

Coordinator Notes:

Module 5.3: Engineering – Chemical Engineering

This session explores the role of a chemical engineer. Students explore some of the unique areas a chemical engineer can be involved in. They then pursue the role of a chemical engineer in pharmaceuticals.

Through this lesson students learn about pH and the digestive system and apply their problem solving skills.

This week's challenge requires teams to decide on a solution to model the stomach as well as developing a tablet coating which can withstand these conditions.

This session would be a fantastic opportunity to invite along a **guest speaker** from an engineering field – this could act as a substitute to or complement the career exploration activity. Some places to enquire about guest speakers are: Engineers Australia, City Councils, Engineering firms and Universities. The engineer may be able to stay and engage in the Challenge activities and assist with testing and scoring. Ensure “Working With Children Checks” are in cleared for any session guests (systems vary in each state of Australia).

Session Length:

This Module can be presented in different session durations per your needs. Lesson plans are provided for:

- A 120 minute session, or, 2 x 60 minute sessions
- 45 minute, 75 minute, and 90 minute sessions

Technology:

PowerPoint: If you do not have access to a data projector and cannot display the PowerPoint presentation, we recommend that you print the most important slides before the session, and either enlarge them onto cardboard to use in place of slides, or create a booklet that students can share in small groups.

The most important slides have been included as a ‘Reduced Slides’ PowerPoint file, and an easily printable pdf version of these slides is also provided. If you choose this option, we recommend that you still read and use the slide notes included in the full PowerPoint for the session. The session can be conducted without slides all together, but they offer visual aid in explanation of scientific concepts. We recommend at the very least that instructions for each experiment are printed for the students.

Videos links: The suggested links to online videos within the session can be helpful with explanation. Notes have been included in the slides if there is an essential component to a video which the facilitator should discuss or demonstrate, if the video cannot be played.

Please read the Module 5 Risk Assessment before proceeding with the session

Contents	Page
Module 5.3 Overview	3
Lesson Plan for Module 5.3 - 120 minute session, or, 2 x 60 minute sessions	5
Activity 5.3.1 – Acid + Base (Facilitator demonstration)	7
Activity 5.3.2 – pH Testing	8
Challenge 5.3 – Coordinator Notes	9
Challenge 5.3 – Score Sheet	11
Challenge 5.3 – Planning / Recipe Sheet	12
Lesson Plan for Module 5.3 – 90 minute session	14
Lesson Plan for Module 5.3 – 75 minute session	16
Lesson Plan for Module 5.3 – 45 minute session	18
References	20
Materials Required for Module 5.3 sessions	21

Module 5.3: Engineering – Chemical Engineering

Overview

In this Module, students explore the role of a chemical engineer.

Students will put themselves in the shoes of an engineer in this session's challenge, to creatively design a tablet coating.

Content overview:

Concept / Activity	Session Duration (minutes)			
	120	90	75	45
Introduction to Chemical engineering roles	*	*	*	*
Exploring Acids and Bases Activity 5.3.1 – Acid base reaction	*	-	-	-
Exploring the pH scale Activity 5.3.2 – Measuring the pH of solutions	*	*	*	-
Chemical engineers in pharmaceuticals (medicines)	*	*	*	*
Digestive System: pathways for food, pH of system	*	*	*	*
Tablet coatings: why are tablets coated?	*	*	*	*
Tablet Coating Challenge 5.3: Design and test tablet coatings in a simulated stomach environment	*	*	*	*

Slides:

PowerPoint Slides are available to support the delivery of this module. Slides explain concepts visually, and include short, engaging videos relevant to the topic. A full list of slides and recommended inclusions for each session duration are provided in the table below. Appropriate slides are also noted in lesson plans for each duration.

