol metabolism, intoxication and risk.

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Your task

During the unit of work, Biotech in the Kitchen, we will be examining the use of micro-organisms to create food and beverage products. Your task is to further this investigation by developing a protocol for the brewing of beer. During your investigation, you will need to address the following aspects:

- **Quantitatively** and **qualitatively** determine the effect of varying an aspect of the brewing process on the percentage of alcohol produced through a fermentation process, such as:
  - the type of sugar
  - the amount of sugar
  - the environmental conditions
  - the duration of fermentation

    or
  - another factor negotiated with your teacher.
- Select, implement and evaluate **two** methods of determining the percentage alcohol in one of the above

Follows the syllabus definition of an EPI (see p. 28). The task requires students to design an investigation.

You will need to document your investigation in a **formal scientific report**. Your report should include the following sections:

- **Theoretical Background:** In this section you should explain the processes of fermentation and the conditions necessary for it to occur. You should connect this to the cellular and biochemical nature of the yeast, including why yeast (as opposed to other micro-organisms used in biotech) is used for brewing. You should also outline the concept of percentage alcohol and explain why it is important part of alcohol labelling laws in Australia.
- **Aim:** Briefly state the specific aim of your investigation.
- **Hypotheses:** Predictions about the outcomes of aspects your investigation.
- **Materials:** List all of the equipment used in your investigation. A range of brewing equipment will be made available to you. Additional equipment may be available upon negotiation with your teacher.
- **Risk assessment:** A thorough examination of the hazards and risks, and how you managed them.
- **Methods:** Summarised from your journal entries, this section will detail the steps you actually undertook in your investigation, including any mistakes, misadventures and refinements. (They're the best bits!).
- **Results:** Tabulation of the qualitative and quantitative results of your investigation. Note: your journal will contain *all* of your raw data. However, your report should contain present the data in a processed, concise form.
- **Discussion:** Discuss your results and the patterns, trends and interrelationships evident therein. Your focus should be on the impact of your chosen independent variable and the biological/chemical explanation of that impact. What are the limits of your independent variable in influencing percentage alcohol? You should also compare and evaluate the different methods for estimating percentage alcohol, including the chemistry underlying each technique.
- **Conclusion:** Summarise the findings of your investigation and discuss the extent to which your hypothesis has been confirmed or refuted. You could also link the findings of your investigation to the concept of a "standard drink".

These starting points for investigation and information about the scientific report genre provide scaffolding.

Scaffolding should be reduced over the two years of the course.

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Conditions

- **Length:** 800 words in the theoretical background/discussion/conclusions sections of your report.
- **Class time allowed to prepare:** Throughout term, one lesson per week. Note that beer takes several weeks to brew and you will need plan for this.
- **Library/computer room lessons:** Three lessons.
- **Homework requirements:** Significant
- **Other important information:**

  — **Checkpoints:**

  1. Background research & topic selection
  2. Research proposal approved (Aim, Method, Materials, Risk Assessment)
  3. Practical work completed
  4. Draft report
  5. Final deadline

  Note: Checkpoints 1 & 2 must be completed before any practical work can begin.

  — Teacher feedback will be given once — on the draft report.

  — The criteria by which this task will be assessed are provided here.

  Note: If you simply collect information and assemble your report, your overall result will be low. In order to achieve high levels of achievement your response needs to demonstrate synthesis of information from a range of sources, application of your knowledge in complex ways.

  — Only work submitted up to and including the due date will be accepted for marking. Late work will be appraised and feedback given, but it will not be marked or included in your folio. A "Not Rated" will be recorded for the task, which may affect your completion of this semester in this subject.

Conditions described:

- provide some scaffolding
- are consistent with syllabus description of EPI (p. 28)
- contribute to the authentication of student work
- reflect a school policy that is consistent with QSA policy on late submission and non-submission of student assessment in Authority subjects and Authority-registered subjects.

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	Task indicator	A	B	C	D	E
KCU	Theoretical background (Fermentation)	Describes and explains fermentation, including complex discussion linking cellular and biochemical aspects; and comparing yeast to micro-organisms.	Describes and explains fermentation, including cellular and biochemical aspects, and role of yeast.	Describes fermentation, including cellular and biochemical aspects, and role of yeast.	States scientific information about fermentation.	States isolated scientific facts about brewing.
IP	Investigation design	Scientific investigation of chosen aspect of brewing is justified in report and refined during execution.	Scientific investigation of chosen aspect of brewing is justified in report.	Scientific investigation of chosen aspect of brewing is selected and implemented.	Given scientific investigation is implemented.	Given scientific direction to collect and record data about brewing is followed
	Materials	Safe selection, operation and adaptation of equipment in order to gather, record and manipulate valid qualitative and quantitative % alcohol data.	Safe selection and operation of equipment to gather, record and manipulate valid qualitative and quantitative % alcohol data.	Safe operation of equipment to gather and record qualitative and quantitative % alcohol data.	Safe directed use of equipment to record qualitative observations of % alcohol.	
	Results/Discussion	Valid data generated, processed and analysed using appropriate mathematical techniques to identify trends and interrelationships between % alcohol and chosen variable.	Valid data generated, processed and analysed using appropriate mathematical techniques to identify trends related to % alcohol and chosen variable.	Data generated, processed and analysed using given mathematical techniques.	The % alcohol data is generated, recorded and presented.	
		Valid data about % alcohol is generated by two different methods, processed and analysed using appropriate mathematical techniques to compare techniques and their underlying chemistry.	Valid data about % alcohol is generated by two different methods, processed and analysed using appropriate mathematical techniques to compare techniques.	Valid data about % alcohol is generated by two different methods, processed and analysed using given mathematical techniques.		
	Report	Discriminating selection, use and presentation of investigative methodology and findings in order to allow replication and confirmation of data by scientific audience.	Selection, use and presentation of investigative methodology and findings in order to allow replication and confirmation of data by scientific audience.	Selection, use and presentation of investigative methodology and findings to scientific audience.		
I & I	Theoretical background (% alcohol)	Synthesises information about % alcohol, alcohol metabolism etc. and expresses reasoned conclusions about its importance in alcohol labelling.	Synthesises information about % alcohol, alcohol metabolism etc. and expresses plausible conclusions about its importance in alcohol labelling.	Expresses plausible conclusion about importance of labelling % alcohol.	States conclusion about labelling % alcohol, standard drinks etc.	Uses given information to make statements about implications of alcohol consumption.
	Conclusions	Synthesises findings of investigation to express informed positions about alcohol consumption, standard drinks etc.	Synthesises findings of investigation to express positions about alcohol consumption, standard drinks etc.	Expresses positions about alcohol consumption, standard drinks etc.		

Key: **KCU** — Knowledge and conceptual understanding **IP** — Investigative processes **I & I** — Issues and impacts

Task-specific criteria and standards are derived from “Standards associated with exit criteria” (see pp. 36–37of the syllabus) using the strategy outlined in the flowchart available on the QSA website: <www.qsa.qld.edu.au>. Select: <P–12 syllabuses & support > Years 11 and 12 > Science > Science21 (2007 pilot) > Advice for teachers > *Developing effective criteria and standards matrixes: Flowchart*>.

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