

T Level in Science Rationale

Formative assessment tasks
Occupational specialism – Laboratory science

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Developing formative assessment materials to support learner success in the T Level in Science occupational specialism (OS) in laboratory science.

Background information

The T Level in Science includes a synoptic assessment of the OS element, which in this case is laboratory science. This assessment is completed at the end of the second year of the course. There are three parts to the summative synoptic assessments for the OS:

- Assessment 1: In this assessment, learners complete a literature review based on a problematic, technical scenario provided. From this research, learners are then expected to produce a standard operating procedure (SOP) and a risk assessment for that SOP.
- Assessment 2: This is a practical assessment of the learners' practical skills, competency and safety skills.
- Assessment 3: This assessment provides learners with data to review, with the learners expected to identify errors, give reasons for these errors and suggest improvements.

Overview

These formative assessment activities have been created as a flexible tool with multiple functions. The primary purpose is to check that learning is taking place and to track individual progress at any point in each learner's learning journey.

The topic running through all the assessment tasks is the production of aspirin, but the tasks can be adapted for use with other topics.

The tasks can be collated into a complete sample synoptic assessment. As learners will not be familiar with synoptic assessments, the collated version of these tasks will help them to practise and become familiar with the approach.

The formative assessment tasks, though contextualised, can be adapted and adopted for other scientific tasks, e.g. aseptic techniques and radioactive count.

Academic, technical and professional behaviours

T Levels have been developed to prepare learners for work and include industry placements. The OS synoptic assessment encompasses academic and technical skills and professional behaviours taught in the classroom or workshop then developed during industry placement. These assessments have been designed to integrate industry-ready skills and academic studies to allow learners to achieve their potential in both the industry placement and academic setting. These will prepare the learners for further study and ultimately employment.

The formative assessment tasks include relevant assessment of these skills and behaviours as well as naturally occurring opportunities to develop English, maths and digital skills.

The assessment tasks provide opportunities for feedback during and after as relevant (feed forward). Each assessment task includes peer and tutor assessment and feedback, and self-reflection. This will enable tutors and learners to track their progress.

Some assessment tasks require learners to peer-assess and act on feedback received. This independent work will provide opportunities for the tutor to have one-to-one tutorials with learners to discuss progress and next steps.

An adapted mark scheme has been created for some tasks in addition to that developed by the awarding organisation. These are used in some of the assessment tasks. This will help learners to understand and monitor their own progress and to develop as independent learners – a transferable and key skill for their industry placement and future career.

The formative assessment tasks are:

Formative assessment 1 – Writing literature reviews

This links directly to part 1 of the synoptic assessment.

- Formative assessment activities:
 - Reviewing scientific literature
 - Writing references
 - Features of abstracts
 - Writing an introduction
 - Writing a literature review
- Types of assessment covered in this task:
 - Peer assessment
 - Review and improve
 - Verbal feedback
- Skills:
 - Independent study
 - Organisational skills
 - Problem-solving
 - Scientific knowledge

Formative assessment 2 – Standard operating procedure (SOP)

Directly linked to synoptic assessment 1

- Formative assessment activities:
 - SOP
 - SOP equipment
 - Writing a hypothesis
 - Writing a scientific introduction in an SOP
 - Writing a method for an SOP
- Types of assessment covered in this task:
 - Peer assessment
 - Review and improve
 - Verbal feedback
- Skills:
 - Independent study
 - Organisational skills
 - Problem-solving
 - Scientific knowledge

Formative assessment 3 – Risk assessment

Directly linked to synoptic assessment 1.

- Formative assessment activities:
 - Hazards
 - Risk assessment content
 - Writing a risk assessment
- Types of assessment covered in this task:
 - Peer assessment
 - Review and improve
 - Verbal feedback
- Skills:
 - Independent study
 - Organisational skills
 - Problem-solving
 - Scientific knowledge

Formative assessment 4 – Practical skills

Directly linked to synoptic assessment 2.

- Formative assessment:
 - Equipment
 - Recording data
 - Identifying important steps in an SOP
 - Following an SOP
- Types of assessment covered in this task:
 - Self-assessment
 - Peer assessment
 - Verbal feedback
- Skills:
 - Organisational skills
 - Scientific knowledge
 - Professional behaviour
 - Promotion of best practice
 - Critical analysis

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T Level in Science

Framework of learning and lesson plans

Formative assessments

Occupational specialism – Laboratory science

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Framework of learning – Laboratory science

These resources have been designed to be used independently as formative assessment activities to check learner progress. They are presented in two documents: one containing the session plans, with the associated resources at the end, and the second document containing all the PowerPoint slides. A contents page is provided below for each section, with the session title, resource title and relevant slide numbers.

It is recommended that each section be read as a separate formative assessment comprising session plan, resources and slide deck. The formative assessments have been grouped together under section titles which follow the format of the final synoptic assessment.

Section title (Slide number)	Formative assessment	Activities	Slide numbers	Resources provided	Resources page number	Total time for each formative assessment
Review of literature resources (2)	01 Reviewing scientific literature	Research, peer and class discussion	3–8	'Aspirin sources list'	75	40
		Plenary		'Self-reflection tracker'	103	
Writing references (9)	02 Writing references	Research, write and peer mark	9–13	Slide 12 as a handout		35
				'Aspirin sources list'	75	
		Spot the errors				
Conducting research (15)	03 Features of abstracts	Research, peer and class discussion	14–18	'Articles and journals related to aspirin'	74	55
		Plenary		'Self-reflection tracker'	103	
	04 Writing an introduction	Research, peer and class discussion	19–23	'Articles and journals related to aspirin'	74	55
		Plenary		'Self-reflection tracker'	103	
Writing a literature review (26)	05 Writing a literature review	Written task	24–29	'Aspirin sources list'	75	105
				'Literature review guide'	76	
		Peer assessment		'Mark scheme'	77–78	

		Improvement and reassessment Plenary				
				'Self-reflection tracker'	103	
Standard operating procedure (SOP) (30).	01 Standard operating procedure (SOP)	Peer work and class discussion	31–34			25
		Plenary		'Self-reflection tracker'	103	
	02 SOP equipment	Accuracy	35–44			65
		Suitability				
		Purpose		'Purpose of equipment handout'	80	
		Writing the equipment list and marking		'Aspirin sources list'	81	
				List of equipment from SOPs	92–96, 97–100	
		Plenary		'Self-reflection tracker'	103	
	03 Writing a hypothesis	Defining variables	45–52			55
		Identifying variables				
		What is a hypothesis?				
		Writing and marking the hypothesis		'Standard operating procedure (SOP) template'	82–83	
				'Mark scheme – Producing a hypothesis'	84	
		Plenary		'Self-reflection tracker'	103	
	04 Writing a scientific introduction in an SOP	Writing and marking	53–57	'Aspirin sources list'	81	45
				'Standard operating procedure (SOP) template'	82–83	
		Plenary		'Self-reflection tracker'	103	
Writing an SOP (70)	05 Writing a method for an SOP	Written task	58–63	'Standard operating procedure (SOP) template'	82–83	105

		Peer marking		'Mark scheme – Writing an SOP'	85	
		Improvement				
		Plenary		'Self-reflection tracker'	103	
Risk assessment (64)	01 Hazards	Identifying risks	65–76	Slide 76 as a handout		90
		Hazard symbols and marking		Slide 78 as a handout		
		Research hazards part 1 and marking				
		Research hazards part 1 and marking				
		Reducing risks				
		Plenary		'Self-reflection tracker'	103	
	02 Risk assessment content	Purpose of a risk assessment presentation	77–82	'Standard operating procedure (SOP) – SOP for the preparation and recrystallisation of aspirin'	92–96	70
		Present and feedback		'Presentation feedback form'	87	
		Severity and likelihood				
		Plenary		'Self-reflection tracker'	103	
Producing a risk assessment (96)	03 Writing a risk assessment	Written task	83–88	'Risk assessment guide'	88	65
				'Aspirin sources list'	81	
		Peer marking		'Mark scheme – Risk assessment'	89	
		Improvement				
		Plenary		'Self-reflection tracker'	103	
Practical skills (89)	01 Equipment	Health and safety	90–98			80
		Setting up equipment		'Standard operating procedure (SOP)'	88–93, 94–96	
		Calibration of equipment		'Standard operating procedure (SOP)'	92–96, 97–100	
		Plenary		'Self-reflection tracker'	103	

	02 Recording data	Methods of data collection	99–104	'Presenting data and information'	91	55
		Presenting data		'Standard operating procedure (SOP)'	92–96, 97–100	
		Plenary		'Self-reflection tracker'	103	
	03 Identifying important steps in an SOP	Identifying health and safety steps in the SOP	105–109	'Standard operating procedure (SOP)'	92–96, 97–100	60
		Identifying accuracy steps		'Standard operating procedure (SOP)'	92–96, 97–100	
		Plenary		'Self-reflection tracker'	103	
Following an SOP (124)	04 Following an SOP	Practical task (preparation and recrystallisation of aspirin)	110–115	'Standard operating procedure (SOP)'	92–96	205
		Practical task (analysis of aspirin)		'Standard operating procedure (SOP)'	97–100	
		Self-marking		'Mark scheme – Following an SOP'	101	
		Reflection		'Self-reflection tracker'	103	

The formative assessments highlighted in yellow are those which can also be used as mock assessments. These collate the information obtained in previous formative assessment activities and draws it together into the style of a mock assessment. These formative assessments have a technical scenario associated with them and can be found in the PowerPoint slides after the introduction slide.

Revision materials linked with aspirin can be found in the appendix and slides 116–124. Those materials represent one hour of teaching.

Literature review

Formative assessment

Lesson plan
T Level in Science
Occupational specialism – Laboratory science

Session number: 1 of 4	Session title: Writing literature reviews
NCFE reference	Specification references K2.1: How considerations inform the planning of laboratory procedures. K2.2: How to undertake literature searches and use scientific papers to plan scientific tasks. S2.16: Perform a literature review to extract relevant information to support planning a scientific task. S2.17: Apply knowledge of scientific techniques to an unfamiliar context when planning a scientific task.
Session rationale and guidance This session comprises four formative assessment activities for the literature review topic for the T Level in Science occupational specialism (OS) in laboratory science. These are standalone tasks and can be used to assess whichever aspect or aspects of the curriculum the tutors choose. Each assessment activity comprises an introduction to the task, task instructions, learner self-reflection and any other form of tracking activity deemed appropriate. As there are several peer assessment activities (e.g. peer discussion), tutors will need to model how to do this effectively prior to the first peer discussion. Modelling could be by doing a role-play activity in which the tutor is part of the discussion and provides a criteria or support sheet to scaffold the peer discussion. The criteria or support sheet could be used for the first few peer activities. Tutors can of course substitute other tracking activities as they wish. Best practice would be for the tutor to track the formative assessment activities by keeping a record of how the learners have performed in these activities. This data could be qualitative (such as verbal feedback) or quantitative (such as marks or points given). Tutors should use their organisation's tracking system to monitor learners' progress or set up a tracking system for these formative assessment activities. Tutors would need to use each learner's results to decide how to scaffold any support that may be required to address any learner progress concerns (such as revising a topic in the next lesson, specific work set in directed study or intervention sessions and directing learners to online resources to support their progression). Tutors may also wish to complete a revision exercise prior to doing the formative assessment activity. An example that tutors can use is provided at the end of this section. To support learners' progress, they need to circulate to check learners' work throughout the activities to ensure that they are completing the activities correctly.	