PowerPoint Presentation: 'M 5.3 - Master Slides 120 minute Session Duration'		Session Duration (minutes)			
Slide	Content	120	90	75	45
1	Introductory Title Slide for the Session	*	*	*	*
2	Prompt slide and video link: What is chemical engineering?	*	*	*	*
3	Prompt slide: chemical engineering of products	*	*	*	-
4	Activity 5.3.1 Acid + Base – Facilitator Demonstration	*	-	-	-
5	Overview of the pH scale, acids, bases and indicators	*	*	*	-
6	Recap: Molecules and atoms. Introducing charged particles: Ions.	*	*	*	-
7	Activity 5.3.2 pH Testing	*	*	*	-
8	Prompt slide: chemical engineering in medicine	*	*	*	*
9	Overview: Digestive system, pH of mouth, stomach, intestines	*	*	*	*
10	Overview: Tablet coatings, why do we coat them?	*	*	*	*
11	Intro slide: Challenge 5.3 Tablet Coating Challenge	*	*	*	*
12	Video link: example recipes and testing	*	*	*	*
13	The Engineering Process	*	*	*	*
14	Challenge rules	*	*	*	*
15	Challenge Materials	*	*	*	*
16	Session references	*	*	*	*

Module 5.3 Chemical engineering Lesson Plan 120 minute session or 2 x 60 minute sessions			
High Tech: Use PowerPoint Presentation 'M5.3 - Master Slides' Low Tech: Print PowerPoint 'M5.3 - Reduced Slides for Printing'. Use slide notes from the ENTIRE 120 minute presentation, adapting discussion to cover omitted slides.			
Key Learning Area Chemistry, human body Engineering, Careers			Topic Chemical engineering
Timing	Running Time (hh:mm)	Procedure	Materials
5 min	00:05	Lesson Introduction Welcome! Has anyone heard of an environmental engineer? Introduce chemical engineering. Watch video. Note: This is a good opportunity for an invited guest engineer to talk about their career, instead of, or as well as the notes/slides.	PowerPoint M5.3 (Slides 1-2)
3 min	00:08	Body of Lesson (Lesson 1, 2 x 60 minute sessions) Discuss products chemical engineers may help to make.	PowerPoint M5.3 (Slide 3)
12 min	00:20	Introduce and undertake Activity 5.3.1 'Acid + Base' as a demonstration. Discuss results.	PowerPoint M5.3 (slide 4) Clear bottle / jar, white vinegar, bi-carb soda, food colouring, paper towel, rubber band, tray, mixing bowl.
2 min	00:23	Introduce the pH scale and highlight / compare the nature of stomach acid, water, bleach. Note the results of activity 5.3.1: the acid vinegar reacted with the base bi-carb soda.	PowerPoint M5.3 (slide 5)
2 min	00:25	Outline idea of charged particles, ions, present in acids and bases.	PowerPoint M5.3 (slide 6)

20 min	00:45	Introduce and undertake Activity 5.3.2 'pH testing'. Discuss results.	PowerPoint M5.3 (slide 7) Plastic cups, liquids, pH Indicator strips
5 min	00:50	Discuss chemical engineering in medicine, for tablet coating. Introduce the digestive system, and the pH of our mouth, stomach and intestines.	PowerPoint M5.3 (slides 8-10) Optional Human body digestive system model.
(Break for 2 x 60 minute sessions) (Lesson 2, 2 x 60 minute sessions)			
5 min	00:05 / 01:05	Introduce the Challenge <i>Note: Revisit pH results from activity 5.3.2 if starting lesson 2 on a different day to ending lesson 1).</i> Watch the video. If video unable to be played, the coordinator should watch prior to the session.	PowerPoint M5.3 (slides 11-12)
2 min	00:07 01:07	Introduce the engineering process. It is similar to the scientific method discussed in earlier sessions.	PowerPoint M5.3 (slide 13)
2 min	00:10 / 01:10	Discuss the rules, materials available, and form into groups of 2 – 4. Hand out planning sheets and available materials.	PowerPoint M5.3 (slides 14-15) Planning sheets. Timer, plastic cups, skittles, lemon juice, lemonade, paper plates, plastic spoons, flour, corn flour, vegetable oil, sugar honey
15 min	00:25/ 01:25	Plan, design and pre-test coatings. Allow students to test and re-fine recipes as they go.	
10 min	00:35/ 01:35	Trial Testing of 1 recipe per group. Discuss test results and which recipes were more successful.	
5 min	00:40/ 01:40	Modify and refine recipes and coatings.	
10 min	00:50/ 01:50	Official testing.	Score sheets.
10 min	01:00/ 02:00	Lesson Conclusion Clean up and discussion. Announce scores / winning team.	