Session rationale and guidance (continued)

If the tutor identifies several learners making mistakes in their work, then tutor should complete revision or recap activities before the activity is re-attempted or provide additional resources to will make the activity more accessible to the learners. Tutors will need methods of checking the learners' understanding for each of these activities, e.g. by using probing questions, taking work in for marking or noting outputs from group discussions. This topic also includes the application of skills development from other parts of the T Level in Science. These are noted in the 'Embedded skills development' section below.

Tutors may wish to merge all the formative assessment activities in this project and use them as examination practice.

These formative assessment activities can be used in other topic areas such as radioactive count in food and sampling of organisms. For these activities to be used for an alternative topic, resources related to this formative assessment activity would need to be adapted, as the resources currently relate specifically to aspirin.

Embedded skills development

Science	Learners will read scientific methods and identify their qualities. Learners will also read scientific theory and link the theory to the practical method.
English	Learners will read scientific literature critically to produce a literature review including references.
Digital	Learners will use the internet to complete their research for the literature review task. They will have access to the 'Aspirin sources list'. Tutors may decide that learners are to research the sources themselves, without the use of the 'Aspirin sources list'
Employability	Learners will be given a technical scenario to help them to see how their classwork would be used in the workplace laboratory.
Health and safety	As part of the research, learners will identify and write about any health and safety considerations.
OS	Some of the technical skills and organic chemistry theory incorporated into the method are directly linked to the specification for the OS. These are: • S2.16: Perform a literature review. • K1.21: Uses of reflux and recrystallisation techniques during organic synthesis. • K1.51: Filtration. • K2.2: Undertake literature searches and use scientific papers to plan scientific tasks.

Examinations		These tasks can be amalgamated and used to practise part of the OS synoptic assessment (OSA) 1 for performing a literature review. Links to core skills: CS2: Researching. Please see the specification (on page 92) for more information. CS3: Working with others. Please see the specification (on page 93) for more information. CS6: Communication. Please see the specification (on page 95) for more information. CS7: Reflective evaluation. Please see the specification (on page 96) for more information.		
Formative assessment activities				
• Writing references • Working in pairs to review a reference source each (Think, pair and share) • Research sources of information • Reflection diary and exit ticket • Green, orange and red cards displayed throughout the activity				
Time	Tutor activity	Learner activity	Slide number and resources (these can be found in the resource pack)	Assessment of learning
01 Review of sources				
5	Introduce the activity and explain what you want learners to do and why (see the red box for instructions).		Slide 4	Throughout these activities, the following assessment for learning will be observed:
	Put the learners into pairs and provide them with a source to read (please see the 'Literature review source list').		'Aspirin sources list'	

10	Describe activity 1 to the learners. Tutors may choose to show learners exemplar assessment materials which are available on the NCFE T Level Science website. As learners complete this task, circulate to ask probing questions to develop their knowledge and understanding.	Activity 1 Learners to read and answer the questions shown on the board.	Slide 5 http://www.ncfe.org.uk/qualification-search/qualification-detail/t-level-technical-qualification-in-science-level-3-delivered-by-ncfe-883	• Think, pair and share • Probing questions to be asked during the activity • Scaffolded questions to be used during the group discussion • Tutor will discuss the learners' reflections that they completed, offer support and give verbal feedback
5	Ask learners to move on to activity 2.	Activity 2 Learners then discuss their source and their findings with another learner.	Slide 6	
10	After this, move on to activity 3 and discuss the two sources as a whole group. Do learners agree with one another on what they have found?	Activity 3 Learners then discuss their source with the whole group.	Slide 7	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 8	

	through each aspect of the reflection shown on the slide. Allow a quiet environment for this. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.		'Self-reflection tracker' Possibly access to the internet and laptops	
02 Writing references				
5	Introduce the session (see the red box for instructions).		Slide 10	Throughout these activities, the following assessment for learning will be observed: • Verbal and written feedback • Peer discussion • Self-assessment • Probing questions to be asked during the activity • Support and verbal
10	Tutor to go through the slide showing all aspects of a reference. Set the activity to write the reference for the source they used in the previous task. Tutor to circulate to give verbal feedback. Tutor can also use a green pen to assess the work as it is being completed. Tutor should keep a record of this in their organisation's tracking system.	Activity 1: Writing references Learners to write the reference on the source they were given for the previous task.	Slide 11: This slide should be printed as a handout for learners to use 'Aspirin sources list'	
5	Ask learners to pair up with someone who had the same source as them to compare their answers.	Once completed, learners to pair up with someone who has the same source as them to compare their work and make improvements if required. Mark their answer using a different colour pen.	Slide 11: This slide should be printed as a handout for learners to use	

			'Aspirin sources list'	feedback for the plenary activity
5	Show the learners the three references on the board. Ask learners to identify the errors. Tutors may ask learners to use websites to collect responses electronically (such as Slido or Mentimeter).	Activity 2: Spot the difference Learners to discuss with the tutor the errors in each of the references written and, if possible, rectify them.	Slide 12 Possibly laptops and access to the internet	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. Tutors may choose to remove the information in italics on this slide and only provide it to learners who require some support. If this is the case, tutors may choose to provide only some of the	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 13 'Self-reflection tracker' Possibly access to the internet and laptops	

	information in italics initially and only provide more if more support is needed. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.			
03 Features of abstracts				
5	Introduction (see the red box for instructions).		Slide 15	
20	Allow learners to choose two of the selection of articles and journals. Once they have the articles and journals, they have to: • identify the type of source it is • read the abstract • make a list of keywords and write definitions for them • write the reference for both papers. If the tutor feels that learners may be struggling with technical vocabulary, the tutor can start this task by going through some of the vocabulary found in the abstract with the group.	Learners to read through two articles or journals. Learners to complete the activity on the slide.	Slide 16 Access to the internet 'Articles and journals related to aspirin'	
20	Once completed, inform the learners that they will have: • peer discussions • whole-class discussion.	Once completed, learners move around the room discussing their findings with other learners. Based on what the learners have discussed, learners provide feedback to the tutor on what	Slide 17 Possibly access to the	Throughout these activities, the following assessment for

	Tutors may choose to use websites (such as Mentimeter) to collate learners' ideas about what is found in an abstract.	multiple abstracts have in common and what they think the purpose of abstracts are. Learners could create an academic poster.	internet and laptops	learning will be observed: • Verbal and written feedback • Probing questions to be asked during the activity • Peer discussion • Scaffolded questions to be used during the group discussion • Support and verbal feedback for the plenary activity
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. Tutors should review these self-reflections to see whether they agree with the comments. Verbal or written feedback can be given. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 18 'Self-reflection tracker' Possibly access to the internet and laptops	
04 Writing an introduction				
5	Introduction (see the red box for instructions).		Slide 20	
15	Set the activity, find two papers online (this could be the two used in the previous	Learners to research articles or journals and choose two to read (this could be the two used in the previous task, 'Abstract').	Slide 21	

	activity, 'Abstract') and identify (by highlighting): • the objective or aim • the hypothesis • why they are investigating this • whether this been investigated before. Tutors may want to use these links which may be useful for this task: • https://www.youtube.com/watch?v=W_xKvu4Sbuc • https://www.adelaide.edu.au/writingcentre/ua/media/46/learningguide-practicalreportinscience.pdf	Learners to complete the activity on the slide.	Access to the internet and sources used in the previous task	
10	Once completed, inform the learners that they will have: • peer discussions • whole-class discussion. If a printer is not available, write a list of what you have identified in the introduction. Circulate to support and observe learners.	Once completed, learners move around the room discussing their findings with other learners.	Slide 22	Throughout these activities, the following assessment for learning will be observed: • Verbal and written feedback

10	Give instructions for the next question. Continue to circulate and support.	Once completed, learners answer the three questions on the slide: • What did your introduction contain from the list above? • What else did your introduction contain? • Why are introductions important for an article and a journal?	Slide 22	• Probing questions to be asked during the activity • Peer discussion • Scaffolded questions to be used during the group discussion • Support and verbal feedback for the plenary activity
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 23 'Self-reflection tracker' Possibly laptops and access to the internet	

05 Writing a literature review

5	Introduction (see the red box for instructions).		Slide 25	Throughout these activities, the following assessment for learning will be observed: • Verbal and written feedback
40	Provide learners with relevant templates and resources. Read through the activity with the learners. During this activity, the tutor will go around the room providing verbal feedback and written feedback (if this is done on a shared	Learners to start their literature review research. Learners can use the template to help them to collate the information required and to formulate the literature review. If the learners have completed any of the previous formative assessments, they can use this	Slide 26 'Aspirin sources list'	

	document, tutors can provide e-feedback on the document). This task can be broken down into 10–15 minute chunks where learners self-assess using the mark scheme then continue after marking what they have done so far.	information to help them to write their literature review.	‘Literature review guide’	throughout the activity • Learners to use the feedback to improve their work • Support and verbal feedback for the plenary activity
25	Tutor to read through the instructions shown on the slide. Circulate around the room offering support with this task and verbal feedback. Read through the reflections and discuss these with the learners. Tutors can then use this information to track learners’ progress and for future planning based on the progress made.	Learners to swap work with a peer. The learners are to collect the mark scheme and three highlighters (ideally green, orange and pink). Learners to read their peer’s work and highlight the mark scheme on what they: • have done well (green) • need to improve on or complete (orange) • have not done. (pink) Once learners have done this, they can grade the work and add comments to the feedback sheet.	Slide 27 ‘Mark scheme literature review’ (adapted from NCFE mark scheme)	

20	Tutor to read through the instructions shown on the slide. Tutor to circulate and support as necessary.	Learners to receive their work back and read through the feedback or mark scheme. They then need to improve on their work. Any changes or additional work needs to be added in a different colour so that it is clear what they have done to improve their work.	Slide 28	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 29 'Self-reflection tracker' Possibly laptops and access to the internet	

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Standard operating procedure (SOP) Formative assessment

Lesson plan
T Level in Science
Occupational specialism – Laboratory science
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Session number: 2 of 4	Session title and topic: Standard operating procedure (SOP)
NCFE reference	Specification references K1.48: The factors to consider when choosing between a range of scientific techniques. K1.62: The importance of using appropriate reagents and raw materials to complete practical scientific tasks. K1.67: The purpose and importance of SOPs in the laboratory environment. K2.1: How considerations inform the planning of a laboratory task. K2.3: The principles of laboratory method validation when planning scientific tasks. K2.4: The principles of laboratory equipment validation when planning scientific tasks. K2.7: How to establish the validity of the results against standards and controls. S2.15: Design a scientific task in an unfamiliar context, taking into consideration a range of factors. S2.16: Perform a literature review to extract relevant information to support planning of a scientific task. S2.17: Apply knowledge of scientific techniques to an unfamiliar context when planning a scientific task. S1.84: Select appropriate equipment to complete practical scientific techniques: three digital places balance.
Session rationale and guidance This session comprises five formative assessment activities for the standard operating procedure (SOP) topic for the T Level in Science occupational specialism (OS) in laboratory science. These are standalone tasks and can be used to assess whichever aspect or aspects of the curriculum the tutors choose. Each assessment activity comprises an introduction to the task, task instructions, learner self-reflection and any other form of tracking activity deemed appropriate. Tutors can of course substitute other tracking activities as they wish. Best practice would be for the tutor to track the formative assessment activities by making a record of how the learners have performed in these activities. This data could be qualitative (such as verbal feedback) or quantitative (such as marks or points given). Tutors should use their organisation's tracking system to monitor learners' progress or set up a tracking system for these formative assessment activities. The tutor would need to use the learners' results to decide how to scaffold any support that may be required to address any learner progress concerns (such as revising a topic in the next lesson, specific work set in directed study or intervention sessions and directing learners to online resources to support their progression). To support learners' progress, tutors need to move around the room to look at learners' work throughout the activities to ensure that they are completing the activities correctly.	

Session rationale and guidance (continued)

If the tutor identifies several learners making mistakes in their work, the tutor should complete revision or recap activities before re-attempting the activity or provide additional resources to make the activity more accessible to the learners. Tutors may want to mark this work themselves to get a better insight into the learners' understanding prior to each of these activities. This topic also includes the application of skills development from other parts of the T Level in Science curriculum. These are noted in the 'Embedded skills development' section below.

Tutors may wish to merge all the formative assessment activities in this project and use them as examination practice. These formative assessment activities can be used in other topic areas such as energy in fuel (calorimetry) and determining the concentration of an unknown analyte (titration or redox titration). For these activities to be used for another topic, the resources related to this formative assessment activity would need to be adapted, as the resources currently relate specifically to aspirin.

Embedded skills development

Science	Learners will research methods related to the task. Learners will develop their research, organisational and problem-solving skills to produce an SOP.
Maths	As the quantities used in practicals is important, learners will need to identify the correct quantities required. The correct equipment should be identified to reduce errors and improve accuracy.
English	Learners will write an SOP including references.
Digital	Learners will use the sources list provided to aid their SOP writing. Learners may need support with accessing the websites.
Employability	There is a technical scenario with this task to give it some context. The scenario is linked with the industry and situations learners are likely to encounter in their industry placement, future employment and their qualification.
Health and safety	Learners will research methods for this practical. Parts of the method have health and safety considerations which will help to reinforce and support learning of this key aspect of the subject.
OS	Some of the equipment and techniques discussed are directly linked to the OS specification. These are: • S1.73: Refluxing and filtration. • S1.79: Filtration and refluxing. • K1.21: Uses of reflux and recrystallisation technique during organic synthesis.

	• K1.51: Filtration.			
Examinations	These tasks can be amalgamated and used to practise part of the OS synoptic assessment (OSA) 1 for developing an SOP. Links to core skills: CS2: Researching. Please see the specification (on page 92) for more information. CS3: Working with others. Please see the specification (on page 93) for more information. CS6: Communication. Please see the specification (on page 95) for more information. CS7: Reflective evaluation. Please see the specification (on page 96) for more information.			
Formative assessment opportunities				
• Equipment list – tutors could provide a list of equipment from which learners select the most appropriate for the context and justify their choices • Writing a hypothesis – Think, pair and share • Writing a method • Writing references • Writing an introduction • Reflection diary and exit ticket				
Time	Tutor activity	Learner activity	Slide number and resources (these can be found in the resource pack)	Assessment of learning
01 Standard operating procedure				
5	Introduction (see the red box for instructions).		Slide 32	Throughout these activities, the following assessment for learning will be observed:
15	Ask learners to get into pairs to discuss the statements on the board and write their ideas on the correct colour of sticky notes.	Learners work in pairs to write down their ideas on: • what a SOP is • why SOPs are needed and important	Slide 33	

	While learners are completing this task, tutors circulate to have discussions with each group about their ideas and ask strategic questions.	• what needs to be included in a SOP • examples of what SOPs are used for.		• Verbal and written feedback throughout the activity • Probing questions to be asked during the activity • Scaffolded questions to be used during the group discussion • Tutor will discuss the learners' reflections that they completed, offer support and give verbal feedback
	Ask learners to place these sticky notes on either the whiteboard or a wall. <i>If no sticky notes are available, use A3 paper and highlighters or pens.</i> Once you have all the answers collated, discuss these with the group. Ask questions about their ideas and whether others agree.	Learners put their sticky notes on the whiteboard or a wall. Learners to answer questions and get involved with any other prompted tasks.		
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 34. 'Self-reflection tracker' Possibly laptops and access to the internet	

	apps such as Flipgrid to collate learners' self-reflections.			
02 SOP equipment				
5	Introduction (see the red box for instructions).		Slide 36	Throughout these activities, the following assessment for learning will be observed: • Probing questions to be asked during the activity • Verbal and written feedback throughout the activity • Learners to use the feedback from the group discussion to improve their work • Tutor will discuss the learners' reflections that they completed to offer support and verbal feedback
15	On the board, show the learners the images of the measuring equipment and ask them to write down the name of the piece of equipment which is the most accurate. If tutors are teaching in a lab, they could choose to set up this equipment for this task. Ask learners to write down their reasoning for their choice. Then ask learners to hold up their whiteboards and ask questions about their reasoning. Repeat this again for the next slide, which is about weighing equipment.	Learners to complete the activity on the whiteboard. Learners to hold up their whiteboards and be prepared to answer questions.	Slide 37–38 Whiteboards	
15	Tutors to ask learners to complete activity 2 (writing a method on calibrating a balance) on their whiteboards. Alternatively, tutors may ask learners to complete this task on an electronic form (e.g. Google Forms or Microsoft Forms) so that these can be displayed on the board. Ask learners to show their whiteboards. As a group, discuss the answers and decide what this method should include.	Learners to complete the activity on the whiteboard. Learners to hold up their whiteboards and be prepared to answer questions.	Slide 38 Whiteboards Possibly laptops and access to the internet	

	Then ask learners to write the method of calibrating a balance in their workbooks or on an electronic form (e.g. Google Forms or Microsoft Forms).	Learners to write down in their workbook the method of calibrating the balance.		
10	Tutors to read out the title and the scenario shown on the board. Ask learners to pick the most appropriate piece of equipment for the scenario and explain their choice. Then ask learners to hold up their whiteboards and ask them questions about their reasoning. Tutors may choose to use an online poll (such as Slido, Google Forms, Microsoft Forms or Mentimeter). This could be displayed on the board live or after all the answers have been collected.	Learners to complete the activity on the whiteboard. Learners to hold up their whiteboards and be prepared to answer questions.	Slide 39–40 Whiteboard Possibly laptops and access to the internet	
15	Ask learners to work in pairs to complete the table with information about the purpose of the equipment and when would it be used. This should be done without access to the internet. Once completed, ask learners to share their ideas with the group. Bounce questions around the room to encourage learners to discuss other answers and extend them.	Learners to write their answers on the handout. Learners to be involved with the discussion and to improve any of their answers based on the group discussion. Learners should use a different colour of pen to improve their work.	Slide 41 ‘Purpose of equipment’ handout	

20	Ask learners to use the resource list to research the equipment required to complete the 'Preparation, recrystallisation and analysis of aspirin'. While learners are completing this, tutors may choose to circulate around the room to ask learners strategic questions.	Learners to use the resources to produce a list or table of equipment required for the aspirin practical experiments. This can be completed in their workbook or laptop. Learners may choose to include the reasons the selected equipment is used.	Slide 42 'Aspirin source list' handout	
	Ask learners to swap their work and collect a copy of the SOP. Ask learners to use the SOPs provided to check their equipment list against the SOP. If any equipment is incorrect or missing, ask the learners to correct it.	Learners need to use a different colour of pen to mark their peer's work. If any equipment is incorrect or missing, ask learners to correct it.	Slide 43 The list of equipment from the SOPs	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections. Tutors may choose to use electronic forms (Google Forms or Microsoft Forms) for this activity. Tutors may want to use apps such as Flipgrid to collate learners' self-reflections.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 44 'Self-reflection tracker' Possibly laptops and access to the internet	

03 Writing a hypothesis

5	Introduction (see the red box for instructions).		Slide 46	Throughout these activities, the following assessment for learning will be observed: • Verbal and written feedback throughout the activity • Probing questions to be asked during the activity • Peer assessment • Learners to use the feedback to improve their work • Tutor will discuss the learners' reflections that they completed to offer support and verbal feedback
30	Tutors can choose to recap variables and hypotheses. If tutors choose to not do these recap activities, hide slides 47–49.		Slide 47–49	
10	Tutors to emphasise the last part of the technical scenario. Describe the activity to the learners and state what they are going to be assessed on. This needs to be done with no resources.	Learners to write down their hypothesis based on the technical scenario on their SOP template. This SOP template would be better as an electronic copy, but a paper version could be used.	Slide 50 'Standard operating procedure (SOP)' template	
5	Provide learners with a copy of the mark scheme (one each) and ask them to write their name at the top. Ask learners to swap their work and mark scheme. Learners need to read the questions in the mark scheme and add a tick or cross against the questions as appropriate.	Learners swap work and use the mark scheme to add a tick or cross next to the questions on the mark scheme.	Slide 51. 'Mark scheme – Producing a hypothesis'	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 52 'Self-reflection tracker'	

	To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.		Possibly laptops and access to the internet	
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04 Writing a scientific introduction in an SOP

5	Introduction (see the red box for instructions).		Slide 54	Throughout these activities, the following assessment for learning will be observed: • Verbal and written feedback throughout the activity • Probing questions to be asked during the activity • Peer assessment • Learners to use the feedback to improve their work • Tutor will discuss the learners' reflections that they completed to offer support and verbal feedback
25	Provide the learners with a copy of the 'Aspirin sources list' and ensure that they have the 'SOP template' (this can be the same copy as for the previous task). Read through the activity instructions. Ensure learners have laptops if they are completing their SOP template electronically.	Learners to use the sources given and the information from the board to write an introduction for an SOP relating to aspirin.	Slide 55 Laptops 'Aspirin sources list' 'Standard operating procedure (SOP)' template	
10	If this work has been done electronically, ask learners to print off their work. Ask learners to swap work and indicate with highlighters where their peer has completed the actions listed on the slide. Once they have done this, ask learners to write any suggestions they have at the bottom. If no printer is available, i.e. the task needs to be completed electronically, ask learners to write comments using the comment boxes.	Learners to swap their work and complete the peer assessment stated on the slide by following the tutor's instructions.	Slide 56 Highlighters Ideally, access to a printer	

	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learner's self-reflection.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 57 'Self-reflection tracker' Possibly laptops and access to the internet	
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05 Writing a method for an SOP

5	Introduction (see the red box for instructions).		Slide 59	Throughout these activities, the following assessment for learning will be observed: • Probing questions to be asked during the activity • Verbal and written feedback throughout the activity • Peer assessment • Learners to use the feedback to improve their work • Tutor will discuss the learners' reflections that they completed to offer support and verbal feedback.
50	Ensure that the learners have access to the 'Standard operating procedure (SOP) template' and the 'Aspirin sources list'. State the task from the slide. Ensure learners know that the boxes in the SOP template can be expanded if they need to add more detail.	Learners to complete the SOP template.	Slide 60 'Standard operating procedure (SOP)' template Possibly access to a laptop	
15	Provide learners with a copy of the mark scheme (one each) and ask them to write their name at the top. Ask learners to swap their work and mark scheme. While learners are completing the peer assessments, tutors can go around and select learners' work to team mark or offer support to learners who need help with this task.	Once learners have written their name on the mark scheme, they need to swap their work and mark scheme. Learners to read through their peer's work and identify on the mark scheme what they have or have not done. Using the mark scheme, learners identify what improvements need to be made. These improvements can either be highlighted on the mark scheme or written on the back of the sheet. Learners also need to give a grade for the work.	Slide 61. 'Mark scheme – Writing an SOP' Possibly access to a laptop	