Activity 5.3.1: Acid + Base (Facilitator Demonstration)

Aim: To observe an acid base chemical reaction

Materials (Facilitator demonstration):

- 1 clear glass bottle / jar (wide top)
- 1 cup white vinegar
- Food colouring
- A mixing bowl
- Washing-up liquid
- Paper-towel
- Rubber band
- Bicarbonate of soda (3 tablespoons)
- Large baking tray / tub

Procedure:

1. Stand the bottle / jar in the centre of the tray.
2. Mix the vinegar, a few drops of food colouring, and a squirt of washing up liquid together in the bowl.
3. Pour the mixture into the bottle.
4. Wrap the bicarbonate of soda in a small piece of paper-towel and secure with the rubber band.
5. Carefully place the bicarb soda package into the bottle.
6. Observe and document results.

Expected Result & Explanation:

The bi-carbonate of soda will react with the vinegar. The reaction will create carbon dioxide gas, and cause the dish-washing liquid to make bubbles. The bubbly foamy mixture will expand up and out of the bottle / jar.

Bicarbonate of soda is another name for the chemical sodium bicarbonate. This substance is a base. Vinegar contains acetic acid. When the acid and base mix, they create carbon dioxide gas. As the gas rises through the dishwashing liquid it creates soapy foamy bubbles.

Extension: What happens if you repeat the experiment without the dish-washing liquid?

Video Demonstration: <https://youtu.be/tTP1LJl4BTk>

Notes:

- ***Take care to determine food allergies and sensitives prior to the session. Remove / change liquids to be tested as needed.***
- ***Do not stand immediately over the top of the jar / bottle after placing in the bi-carb soda. Wear protective eye wear / safety glasses.***
- ***Food colouring can stain hands, skin, clothes and work stations.***

Activity 5.3.2: pH testing

Aim: To observe the pH of common liquids

Materials (per group):

- 8 plastic cups, 1 marker
- 30 ml lemon juice
- 30 ml white vinegar
- 30 ml brown vinegar
- 30 ml lemonade
- 30 ml Coca-Cola
- 30 ml water
- 30 ml milk
- 30 ml liquid soap
- 8 pH indicator test strips

Procedure:

1. Use the marker to label each plastic cup with a different liquid: lemon juice, white vinegar, water etc.
2. Add 30 ml of each liquid to the correspondingly labelled cups.
3. Dip a pH indicator strip into each one of the liquids, follow the instructions for the strip on how long to leave it in. Observe the colour change.
4. Compare the colour of the strip to the indicator chart to decide the approximate pH of the liquid.
5. Repeat for the other 7 liquids.

Extension: Can you sort the liquids into acids, bases and neutral, based on their pH? Which liquids have similar pH to the human stomach (pH 1.5 – 3.5).

Expected result and explanation:

The indicator strips will change colour in the liquids. Each liquid will have a slightly different pH. Some liquids may appear closer in pH than others.

Neutral substances such as water have a pH of 7. A substance with a pH lower than 7 is acidic, one with a pH higher than this (up to 14) is a base (alkali).

Lemon juice (and lemonade) will be close in pH to the human stomach.

Expected pH sorting order:

ACID	NEUTRAL	BASE
Lemon juice vinegar Coca-Cola lemonade milk	water	soap

Notes:

- **Take care to determine food allergies and sensitives prior to the session. Remove / change liquids to be tested as needed.**
- **Ensure a water station is available to wash hands and flush eyes if liquid splash / spill. Clean up all spills straight away.**

Challenge M5.3 – Tablet Coating Challenge

Scoring:

A scoring mechanism is included so that the element of ‘competition’ may challenge all students to participate to their fullest. You may remove the scoring system all together if it does not work with your group of students.

When scoring it is important to only announce who the winning team is - so there will be no ‘losers’ or last place. Highlight the good strategies of each team. Consider asking how the students might approach the task differently if asked to do it again, or how they might teach the same things they learned during the club to a younger student.

The Problem:

“A new drug has been designed to treat a disease harming the small intestine. Hooray!

The clinical trials so far show that the new drug breaks down in the acidic environment of the stomach, so it never reaches the small intestine to help patients.

You and your team of chemical engineers and gastroenterologists (doctors of the digestive organs!) have been asked to experiment with different tablet coatings, to find a coating which will allow the drug to reach the small intestine.”

Activity Notes:

- Teams will need a work space such as a table to plan out and make their tablet coating. Using a disposable tablecloth or newspaper mat below may be recommended if it is a carpeted room.
- Supervisors should be available to assist student’s document their recipes. The ‘total number of spoonful’s’ cell in the table (M5.3 Worksheet) is intended to assist students calculate recipe fractions, if this is of interest to them.
- Ensure students don’t have super thick coatings, they need to be 5 mm, or less if possible.
- Add the lemonade to the lemon juice to create the stomach solution just before testing, so there are bubbles present for the testing. The solution should be $\frac{1}{4}$ lemonade, $\frac{3}{4}$ lemon juice.
- Suggestions for coatings: if it crumbles and doesn’t surround the skittle properly, add more oil/water/honey; if it is too wet add more flour or sugar.
- **Take care to determine food allergies and sensitives prior to the session. Remove / change liquids to be tested as needed.**
- **Ensure a water station is available to wash hands and flush eyes if liquid splash / spill. Clean up all spills straight away.**

Video demonstration: <https://youtu.be/wzitxKO1IEE>
https://www.teachengineering.org/activities/view/cub_biomed_lesson05_activity1

Rules:

- Your tablet coating needs to withstand the stomach solution for 5 minutes during the official test.
- Coating effectiveness will be judged based on the colour of the stomach fluid after 5 minutes. If the fluid is still clear, and the lolly has kept its colour, the coating has worked!
- If the coating is still intact after 5 minutes it will be put to the test with 2 minutes of stirring (if time permits).
- Tablet coating can be no more than 5 mm thick. Thinner coatings will get more points.

Scoring notes:

- Testing will be performed by all teams at once.
- Two controls test stations are also required:
 - A skittle in an empty cup and,
 - A skittle in a cup of 'simulated stomach' solution, without a coating
- Before official testing, ensure each coated skittle is measured. The diameter cannot be more than 10mm greater than an uncoated skittle (i.e. the coating cannot be more than 5 mm thick on any side around the skittle).
- Each team needs to watch their cup, if the solution starts to become coloured by the skittle they need to record the time that this began on their score sheet. If the skittle is still coated by the end of the 5 min and no colour has leached out, it will now undergo the second test phase.
- After 5 minutes of testing, the remaining successful tablet coatings will be tested further by stirring the solutions with a spoon for 2 minutes. Tablet coatings which survive this will get bonus points!

Points Available:

Thickness of coating (mm)	Score
< 1	100
<2	80
<3	60
<4	40
<5	20
>5	5

Challenge Element	Points Available
Thickness of coating	5 to 100 points (see table)
Recipe planning sheet completed	15 points
Tablet coating survives in simulated stomach	Score = number minutes x 20 (max 100 points)
Time tablet coating survives stirring	Score = number minutes x 20 (max 40 points)

Challenge 5.3: Score Sheet

Team name		
		Points Scored
Max thickness of coating	mm	
Recipe Planning Sheet Completed	Yes / No	
Time tablet coating survives in simulated stomach	1, 2, 3, 4, 5 minutes	(minutes x 20)
Bonus: Time tablet coating survive stirring	1, 2 minutes	(minutes x 20)
Total Score:		

Team name		
		Points Scored
Max thickness of coating	mm	
Recipe Planning Sheet Completed	Yes / No	
Time tablet coating survives in simulated stomach	1, 2, 3, 4, 5 minutes	(minutes x 20)
Bonus: Time tablet coating survive stirring	1, 2 minutes	(minutes x 20)
Total Score:		

Challenge M5.3 – Planning Sheet: Tablet Coating Challenge

To design your coating consider:

THICKNESS – How thick your coating is will impact points. Aim for a maximum 5mm thickness in any direction.

SMOOTH SEAL – How smooth can you make your coating surface? Surfaces with pits / holes in them will let in the stomach “acid” more quickly than surfaces that are smooth all over.

Take a look at the materials available, and experiment with your coatings!



Image source: pixabay.com

Tablet Coating Trial Recipe 1

Ingredient	Number of Spoonful's	Fraction of recipe (number of spoonful's divided by total spoonful's)
Total # Spoonful's =		

Tablet Coating Trial Recipe 2

Ingredient	Number of Spoonful's	Fraction of recipe (number of spoonful's divided by total spoonful's)
Total # Spoonful's =		

Tablet Coating Recipe - For Official Testing!