	Ask learners to swap. State the activity from the slide. Tutor to circulate to see what grade and feedback they received.	Learners swap their work and provide feedback (five minutes each). Learners then act on this feedback to improve their work using the mark scheme. Learners need to make improvements in a different colour of pen to show it was added after receiving feedback.	Slide 62 Possibly access to a laptop	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 76 Page 33: 'Self-reflection tracker' Possibly laptops and access to the internet	

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Risk assessment Formative assessment

Lesson plan
T Level in Science

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Session number: 3 of 4	Session title and topic: Risk assessment (preparation, recrystallisation and synthesis of aspirin)
NCFE reference	Specification references K2.1: How considerations inform the planning of laboratory procedures. K2.2: How to undertake literature searches and use scientific papers to plan scientific tasks. S2.16: Perform a literature review to extract relevant information to support planning a scientific task. S2.17: Apply knowledge of scientific techniques to an unfamiliar context when planning a scientific task.
Session rationale and guidance This session comprises three formative assessment activities for the risk assessment topic for the T Level in Science occupational specialism (OS) in laboratory science. These are standalone tasks and can be used to assess whichever aspect or aspects of the curriculum the tutors choose. Each assessment activity comprises an introduction to the task, task instructions, learner self-reflection and any other form of tracking activity deemed appropriate. Tutors can of course substitute other tracking activities as they wish. Best practice would be for tutor to track the formative assessment activities by making a record of how the learners have performed in these activities, whether this data is qualitative (such as verbal feedback) and/or quantitative (such as marks or point given). Tutors should use their organisation's tracking system to monitor learners' progress or set up a tracking system for these formative assessment activities. Tutors would need to use each learner's results to decide how to scaffold any support that may be required to address any learner progress concerns (such as revising a topic in the next lesson, specific work set in directed study or intervention sessions and directing learners to online resources to support their progression). Tutors may also wish to complete a revision exercise prior to doing the formative assessment activity. An example that tutors can use is provided at the end of this section. To support learners' progress, they need to circulate to check learners' work throughout the activities to ensure that they are completing the activities correctly. If the tutor identifies learners making mistakes in their work, tutors should complete revision or recap activities before the activity is re-attempted or provide additional resources to make the activity more accessible to the learners. Tutors may want to mark this work themselves to get a better insight into the learners' understanding prior to doing these activities. This topic will also include the application of skills development from other parts of the T Level in Science curriculum. These are noted in the 'Embedded skills development' section below. Tutors may wish to merge all the formative assessment activities in this project and use them as examination practice.	

These formative assessment activities can be used in other topic areas such as electrolysis and aseptic culturing. To use these assessments for an alternative topic, the resources related to this formative assessment activity can be adapted.

Embedded skills development

Science	Learners will focus on health and safety, identifying hazards and risks, and using these to produce control measures.
Maths	Learners will use the risk assessment matrix to calculate the risk level. Information on how to do this is on the risk assessment template.
English	Learners will write a risk assessment including references.
Digital	Learners will use the internet to complete their research for the risk assessment task.
Employability	A technical scenario included with this task provides some context which is linked to the learners' qualification, industry placement and future career.
Health and safety	The whole session is focused on health and safety, as hazards, risks and control measures will be explored.
OS	Some of the technical skills are directly linked to the OS specification. These are: • K1.1: How health, safety and environmental practices are applied when performing scientific techniques – completing an appropriate risk assessment. • S1.70: Complete a risk assessment.
Examinations	These tasks can be amalgamated and used to practise part of the OS synoptic assessment (OSA) 1 for developing a risk assessment. Links to core skills: CS1: Project management. Please see the specification (on page 91) for more information. CS2: Researching. Please see the specification (on page 92) for more information. CS3: Working with others. Please see the specification (on page 93) for more information. CS4: Creativity and innovation. Please see the specification (on page 94) for more information. CS6: Communication. Please see the specification (on page 95) for more information. CS7: Reflective evaluation. Please see the specification (on page 96) for more information.

Formative assessment opportunities

- Research task
- Hazard symbols
- Writing the risk assessment
- Write a risk assessment for one substance (Think, pair and share)
- Reference list
- Discussion with the tutor
- Reflection diary and exit ticket

Reflection diary and exit ticket				
Time	Tutor activity	Learner activity	Slide number and resources (these can be found in the resource pack)	Assessment of learning
01 Hazards				
5	Introduction (see the red box for instructions).		Slide 66	Throughout these activities, the following assessment for learning will be observed: • Probing questions to be asked during the activity • Scaffolded questions to be used during the group discussion • Verbal and written feedback throughout the activity • Peer assessment • Tutor will discuss the learners' reflections that they completed, offer support and give verbal feedback
10	Show the slide with the picture and provide it as a handout.	Learners to annotate the image of hazards.	Slide 67	
	Give learners five minutes to annotate the handout with the risks and reasons. Ask learners questions about the risks and reasons. Strategic questioning could be used. Tutors may choose to collate the learners' ideas on sticky	Group discussion about the risks and reasons. If handouts cannot be given, ask learners to create a list of the risks in their workbook or on their laptop.	Image of hazards (print the slide and give as handout) Possibly laptops and access to the internet	

	notes or e-sticky notes (such as Google Sticky Notes or Microsoft Sticky Notes) which can be displayed on the board.	Alternatively, learners could be given sticky notes on which to write a risk and the reason then stick them on the picture projected onto a whiteboard.		
5	Tutor to show the slide with the incorrect hazard names next to hazard symbols. Ask learners to correct these.	Learners to correct the hazard symbols either verbally with a peer or on a handout.	Slide 68	
	Ask learners for answers prior to showing the correct answers on this animated slide, which reveals the answers one at a time.	Learners to provide answers and mark their handout (if used).	Slide 69 may be printed as a handout (as table on this slide will show blank spaces when printed) Slide 69	
30	Tutors to show learners how to access information about hazards and risks associated with substances on CLEAPSS.		Slide 70 Laptops and access to the internet CLEAPSS: Available at https://www.cleapss.org.uk/	
	Introduce the activity. Circulate around the room providing written and verbal feedback as required.	Learners to produce their own version of the table (either handwritten or on a laptop) and research each	Slide 71 CLEAPSS: Available at https://www.cleapss.org.uk/	

		of the substances to complete the hazards and risks for each substance.	Laptops and access to the internet	
	Ask learners to swap work and go through the answers on the board. You may choose to ask learners to answer before going through the answers.	Learners mark their peer's work with either a different coloured pen (paper-based risk assessment) or with different coloured ink (if completed on a laptop).	Slide 72	
25	Introduce the activity. Circulate around the room providing written or verbal feedback as required.	Learners to produce their own version of the table (either handwritten or on a laptop) and research each of the substances to complete the hazards and risks for each substance.	Slide 73 Laptops Access to the internet CLEAPPS: Available at https://www.cleapss.org.uk/	
	Ask learners to discuss their work, then go through the answers on the board. You may choose to ask learners for their answers before going through the answers.	Learners discuss what they have written on their risk assessment (and adapt it if they feel they need to). This needs to be done in a different colour, then they mark their own work with either a different colour pen (paper-based risk assessment) or ink colour (if completed on a laptop).	Slide 74	

15	Hand out sticky notes to the learners and show the slide activity. Ask learners to write their ideas down and add them to the board or wall.	Learners will write down one idea per sticky note on what personal protective equipment can be worn to reduce risks and what equipment or features a laboratory has which can reduce risks.	Slide 75 Possibly laptops and access to the internet	
	Review the answers on the sticky notes and discuss the ideas written there. Tutors may choose to ask questions. Tutors may choose electronic sticky notes for this activity (such as Google Sticky Notes or Microsoft Sticky Notes).	Learners to be prepared to answer questions.		
	Go through the animation on the slide to show some examples. This list is not exhaustive, so tutors may want to discuss or show more examples if they are teaching a laboratory.	Learners to be prepared to answer questions.		
10	Plenary: Show the learners the reflection information on the board, discuss with them the	Learners to complete the self-reflection task using the	Slide 76 'Self-reflection tracker'	

	importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learner's self-reflections.	information on the board to guide them.	Possibly laptops and access to the internet	
02 Risk assessment content				
5	Introduction (see the red box for instructions).		Slide 78	

30	Go through the activity on the slide. Learners will require a laptop for this activity, which is to produce a health and safety poster. The poster needs to be related to the production of aspirin and needs to be aimed at a workplace. Tutors may choose to show learners examples of workplace health and safety posters to emphasise the layout, amount of content, images, appearance, etc. Some examples are: • Health and safety at work • Health and safety for computer operators • Control of substances hazardous to health (COSHH) Tutors may choose to discuss good presentation skills.	Learners will use their understanding of the equipment and substances related to the production of aspirin to create a safety poster, which needs to include: • hazards related to their laboratory • risks related to their laboratory • how to reduce the risks related to the laboratory • the purpose of a risk assessment. The information about the required content can also be seen on the PowerPoint slide.	Slide 79 Laptop Possibly required (if the learners have not completed the previous formative assessment: 01 – Hazards): • ‘Standard operating procedure (SOP) – SOP for the preparation and recrystallisation of aspirin’	Throughout these activities, the following assessment for learning will be observed: • Verbal and written feedback throughout the activity • Probing questions to be asked during the activity • Peer assessment • Scaffolded questions to be used during the group discussion • Tutor will discuss the learners’ reflections that they completed, offer support and give verbal feedback
5 per learner	Tutors to ask learners to share or email their posters. Tutors need to explain that learners will present their posters to the group, which will peer-assess the presentations. Each learner will peer-assess	Learners will present their poster and answer follow-up questions. If learners are not presenting, they complete a feedback form the learner	Slide 80 ‘Presentation feedback form’ Laptop	

	each other learner. Ensure that there are enough feedback sheets printed.	who is presenting. They need to put their name and the name of the person they are peer-assessing on the feedback form. Learners add a tick or cross in each row. Learners may want to add comments at the bottom of the feedback sheet.	Access to the internet	
5	Show learners the matrix from the slide. Ask learners to complete the activity questions.	Learners first think about their answers, then share them with a peer.	Slide 81	
10	At the end of the group discussion, go through the animation and discuss the answers.	Finally, learners share their thoughts with the group.	Slide 81	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 82 'Self-reflection tracker' Possibly laptops and access to the internet	

	To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree. Tutors may instead choose to ask learners to peer-assess these self-reflections. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate each learner's self- reflections.			
03 Writing a risk assessment				
5	Introduction (see the red box for instructions).		Slide 84	Throughout these activities, the following assessment for learning will be observed: • Verbal and written feedback throughout the activity • Probing questions to be asked during the activity • Peer assessment
30	Ensure that the learners have access to the 'Risk assessment guide' and the 'Aspirin sources list'. State the task from the slide. Ensure learners know that the boxes in the risk assessment template can be	Learners complete the risk assessment on the template. This template should be provided electronically so that learners can adjust its size if required.	Slide 85 'Risk assessment guide' 'Aspirin sources list'	

	expanded if they need to add more detail or add more rows.			• Learners to use the feedback to improve their work • Tutor will discuss the learners' reflections that they completed, offer support and give verbal feedback
10	Provide learners with a copy of the mark scheme (one each) and ask them to write their name at the top. Ask learners to swap their work and mark scheme. While learners are completing the peer assessments, the tutor can circulate and select learners' work to team mark and offer support to learners who need help with this task.	Once learners have written their name on the mark scheme, they need to swap their work and mark scheme. The learners need to read through their peer's work and highlight on the mark scheme what they have done well (green), need to improve (orange) and what has not been attempted (pink). Using the mark scheme, learners can identify what improvements need to be made. These comments can be written on the back of the mark scheme. Learners also need to give a grade for the work.	Slide 86 'Mark scheme – Risk assessment'	

10	Ask learners to swap back and state the activity from the slide. Move around the room to see what grade and feedback they received.	Learners swap their work back and provide feedback (five minutes each). Learners then act on this feedback to improve their work using the mark scheme. Learners need to make improvements in a different colour of pen so that it is clear this was added after receiving feedback.	Slide 87	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 88 'Self-reflection tracker' Possibly laptops and access to the internet	

	Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate each learner's self- reflections.			
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Practical skills Formative assessment

Lesson plan
T Level in Science

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Session number: 4 of 4	Session title and topic: Practical skills
NCFE reference	Specification references K1.21: Uses of the following techniques used during organic synthesis: • Refluxing. • Recrystallisation. K1.47: When scientific and mathematical skills may be applied when completing scientific tasks. K1.49: The purpose of: • analysing substances and chemical environments to confirm composition and quantity of materials. K1.51: Appropriate use of the following techniques to identify or determine, separate or analyse substances and environments: • Distillation. • Filtration. K1.63: The principles of producing reliable and verifiable results: • Recording in a clear and unambiguous way, such as the use of tables, indelible ink, not using sticky notes or loose papers and ensuring that writing is legible. • Using appropriate units, notation and correct number of significant figures. K1.67: The purpose and importance of SOPs in the laboratory environment. S1.68: Work safely in a laboratory when performing specific scientific techniques. S1.69: Comply with relevant health and safety legislation and regulations, including COSHH and biosafety containment levels, when handling and disposing of solids, liquids and gases relevant for the scientific technique being performed. S1.71: Use appropriate personal protective equipment when performing scientific tasks, e.g. suitable eye protection and gloves. S1.75: Apply a range of science and mathematical skills when performing practical scientific techniques. S1.77: Use the following practical scientific techniques to analyse substances: • Preparation of serial dilutions. S1.79: Use the following practical scientific techniques to prepare, isolate or separate: • Distillation. • Filtration.

- Refluxing.
- S1.85: Demonstrate practical technical competence in the use of equipment:
- Taking accurate measurements.

Session rationale and guidance

This session comprises four formative assessment activities for the practical skills topic for the T Level in Science occupational specialism (OS) laboratory science. These are standalone tasks and can be used to assess whichever aspect or aspects of the curriculum tutors choose.

Each assessment activity comprises an introduction to the task, task instructions, learner self-reflection and any other form of tracking activity deemed appropriate. Tutors can of course substitute other tracking activities as they wish. Best practice would be for the tutor to track the formative assessment activities by keeping a record of how the learners have performed in these activities. This data could be qualitative (such as verbal feedback) or quantitative (such as marks or point given).

Tutors should use their organisation's tracking system to monitor learners' progress or set up a tracking system for these formative assessment activities. The tutor would need to use the learners' results to decide how to scaffold any support that may be required to address any learner progress concerns (such as revising a topic in the next lesson, specific work set in directed study or intervention sessions and directing learners to online resources to support their progression). Tutors may also wish to do a revision exercise prior to completing the formative assessment activity. To support learners' progress, tutors need to move around the room to look at learners' work throughout the activities to ensure that they are completing the activities correctly.

If the tutor identifies several learners making mistakes in their work, the tutor should complete revision or recap activities before re-attempting the activity or provide additional resources to make the activity more accessible to the learners. Tutors may want to mark this work themselves to get a better insight into the learners' understanding prior to each of these activities. This topic also includes the application of skills development from other parts of the T Level in Science curriculum. These are noted in the 'Embedded skills development' section below.

Tutors may wish to merge all the formative assessment activities in this project and use them as examination practice. These formative assessment activities can be used in other topic areas such as Gram staining and colorimetry. For these activities to be used for another topic, the resources related to this formative assessment activity would need to be adapted, as the resources currently relate specifically to aspirin.

Embedded skills development

Science	Learners will develop their practical skills with regards to setting up equipment and performing a reflux, filtration and recrystallisation.
Maths	Learners will follow an SOP which requires learners to measure. Learners will practise writing values to a certain number of decimal places and to the same number of significant figures. Evidence of this will be on their table of results and practical notes. Tutors can review these during the practical.
English	Learners will need to read the SOP carefully to ensure it is followed correctly. This is crucial because, if learners misread or misunderstand a step, this could leave to errors in their practical results. Tutors may need to offer support with technical terminology.
Digital	Learners may choose to use Excel or Word to produce tables of results. Learners may not be familiar with producing tables in Excel or Word. Tutors may need to provide support learners with this.
Employability	A technical scenario is included with this task to give some context linked to the qualification, industry placement and future employment.
Health and safety	Learners need to follow the risk assessment in the SOPs. Learners' ability to identify health and safety steps is also reviewed in these activities.
OS	Some of the practical skills are directly linked to the OS specification. These are: • S1.73: Refluxing and filtration. • S1.79: Filtration and refluxing. • K1.21: Uses of reflux and recrystallisation technique during organic synthesis. • K1.51: Filtration.
Examinations	These tasks can be amalgamated and used to practise part of the OS synoptic assessment (OSA) 2 for the experimental practical assessment. CS3: Working with others. Please see the specification (on page 93) for more information. CS5: Problem-solving. Please see the specification (on page 94) for more information. CS6: Communication. Please see the specification (on page 95) for more information. CS7: Reflective evaluation. Please see the specification (on page 96) for more information.

Formative assessment opportunities				
• Labelling-up part of setting up the equipment • Justifying equipment selected • Setting up scientific equipment • Calibrating a three decimal places balance • Completing the practical • Drawing a table of results • Peer-assess each other during the practical • Practise using significant figures • Identify parts of the method which are there to reduce errors and improve accuracy • Mini quiz on significant figures, units and calculating means • Practise doing calculations • Identify anomalies • Use Excel to produce graphs and complete statistical analyses • With each step of the method printed and cut individually, learners work independently or in pairs to put the steps in the correct order • Learners write down the purpose of the equipment or technique • Reflection diary and exit ticket				
Time	Tutor activity	Learner activity	Slide number and resources (these can be found in the resource pack)	Assessment of learning
01 Equipment				
5	Introduction (see the red box for instructions).		Slide 91	Throughout these activities, the following assessment for learning will be observed:
7	Go through the activity information with the learners.	Learners to complete a mind map of the impacts of insufficient or lack of cleaning in a workspace.	Slide 92	

3	Group discussion about the learners' ideas.	Learners to be prepared to discuss their ideas.	Access to a laptop or large paper	• Probing questions to be asked during the activity • Verbal and written feedback throughout the activity • Scaffolded questions to be used during the group discussion • Tutor will discuss the learners' reflections that they completed, offer support and give verbal feedback
10	Provide learners with sticky notes (green, yellow and pink) and ask them to write their ideas on the questions which are on the slide.	Learners to write their answers on the appropriate colour of sticky notes and to put these on the board or wall. One answer or idea per sticky note.	Slide 93 Sticky notes (three different colours, ideally green, yellow and pink)	
	Tutor to go through the answers and start a group discussion about the answers given.	Learners to be prepared to discuss their answers.		
20	Hand out the SOPs to the learners and ask them to complete the activity stated on the slide. Tutors may want to ask the learners questions during this activity.	Learners to read through the SOPs and underline or highlight what personal protective equipment and pre-practical cleaning is required. Learners then need to complete them both.	Slide 94 To be completed in a laboratory 'Standard operating procedure (SOP)'	
7	Using the same SOPs, ask the learners to complete the activity on this slide. Tutors may want to ask the learners questions during this activity.	Learners to read the SOPs again, collect the required equipment and set up all the equipment, except for the reflux apparatus.	Slide 95 To be completed in a laboratory 'Standard operating procedure (SOP)'	

8	Using the same SOPs, ask the learners to complete the activity on this slide. Tutors may want to ask questions during this activity.	Learners to set up their reflux apparatus. They need to be able to explain why they have set it up the way that they have.	Slide 96 To be completed in a laboratory 'Standard operating procedure (SOP)'	
15	Ensure the learners have access to balances and the calibrating equipment. Show the learners the activity information on the slide and ask them to complete it. Tutors may want to ask the learners questions during this activity.	Learners to calibrate the balance. Learners need to be prepared to answer questions from the tutor. Learners may choose to write down their method.	Slide 97 To be completed in a laboratory Equipment to calibrate a balance 'Standard operating procedure (SOP)'	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 98 'Self-reflection tracker' Possibly laptops and access to the internet	

	agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.			
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02 Recording data

02 Recording data				
5	Introduction (see the red box for instructions).		Slide 100	Throughout these activities, the following assessment for learning will be observed: • Think, pair and share • Probing questions to be asked during the activity • Scaffolded questions to be used during the group discussion • Verbal and written feedback throughout the activity • Tutor will discuss the learners' reflections that they completed, offer support and give verbal feedback
10	Provide learners with the handout and ask them to annotate it with all aspects of the table which have been done correctly.	Learners to annotate the handout with all aspects of the table which have been done well.	Slide 101 'Presenting data and information'	
5	Ask learners to discuss their annotations with a peer.	Learners to discuss with peers then as a group. Any additional or changed annotations need to be written in a different colour of pen.		
10	Go through the answers on the board. Tutors may choose to ask learners for their ideas.	Learners to discuss as a group. Any additional or changed annotations need to be written in a different colour of pen.	Slide 102	
15	Hand out the SOPs and go through the activity information from the slide.	Learners to read through the SOP and complete the activity on the slide.	Slide 103 'Standard operating procedure (SOP)'	
5	Ask learners to provide their ideas and discuss these as a group.	Learners need to be prepared to discuss their ideas as a group.		

10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 104 'Self-reflection tracker' Possibly laptops and access to the internet	
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03 Identifying important steps in an SOP

03 Identifying important steps in an SOP				
5	Introduction (see the red box for instructions).		Slide 106	Throughout these activities, the following assessment for learning will be observed: • Verbal and written feedback throughout the activity • Probing questions to be asked during the activity • Learners to use the feedback from the group discussion to improve their work • Tutor will discuss the learners' reflections that they completed, offer support and give verbal feedback
15	Ensure the learners have a copy of the SOPs. Ask learners to complete the activity shown on the slide.	Learners will be asked to produce a table (either in their workbook or on their laptop). After reading the SOPs, learners to complete the table with information about the health and safety steps in the SOP and why they are in the SOP.	Slide 107 'Standard operating procedure (SOP)'	
	Group discussion on the learners' ideas.	Learners need to be prepared to share their ideas.		
15	Ensure the learners have a copy of the SOPs. Ask learners to complete the activity shown on the slide.	Learners will be asked to produce a table (either in their workbook or on their laptop). After reading the SOPs, learners to complete the table with information about the health and safety steps in the SOP and why they are in the SOP.	Slide 108 'Standard operating procedure (SOP)'	
	Group discussion on the learners' ideas.	Learners need to be prepared to share their ideas.		