Ingredient	Number of Spoonful's	Fraction of recipe (number of spoonful's divided by total spoonful's)
Total # Spoonful's =		



Image source: pixabay.com

Module 5.3 Chemical engineering Lesson Plan 90 minute session			
High Tech: Use PowerPoint Presentation 'M5.3 - Master Slides'. Hide slide 4. Low Tech: Print PowerPoint 'M5.3 - Reduced Slides for Printing'. Use slide notes from the ENTIRE 90 minute presentation, adapting discussion to cover omitted slides.			
Key Learning Area Chemistry, human body Engineering, Careers			Topic Chemical engineering
Timing	Running Time (hh:mm)	Procedure	Materials
5 min	00:05	Lesson Introduction Welcome! Has anyone heard of an environmental engineer? Introduce chemical engineering. Watch video. Note: This is a good opportunity for an invited guest engineer to talk about their career, instead of, or as well as the notes/slides.	PowerPoint M5.3 (Slides 1-2)
2 min	00:07	Body of Lesson Discuss products chemical engineers may help to make.	PowerPoint M5.3 (Slide 3)
2 min	00:09	Introduce the pH scale and highlight / compare the nature of stomach acid, water, bleach.	PowerPoint M5.3 (slide 5)
2 min	00:11	Outline idea of charged particles, ions, present in acids and bases.	PowerPoint M5.3 (slide 6)
20 min	00:31	Introduce and undertake Activity 5.3.2 'pH testing'. Discuss results.	PowerPoint M5.3 (slide 7) Plastic cups, liquids, pH Indicator strips
4 min	00:35	Discuss chemical engineering in medicine, for tablet coating. Introduce the digestive system, and the pH of our mouth, stomach and intestines.	PowerPoint M5.3 (slides 8-10) Optional Human body digestive system model.

4 min	00:39	Introduce the Challenge Watch the video. If video unable to be played, the coordinator should watch prior to the session.	PowerPoint M5.3 (slides 11-12)
2 min	00:41	Introduce the engineering process. It is similar to the scientific method discussed in earlier sessions.	PowerPoint M5.3 (slide 13)
2 min	00:43	Discuss the rules, materials available, and form into groups of 2 – 4. Hand out planning sheets and available materials.	PowerPoint M5.3 (slides 14-15) Planning sheets. Timer, plastic cups, skittles, lemon juice, lemonade, paper plates, plastic spoons, flour, corn flour, vegetable oil, sugar honey
15 min	00:58	Plan, design and pre-test coatings. Allow students to test and re-fine recipes as they go.	
12 min	01:10	Trial Testing of 1 recipe per group. Discuss test results and which recipes were more successful.	
5 min	01:15	Modify and refine recipes and coatings.	
10 min	01:25	Official testing.	Score sheets.
5 min	01:30	Lesson Conclusion Clean up and discussion. Announce scores / winning team.	

Module 5.3 Chemical engineering Lesson Plan 75 minute session			
High Tech: Use PowerPoint Presentation 'M5.3 - Master Slides'. Hide slide 4. Low Tech: Print PowerPoint 'M5.3 - Reduced Slides for Printing'. Use slide notes from the ENTIRE 75 minute presentation, adapting discussion to cover omitted slides.			
Key Learning Area Chemistry, human body Engineering, Careers			Topic Chemical engineering
Timing	Running Time (hh:mm)	Procedure	Materials
5 min	00:05	Lesson Introduction Welcome! Has anyone heard of an environmental engineer? Introduce chemical engineering. Watch video. Note: This is a good opportunity for an invited guest engineer to talk about their career, instead of, or as well as the notes/slides.	PowerPoint M5.3 (Slides 1-2)
2 min	00:07	Body of Lesson Discuss products chemical engineers may help to make.	PowerPoint M5.3 (Slide 3)
2 min	00:09	Introduce the pH scale and highlight / compare the nature of stomach acid, water, bleach.	PowerPoint M5.3 (slide 5)
2 min	00:11	Outline idea of charged particles, ions, present in acids and bases.	PowerPoint M5.3 (slide 6)
15 min	00:26	Introduce and undertake Activity 5.3.2 'pH testing'. Discuss results.	PowerPoint M5.3 (slide 7) Plastic cups, liquids, pH Indicator strips
4 min	00:30	Discuss chemical engineering in medicine, for tablet coating. Introduce the digestive system, and the pH of our mouth, stomach and intestines.	PowerPoint M5.3 (slides 8-10) Optional Human body digestive system model.