10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections. Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 109 'Self-reflection tracker' Possibly laptops and access to the internet	
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04 Following the SOP

5	Introduction (see the red box for instructions).		Slide 111	Throughout these activities, the following assessment for learning will be observed: • Verbal and written feedback throughout the activity • Probing questions to be asked during the activity • Self-assessment • Tutor will discuss the learners' reflections that they completed, offer support and give verbal feedback
90	Ensure that the learners have access to the SOP for 'Preparation and recrystallisation of aspirin'. Read the task shown on the slide. Before starting the practical, set up a camera for each learner or for the whole group.	Learners will follow the SOP and complete the practical. Learners will be videoed during this activity.	Slide 112 To be done in the laboratory 'Standard operating procedure (SOP)' Either a camera (this could be a tablet), with a workbench stand or tripod, or a USB flexible neck camera with laptop	
90	Ensure that the learners have access to the SOP for 'Analysis of aspirin'. State the task shown on the slide. Before starting the practical, set up a camera for each learner or for the whole group.	Learners will follow the SOP and complete the practical. Learners will be videoed during this activity.	Slide 113 To be done in the laboratory 'Standard operating procedure (SOP)'	

			Either a camera (this could be a tablet), with a workbench stand or tripod, or a USB flexible neck camera with laptop	
45	Provide learners with a copy of the video and the mark scheme. Ask them to write their name at the top of the mark scheme. While learners are completing the self-assessments, the tutor can circulate and collect learners' work to team mark or offer support to learners who need help with this task.	Learners to highlight the mark scheme based on their own recollection and by watching the video. Use green if that have done well, orange if it needs improving or was incomplete and pink for anything that has not been done. Learners need to write comments.	Slide 114 'Mark scheme – following the SOP'	
10	Plenary: Show the learners the reflection information on the board, discuss with them the importance of self-reflection and go through each aspect of the reflection shown on the slide. Allow a quiet environment for this. To assess each learner's ability to self-reflect, tutors could read through these self-reflections and make verbal or written comments on whether they agree or disagree. Tutors may instead choose to ask learners to peer-assess these self-reflections.	Learners to complete the self-reflection task using the information on the board to guide them.	Slide 115 'Self-reflection tracker' Possibly laptops and access to the internet	

	Tutors may choose to use electronic forms (such as Google Forms or Microsoft Forms) for this activity. Tutors may also want to use apps such as Flipgrid to collate learners' self-reflections.			
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Additional resources: Pre-formative assessment revision tasks
01 Organic chemistry

5	Introduction to the lesson. Using whiteboards, ask learners to write down what they know about aspirin. Tutors can choose to also put the chemical reaction on the board to potentially get more answers. Give learners two minutes. Ask learners to show their whiteboards and discuss their answers. Potential prompting questions: What do we use aspirin for? What functional groups can you identify?	Slide 36 Whiteboards and pens	Questioning	
8	<u>Recap on organic substances</u> There are two tables on the slide. Ask learners to fill in the blanks with the prefix or suffix name. Give learners five minutes to complete this if they are drawing the tables out or two to three minutes if the tables are printed for them. Go through the answers. Ask learners for answers.	Slide 37	Questions and questioning	

22	<u>Functional group recap</u> Using the whiteboards, ask learners to write down the name of the functional group and name of the structure of each of the organic structures on the board. Put one compound on the board at a time. Give learners 30 to 40 seconds to write their answer. Ask learners to hold up their whiteboards to show you their answers. Review answers on the slide before moving on to the next structure. Extend this by asking learners what part of the structure is the functional group and discussing the position of the functional group, e.g. propan-1-ol and propan-2-ol.	Slides 38–40 Whiteboards and pens		
8	<u>Functional groups in aspirin</u> Discuss with the learners what functional groups they can recognise in aspirin. Ask learners to research how esters are produced and identify how the ester on the aspirin structure is produced from salicylic acid and ethanoic anhydride.	Slide 41 Access to the internet and or textbooks, such as: • Save my exams • Any A level chemistry textbooks (such as <i>OCR A Chemistry</i>)	Verbal feedback Think, pair and share Group discussion	

	During the research task, the tutor will be circulating around the room discussing the work with the learners. Discuss the findings with the learners then show them the next animation on the slide with how the ester is formed.			
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T Level in Science resources

Formative assessment materials
Occupational specialism – Laboratory science

ETFOUNDATION.CO.UK

Writing literature reviews

T Level in Science
Occupational specialism – Laboratory science

ETFFOUNDATION.CO.UK

Articles and journals related to aspirin

This list of resources can be used for the following formative assessment tasks:

- *03 Writing an abstract*
- *04 Writing an introduction*

https://www.sciencedirect.com/science/article/abs/pii/S0049384803003797	
https://www.sciencedirect.com/science/article/abs/pii/S0140673609602439#preview-section-abstract	
https://www.sciencedirect.com/science/article/abs/pii/S0140673606680409	
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4317158/	

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Aspirin sources list

This list of resources can be used for the following formative assessment tasks:

- ***01 Reviewing scientific literature***
- ***05 Writing a literature review***

http://www.rsc.org/learn-chemistry/content/filerepository/CMP/00/000/045/Aspirin.pdf	
http://www.rsc.org/learn-chemistry/content/filerepository/CMP/00/000/047/Paracetamol_web.pdf	
https://www.nhs.uk/medicines/aspirin-for-pain-relief/	
https://www.bhf.org.uk/information-support/heart-matters-magazine/medical/drug-cabinet/aspirin	
https://www.aspirin-foundation.com/history/chemistry/	
https://www.birmingham.ac.uk/teachers/study-resources/stem/chemistry/purify-organic.aspx	
https://edu.rsc.org/download?ac=14527	

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Literature review guide

This resource can be used for the following formative assessment tasks:

- ***05 Writing a literature review***

Introduction

- What have you been asked to do or what is the issue?
- Aim of this literature review.

First literature source

- Does it contain a method, technique or equipment?
 - If so:
- Is it relevant to the context given?
- Summarise what the method is testing or aiming for.
 - If not:
- Summarise what the literature covers.
- Does it lack anything that could be useful (e.g. method, technique, data or analysis of data)?
- Is it a reliable source?
- Is this source better than any of the others?
 - If so, why?

Answer the following questions for each literature source

- Does it contain a method, technique or equipment?
 - If so:
- Is it relevant to the context given?
- Summarise what the method is testing or aiming for.
 - If not:
- Summarise what the literature covers.
- Does it lack of anything that could be useful (e.g. method, technique, data or analysis of data)?
- Is it a reliable source?
- Is this source better than any of the others?
 - If so, why?

Summary

- Summarise your literature review. Link to any useful content that can be used in the standard operating procedure.
- Other things to consider:
 - How results are determined.
 - The expected results.
 - Safety considerations.

Add the references

Author. Year of publication. Title of the page (in italics). [Online]. [Accessed date].
Available from: Website.

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Mark scheme – Literature review

This resource can be used for the following formative assessment tasks:

- ***05 Writing a literature review***

Band	Mark	Descriptor
4	13–16	The learner has completed all the following: • Strengths and weaknesses in each of the sources have been discussed. • The science within each source. • The quality and reliability of each piece of literature. • Linking the source to the purpose of the formative assessment activity (is it relevant?). • Correctly referenced in text and produced a reference list. The learner has given reasons for the validity of their view with regards to which sources are overall more appropriate for this task than others. The learner has justified these reasons with evidence from the resources. The literature review overall is well structured and laid out in a clear and professional manner.
3	9–12	The learner has completed most of the following: • Strengths and weaknesses in each of the sources have been discussed. • The science within each source. • The quality and reliability of each piece of literature. • Linking the source to the purpose of the formative assessment activity (is it relevant?). • Correctly referenced in text and produced a reference list. The learner has given reasons for the validity of their view with regard to which sources are overall more appropriate for this task than others. The literature review overall is well structured and laid out in a clear and professional manner.

Adapted from: <https://www.ncfe.org.uk/media/edbob2lt/sci-0007-02-tq-science-osa-laboratory-sciences-assignment-1-mark-scheme.pdf>

Band	Mark	Descriptor
2	5–8	The learner has completed some of the following: • Strengths and weaknesses in each of the sources have been discussed. • The science within each source. • The quality and reliability of each piece of literature. • Linking the source to the purpose of the formative assessment activity (is it relevant?). • Correctly referenced in text and produced a reference list. The learner has given reasons for the validity of their view with regard to which sources are overall more appropriate for this task than others. The description may lack some detail of the advantages or disadvantages of the literature that was selected or rejected.
1	1–4	The learner has listed their selection of literature based on: • the literature content, including limited strengths and weaknesses • some mention of the science • some reference to the quality and reliability of each piece of literature • references that may be incorrect or missing. The list may be supported by general reasons rather than occupational knowledge in context.
0	0	No creditworthy material or describes any performance that would automatically warrant zero marks.

Adapted from: <https://www.ncfe.org.uk/media/edbob2lt/sci-0007-02-tq-science-osa-laboratory-sciences-assignment-1-mark-scheme.pdf>

Standard operating procedure (SOP)

T Level in Science
Occupational specialism – Laboratory science

ETFOUNDATION.CO.UK

Purpose of equipment

This resource can be used for the following formative assessment tasks:

- 02 SOP equipment

The box sizes do not represent the quality required for each section; learners would be expected to extend these boxes if required.

Equipment/technique	When would you use it?
	What is its purpose?
Thin-layer chromatography (TLC)	
Distillation	
Reflux	
Burette	
Pipette	
pH meter	
Filtration	
Colorimeter	

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Aspirin sources list

This list of resources can be used for the following formative assessment tasks:

- ***02 SOP equipment***
- ***03 Writing a hypothesis***
- ***04 Writing a scientific introduction in an SOP***
- ***05 Writing a method for an SOP***

http://www.rsc.org/learn-chemistry/content/filerepository/CMP/00/000/045/Aspirin.pdf	
http://www.rsc.org/learn-chemistry/content/filerepository/CMP/00/000/047/Paracetamol_web.pdf	
https://www.nhs.uk/medicines/aspirin-for-pain-relief/	
https://www.bhf.org.uk/informationsupport/heart-matters-magazine/medical/drug-cabinet/aspirin	
https://www.aspirin-foundation.com/history/chemistry/	
https://www.birmingham.ac.uk/teachers/study-resources/stem/chemistry/purify-organic.aspx	
https://edu.rsc.org/download?ac=14527	

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Standard operating procedure (SOP) template

This list of resources can be used for the following formative assessment tasks:

- **03 Writing a hypothesis**
- **04 Writing a scientific introduction in an SOP**
- **05 Writing a method for an SOP**

Please note that the information in italics in the boxes below is a guide as to what should be written in these boxes, but this information is not exhaustive. The box sizes do not represent the quality required for each section; learners would be expected to extend these boxes if required.

Title:				Version number:
Procedure written by:	Procedure approved by:	Date written:	Review date:	Pages:

Introduction	<i>(What is the science behind the practical?)</i>
--------------	--

Objective	<i>(What is the aim and hypothesis?)</i>
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Procedure	<i>(Write a detailed list of the steps needed for the SOP. This should be the main body of your text and can include bullet points or numbered sections if you wish.)</i> Equipment list: Method: Results: <i>(How is data collected, recorded and analysed?)</i>
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Emergency procedures	<i>(In the event of an emergency, what do you need to do?)</i>
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Disposal procedure	<i>(How are the chemicals disposed of?)</i>
Compliance	<i>(Who is responsible for monitoring compliance with this SOP?)</i>
Review	<i>(When will the SOP be reviewed?)</i>
References	<i>(Include Harvard references for all sources you have selected for use.)</i>

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Mark schemes (adapted from NCFE mark scheme)

Producing a hypothesis

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This list of resources can be used for the following formative assessment tasks:

- ***03 Writing a hypothesis***
- ***05 Writing a method for an SOP***

Band	Mark	Descriptor
3	7–9	Does the hypothesis correctly link the independent and dependent variables? Are there justified scientific reasons to support the statement? Is there an explanation of how this hypothesis will be tested?
2	4–6	Does the hypothesis correctly state the independent and dependent variables? Are there some scientific reasons to support the statement? Is there a description of how this hypothesis will be tested?
1	1–3	Does the hypothesis correctly state the independent or the dependent variable?
0	0	No creditworthy material or describes any performance that would automatically warrant zero marks.

Adapted from: <https://www.ncfe.org.uk/media/edbob2lt/sci-0007-02-tq-science-osa-laboratory-sciences-assignment-1-mark-scheme.pdf>

Writing the SOP

This resource can be used for the following formative assessment tasks:

- ***05 Writing a method for an SOP***

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Band	Mark	Descriptor
3	9–12	The SOP contains information on <u>all</u> sections, and the information is <u>complete</u>. <u>All</u> steps are <u>explained</u> clearly with all relevant detail needed. The SOP has provided <u>all</u> the detail required for someone with <u>no prior knowledge</u> to be able to complete the practical successfully. <u>All</u> steps are in a logical order and would produce <u>correct or accurate</u> results. The SOP is relevant to the technical scenario. The SOP contains <u>all</u> the information about data collection, it is <u>clear</u> which data needs to be collected or how it should be recorded.
2	5–8	The SOP contains information on <u>all</u> sections, but the information <u>may</u> be limited. The SOP contains <u>most</u> steps, which are <u>described</u> correctly. The SOP <u>may</u> have missing steps, but another person with prior knowledge <u>would</u> be able to use it. The SOP has <u>may</u> have steps which <u>lack detail</u>, so the practical <u>may</u> give incorrect or inaccurate results. <u>Most</u> steps are in a logical order. The SOP is relevant to the technical scenario. The SOP contains <u>all</u> the information about data collection, but it is <u>unclear</u> which data needs to be collected or how it should be recorded.
1	1–4	The SOP contains information on <u>all</u> sections, but the information is <u>limited</u>. The SOP contains <u>some</u> steps written correctly. The SOP has <u>some</u> missing steps, so another person may <u>not be</u> able to use it. The SOP has <u>some</u> incorrect steps, so the practical <u>would</u> give incorrect or inaccurate results. The steps <u>may not</u> be in a logical order. The SOP is relevant to the technical scenario. The SOP contains <u>some</u> information about data collection, but it is <u>unclear</u> which data needs to be collected or how it should be recorded.
0	0	No creditworthy material.

Adapted from: <https://www.ncfe.org.uk/media/edbob2lt/sci-0007-02-tq-science-osa-laboratory-sciences-assignment-1-mark-scheme.pdf>

Risk assessment

Formative assessment

T Level in Science
Occupational specialism – Laboratory science

ETFOUNDATION.CO.UK

Presentation feedback form

This resource can be used for the following formative assessment tasks:

- 02 Risk assessment content

Has the learner:	Tick/ cross
...spoken confidently about their presentation?	
...been able to answer any questions to tutor has asked?	
...presented a clear, logical presentation which is eye catching?	
...discussed the presentation without just reading all the information off the poster?	
...included the following in their presentation:	
• correct hazards and risks associated with the technical scenario have been identified?	
• explanations of how these risks can be reduced?	
• explanations of why risk assessments are important?	
• references?	

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Risk assessment guide

This resource can be used for the following formative assessment tasks:

- 03 Writing a risk assessment

Please note that the information in *italics* in the boxes below is a guide as to what should be written in these boxes. The box sizes do not represent the quantity required for each section. Similarly, the quantity of rows may be altered; learners would be expected to extend these boxes if required.

Substance/equipment	Hazard	Risk	Likelihood	Severity	Risk level	Control measures
<i>This is the list of chemicals that you are using in your method</i>	<i>E.g. irritant, corrosive</i>	<i>What can happen?</i>	<i>Use the matrix below</i>	<i>Use the matrix below</i>	<i>Likelihood x severity</i>	<i>What can you do to reduce the chances of the risks occurring?</i>
References						

Adapted from: <https://www.ncfe.org.uk/media/votpuvh/sci-0007-01-tq-science-osa-laboratory-sciences-assignment-1-assignment-brief.pdf>

Severity —

		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Death
Likelihood —	1 Rare	1	2	3	4	5
	2 Unlikely	2	4	6	8	10
	3 Possible	3	6	9	12	15
	4 Likely	4	8	12	16	20
	5 Certain	5	10	15	20	25

Available from: <https://www.haspod.com/blog/paperwork/5x5-risk-matrix#:~:text=Risk%20%3D%20Likelihood%20x%20Severity&text=The%20more%20likely%20it%20is,the%20likelihood%20by%20the%20severity>

Mark scheme

This resource can be used for the following formative assessment tasks:

- 03 Writing a risk assessment

Risk assessment

Band	Mark	Descriptor
4	13–16	The learner has: • accurately <u>evaluated all</u> the relevant risks • demonstrated a <u>clear</u> understanding of priority (hierarchy of risk) • <u>suggested</u> safe, feasible and realistic measures for controlling the risks to minimise their potential impact • provided a <u>logical and valid reason</u> why these control measures would help to minimise identified risks.
3	9–12	The learner has: • <u>explained all</u> the relevant risks • demonstrated <u>some awareness</u> of the hierarchy of risk • <u>described</u> safe and feasible measures for controlling risks to minimise their potential impact, with some explanations of why control measures were chosen.
2	5–8	The learner has: • <u>described all</u> the relevant risks • <u>identified</u> safe and feasible control measures for these, although some detail may be missing (e.g. the type of personal protective equipment required) • <u>mostly</u> used the risk hierarchy realistically with regard to the priority of the risks.
1	1–4	The learner has: • <u>identified most</u> of the relevant risks • <u>identified some</u> feasible control measures, although measures may not always be practicable or realistic • <u>attempted</u> to use the risk hierarchy, but some may be unrealistic.
0	0	No creditworthy material.

Adapted from: <https://www.ncfe.org.uk/media/edbob2lt/sci-0007-02-tq-science-osa-laboratory-sciences-assignment-1-mark-scheme.pdf>

Practical skills Formative assessment

T Level in Science
Occupational specialism – Laboratory science

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Presenting data and information

This resource can be used for the following formative assessment tasks:

- **02 Recording data**

Activity: Annotate your handout with all the ways in which this table has presented the information correctly.

Mass (g)	Extension 1 (mm)	Extension 2 (mm)	Average extension (mm)
0	0.0	1.0	0.5
100	5.0	6.0	5.5
200	9.0	9.0	9.0
300	15.0	15.0	15.0
400	20.0	21.0	20.5
500	24.0	25.0	24.5
600	30.0	31.0	30.5

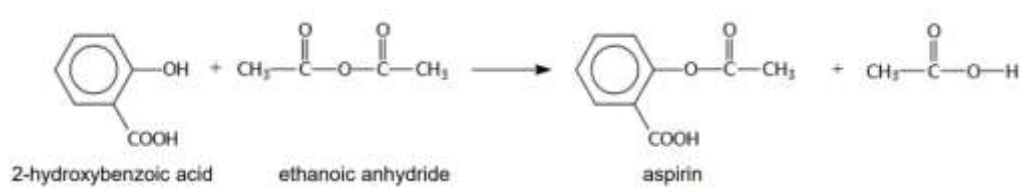
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Standard operating procedure (SOP)

SOP for the preparation and recrystallisation of aspirin

This list of resources can be used for the following formative assessment tasks:

- **01 Equipment**
- **02 Recording data**
- **03 Identifying important steps in an SOP**
- **04 Following the SOP**

Introduction	Aspirin (acetylsalicylic acid or 2-ethanoylhydroxybenzoic acid) can be prepared by the ethanoylation of 2-hydroxybenzoic acid (salicylic acid) using ethanoic anhydride in the presence of phosphoric acid as a catalyst.  2-hydroxybenzoic acid + ethanoic anhydride → aspirin + ethanoic acid You will prepare a sample of aspirin using this reaction and purify the solid product using a technique known as recrystallisation. You are a lab technician working in the research and development department of a pharmaceutical company. One of the products made by the company is aspirin. You have been asked to research how to produce and test the purity of aspirin so that the company can make it efficiently.
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Risk assessment

Risk assessment	Substance, equipment or procedure	Hazard	Risk	Control(s)
	2-hydroxybenzoic acid	Irritant	Serious eye damage Harmful if swallowed Suspected of damaging unborn child	Wear eye protection
	Ethanoic anhydride	Corrosive	Causes severe skin burns Irritant to the skin Potential respiratory irritation	Wear eye protection To be used and kept in a fume cupboard Good ventilation Keep away from naked flames Chemical-resistant gloves must be worn
	2-ethanoxybenzoic acid (aspirin)	Irritant	Causes skin and serious eye irritation Potential respiratory irritation Harmful if swallowed	For a 15-minute exposure, the concentration in the atmosphere should not exceed 15 mg/m ³ Wear eye protection Good ventilation
	Concentrated phosphoric acid	Corrosive	Causes severe skin burn and eye damage	For a 15-minute exposure, the concentration of phosphoric acid vapour in the atmosphere should not exceed 2.0 mg/m ³ Use the lowest concentration

				and smallest volume possible
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Procedure	Equipment list • Fume cupboard • Three decimal places balance and known masses for calibration • Weighing boat and spatula • 2 g of 2-hydroxybenzoic acid (salicylic acid) • 4 cm³ of ethanoic anhydride • 5 drops of concentrated phosphoric acid • Quickfit apparatus for reflux (50 cm³ pear-shaped flask and Liebig condenser with tubing clips) • 10 cm³ measuring cylinder • 50 cm³ measure cylinder • 250 cm³ beaker • 100 cm³ beaker • Bunsen burner, tripod and gauze • Retort stand and clamp • Thermometer (0–110°C) • Distilled water (room temperature and ice cold) • Dropping pipettes • Water bath containing crushed ice • Glass rod • Apparatus for vacuum filtration (Buchner funnel)
	<u>Preparation of aspirin – Method</u> 1 Calibrate the balance using the known masses. 2 Weigh out around 2.0 g of 2-hydroxybenzoic acid. Record the exact mass used in your results table. 3 In a fume cupboard, swirl the 2-hydroxybenzoic acid with 4 cm ³ of ethanoic anhydride (CARE: Corrosive) in a pear-shaped flask. 4 In a fume cupboard, add five drops of concentrated phosphoric acid (CARE: Corrosive) to the mixture in the flask and swirl to mix. 5 Set up your flask with a reflux condenser. Show your tutor before you continue. 6 Set up a water bath around the flask and heat the water to boiling for about five minutes, swirling the flask at regular intervals. 7 Without cooling, add 2 cm ³ of distilled water down the condenser. This will react with any excess ethanoic anhydride in a vigorous reaction. 8 When the reaction of the excess ethanoic anhydride and water has finished, pour the mixture into 40 cm ³ of cold distilled water in a 100 cm ³ beaker and allow to cool to room temperature.

9 Complete crystallisation by placing the beaker and its contents in an ice bath. If necessary, scratch the sides of the beaker with a glass rod to induce crystallisation.

10 Separate the solid from the solvent by filtration under reduced pressure using Buchner apparatus.

11 Wash the solid on the filter paper by adding a little ice-cold distilled water.

Recrystallisation of aspirin – Method

1 Before starting, prewarm the Buchner funnel and filter paper using a hot plate or oven.

2 Place your crystals of aspirin in a boiling tube, then place the tube in a beaker of distilled water maintained at close to boiling point.

3 Using a dropping pipette, dissolve the crystals in a minimal volume of the hot distilled water from the beaker.

4 Quickly filter the solution of aspirin using the pre-warmed Buchner apparatus.

5 Allow the solution in the flask to cool, slowly at first and then in an ice bath until crystals reappear.

6 When a reasonable quantity of crystals has formed, filter the mixture again under reduced pressure using clean Buchner apparatus at room temperature. Use ice-cold distilled water to wash all the contents in the flask into the funnel.

7 Wash the residue in the funnel with a little ice-cold distilled water.

8 Scrape the residue carefully into another piece of filter paper and dry by folding the filter paper around the residue and squeezing hard.

9 Place the residue into a pre-weighed evaporating dish or watch-glass and leave in an oven to dry thoroughly.

10 Measure the mass of your purified aspirin. Record this in your results table.

Measuring the melting point – Method

1 Powder a sample of your aspirin by crushing it gently with a spatula.

2 Fill three sealed capillary tubes with a densely packed column of crystals to a depth of approximately 0.5 cm. To pack a tube, the open end is pressed gently into a small amount of the sample. To transfer the crystals from the open end to the bottom of the tube, tap the bottom gently on the bench top or scratch the top edge of the tube on a small file or a coin with a milled edge.

3 The melting point of pure aspirin is reported as 138–140 °C.

4 Follow the instructions on the melting-point device, setting a plateau temperature of 128°C. The device will ramp up the temperature to the plateau temperature relatively quickly. The temperature will then increase more slowly to ensure thermal equilibrium between the heating block, thermometer and sample. This is required to ensure accurate results.

	5 Record all three melting-point ranges in a suitable table below. Ensure that you quote these to the correct precision.
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Emergency first-aid procedure	Eye: • Check for and remove contact lenses if present and easy to do. • Immediately flush eyes with gentle but large stream of water for at least 20 minutes, lifting lower and upper eyelids occasionally. • Call 999/111. Ingested: • Rinse mouth – do not induce vomiting unless directed to do so by medical personnel. • If vomiting occurs, keep head low so that vomit does not enter lungs. • Never give anything by mouth to an unconscious person. • Call a doctor if symptoms occur. Spilt on the skin or clothing: • Wash skin with soap and plenty of water for at least 15 minutes. • Remove contaminated clothing and shoes – wash clothing before reuse. • Call a doctor if symptoms occur. Spilt on the floor: • Wipe up small amounts with a damp cloth and rinse well. Brush up large amounts and rinse with plenty of water. For more detail please use: SSS026-Salicylic-acid-aspirin-salol-and-oil-of-wintergreen.pdf (cleapss.org.uk) SSS069-Ethanoic-anhydride.pdf (cleapss.org.uk) SSS024-Phosphoric-V-acid.pdf (cleapss.org.uk)
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Disposal procedure	Pour completed reaction mixtures into a pre-prepared waste beaker. If the waste mixture remains blue or black, add additional 0.5 M sodium carbonate solution. All solutions can then be disposed of down the foul water drain with plenty of water. Waste beaker: Provide each group with a beaker or container with 100 cm³ of 0.5 M sodium carbonate solution.
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Adapted from:

https://qualifications.pearson.com/content/dam/pdf/A%20Level/Chemistry/2015/teaching-and-learning-materials/A_level_Chemistry_Core_Practical_16_-_Aspirin.pdf and <https://edu.rsc.org/download?ac=14527>

Produced by: City of Stoke-On-Trent Sixth Form College

City of Stoke-On-Trent Sixth Form College has produced this resource on behalf of the Education and Training Foundation. This programme is funded by the Department for Education.

SOP for analysis of aspirin by TLC

This list of resources can be used for the following formative assessment tasks:

- **01 Equipment**
- **02 Recording data**
- **03 Identifying important steps in an SOP**
- **04 Following the SOP**

Introduction	Chromatography is used to separate mixtures of substances into their components and can be used to assess the purity of prepared samples. All forms of chromatography work on the same principle. They all have a stationary phase (a solid, or a liquid supported on a solid) and a mobile phase (a liquid or a gas). The mobile phase flows through the stationary phase and carries the components of the mixture with it. Different components travel at different rates. Thin-layer chromatography (TLC) is done exactly as it says – using a thin, uniform layer of silica gel or alumina coated onto a piece of glass, metal or rigid plastic. The silica gel or the alumina is the stationary phase. The stationary phase for TLC also often contains a substance which fluoresces in ultraviolet (UV) light. The mobile phase is a suitable liquid solvent or a mixture of solvents.
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Risk assessment	Substance, equipment or procedure	Hazard	Risk	Control(s)
	2-hydroxybenzoic acid	Irritant	Serious eye damage Harmful if swallowed Suspected of damaging unborn child	Wear eye protection
	2-ethanoxybenzoic acid (aspirin)	Irritant	Causes skin and serious eye irritation Potential respiratory irritation Harmful if swallowed	For a 15-minute exposure, the concentration in the atmosphere should not exceed 15 mg/m ³ Wear eye protection Good ventilation
	Glacial ethanoic acid	Corrosive Flammable	Causes severe skin burn and eye damage	Wear eye protection and gloves

	Iodine	Harmful Environmental hazard	Harmful if in contact with skin or inhaled	Wear eye protection and gloves
	Ethyl ethanoate	Flammable Harmful	Harmful if in contact with skin or inhaled	Wear eye protection and gloves
	Cyclohexane	Flammable Irritant Harmful to the environment	Causes skin irritation	Wear gloves
	Ethanol	Flammable	Highly flammable	Wear eye protection and gloves Keep the room well ventilated

Procedure	Equipment list • Fume cupboard • UV light source • Three test tubes • Watch-glass • Melting-point tubes • TLC plates • Small beaker to hold TLC plate • Cover for the beaker • Ethanol • Prepared aspirin sample • Sample of pure aspirin • Sample of pure 2-hydroxybenzoic acid • Solvent for chromatography (cyclohexane, ethyl ethanoate or ethanoic acid) • Iodine crystals • Aluminium foil or clingfilm
	Method 1 Take or cut a pre-dried TLC plate that will fit into a small beaker. Try to handle the TLC plate by the edges only. Draw a fine pencil line about 1 cm from the bottom of the plate. This is the baseline. 2 Take a few crystals of the aspirin that you have prepared and dissolve them in a minimum volume of ethanol on a watch-glass. Try a few drops, then add more ethanol if required. 3 On the baseline, place a small spot of your aspirin sample. The spot is best made by using a very fine dropping pipette or a drawn-out melting-

	point tube. Apply a small quantity of the solution at a time; let it dry, and then add more. Try not to let the diameter of the spot exceed 5 mm. 4 Repeat steps 2 and 3 using pure 2-hydroxybenzoic acid (salicylic acid) then pure aspirin. Ensure the three spots are well spaced out along the baseline but are not too close to the side edges of the TLC plate. It is a good idea to label the top of the chromatography plate (in pencil) so that you know what each spot is. 5 Working in a fume cupboard or a well-ventilated laboratory, pour some of the chromatography solvent into the beaker to a depth of no more than 5 mm. 6 Place the chromatography plate in the beaker, making sure the solvent level is below the baseline. 7 Cover the beaker with clingfilm (or aluminium foil or a watch-glass). Leave the solvent to rise up the TLC plate. This will take about 15–25 minutes. 8 When the solvent has nearly reached the top of the plate, take the chromatogram out of the beaker. Mark the position reached by the solvent with a pencil, then place the plate in a fume cupboard and allow the solvent to evaporate. Dispose of the solvent from the beaker as directed by your tutor. 9 You can locate the positions of the substances on the plate by examining it under UV light (CARE: Do not look directly at the light source). View the plate by reflected light and mark the positions of the spots carefully with a pencil. 10 Alternatively, place the sheet in another beaker containing a few crystals of iodine. Do this in a fume cupboard. Cover the beaker with clingfilm (or aluminium foil). The spots, which were probably just visible before, should show up more clearly now.
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Emergency first-aid procedure	Eye: • Check for and remove contact lenses if present and easy to do. • Immediately flush eyes with gentle but large stream of water for at least 20 minutes, lifting lower and upper eyelids occasionally. • Call 999/111. Ingested: • Rinse mouth – do not induce vomiting unless directed to do so by medical personnel. • If vomiting occurs, keep head low so that vomit does not enter lungs. • Never give anything by mouth to an unconscious person. • Call a doctor if symptoms occur. Spilt on skin or clothing: • Wash skin with soap and plenty of water for at least 15 minutes.
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	- Remove contaminated clothing and shoes – wash clothing before reuse. - Call a doctor if symptoms occur. Spilt on the floor: - Wipe up small amounts with a damp cloth and rinse well. Brush up large amounts and rinse with plenty of water. For more detail please use: SSS023-Ethanoic-acetic-acid.pdf (cleapss.org.uk) SSS056-Iodine.pdf (cleapss.org.uk) SSS063-Hydrocarbons.pdf (cleapss.org.uk) SSS060-Ethanol.pdf (cleapss.org.uk)
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Disposal procedure	Pour completed reaction mixtures into a pre-prepared waste beaker. If the waste mixture remains blue or black, add additional 0.5 M sodium carbonate solution. All solutions can then be disposed of down the foul water drain with plenty of water. Waste beaker: Provide each group with a beaker or container with 100 cm³ of 0.5 M sodium carbonate solution.
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Adapted from: <https://edu.rsc.org/download?ac=14527>

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Mark scheme

Following the standard operating procedure (SOP)

This list of resources can be used for the following formative assessment tasks:

- **04 Following the SOP**

Descriptor
• You used all the correct personal protective equipment throughout the whole practical. • You did pre- and post-practical cleaning. • You collected all the correct equipment. • All the equipment was stored in a safe area (e.g. in a fume cupboard and not near the edge of the table). • You set up the equipment correctly with no support. • You followed all the multi-step SOPs correctly to produce results. • You followed all the multi-step SOPs without support. • You followed the risk assessment correctly. • You completed all steps in the SOPs in a timely manner. • You were able to have a professional discussion with your tutor during and after the practicals. • You recorded data in the correct format.
Self-assessment comments:

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Additional resources

Formative assessment

T Level in Science
Occupational specialism – Laboratory science

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Self-reflection tracker

Reflection	What went well	Even better if	Next steps
Formative assessment			
Writing literature reviews: 01 Reviewing scientific literature			
Writing literature reviews: 02 Writing references			
Writing literature reviews: 03 Features of abstracts			
Writing literature reviews: 04 Writing an introduction			
Writing literature reviews: 05 Writing a literature review			
Standard operating procedure: 01 Standard operating procedure (SOP)			
Standard operating procedure: 02 SOP equipment			
Standard operating procedure: 03 Writing a hypothesis			
Standard operating procedure: 04 Writing a scientific introduction in an SOP			
Standard operating procedure: 05 Writing a method for an SOP			
Risk assessment: 01 Hazards			
Risk assessment: 02 Risk assessment content			
Risk assessment: 03 Writing a risk assessment			
Practical skills: 01 Equipment			
Practical skills: 02 Recording data			
Practical skills: 03 Identifying steps in an SOP			
Practical skills: 04 Following the SOP			

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