3 min	00:33	Introduce the Challenge Watch the video. If video unable to be played, the coordinator should watch prior to the session.	PowerPoint M5.3 (slides 11-12)
2 min	00:35	Introduce the engineering process. It is similar to the scientific method discussed in earlier sessions.	PowerPoint M5.3 (slide 13)
2 min	00:37	Discuss the rules, materials available, and form into groups of 2 – 4. Hand out planning sheets and available materials.	PowerPoint M5.3 (slides 14-15) Planning sheets. Timer, plastic cups, skittles, lemon juice, lemonade, paper plates, plastic spoons, flour, corn flour, vegetable oil, sugar honey
15 min	00:52	Plan, design and pre-test coatings. Allow students to test and re-fine recipes as they go.	
10 min	01:02	Trial Testing of 1 recipe per group. Discuss test results and which recipes were more successful. Modify and refine recipes and coatings.	
10 min	01:12	Official testing.	Score sheets.
3 min	01:15	Lesson Conclusion Clean up and discussion. Announce scores / winning team.	

Module 5.3 Chemical engineering Lesson Plan 45 minute session			
<p>High Tech: Use PowerPoint Presentation 'M5.3 - Master Slides'. Hide slide 3,4,5,6,7 and 13.</p> <p>Low Tech: Print PowerPoint 'M5.3 - Reduced Slides for Printing'. Use slide notes from the ENTIRE 45 minute presentation, adapting discussion to cover omitted slides.</p>			
Key Learning Area Chemistry, human body Engineering, Careers			Topic Chemical engineering
Timing	Running Time (hh:mm)	Procedure	Materials
5 min	00:05	Lesson Introduction Welcome! Has anyone heard of an environmental engineer? Introduce chemical engineering. Watch video. Note: This is a good opportunity for an invited guest engineer to talk about their career, instead of, or as well as the notes/slides.	PowerPoint M5.3 (Slides 1-2)
2 min	00:07	Body of Lesson Discuss chemical engineering in medicine, for tablet coating. Introduce the digestive system, and the pH of our mouth, stomach and intestines.	PowerPoint M5.3 (slides 8-10) Optional Human body digestive system model.
5 min	00:12	Introduce the Challenge Watch the video. If video unable to be played, the coordinator should watch prior to the session. Discuss the rules, materials available, and form into groups of 2 – 4. Hand out planning sheets and available materials.	PowerPoint M5.3 (slides 11-12, 14-15) Planning sheets. Timer, plastic cups, skittles, lemon juice, lemonade, paper plates, plastic spoons, flour, corn flour, vegetable oil, sugar honey
10 min	00:22	Plan, design and pre-test coatings. Allow students to test and re-fine recipes as they go.	

10 min	00:32	Trial Testing of 1 recipe per group. Discuss test results and which recipes were more successful. Modify and refine recipes and coatings.	Score sheets.
10 min	00:42	Official testing.	
3 min	00:45	Lesson Conclusion Clean up and discussion. Announce scores / winning team.	

Module 5.3 - References

Challenge activity inspired by the 'Protect that Pill' activity at TeachEngineering.org. Copyright © 2008 TeachEngineering.org. Used with permission.

https://www.teachengineering.org/view_activity.php?url=collection/cub_/activities/cub_biomed/cub_biomed_lesson05_activity1.xml

Chemical engineering

<https://www.engineersaustralia.org.au/Communities-And-Groups/Colleges/Chemical>

<https://www.youtube.com/watch?v=UXwbxM8Yfi>

Acid and Bases

Video Demonstration: <https://youtu.be/tTP1LJI4BTk>

<https://www.visionlearning.com/en/library/Chemistry/1/Acids-and-Bases/58>

http://www.chem4kids.com/files/react_acidbase.html

Digestive system

<http://www.gesa.org.au/resources/patients/the-gastrointestinal-gi-system/>

<http://patients.gi.org/what-is-a-gastroenterologist/>

Module 5.3- Required Materials

- Pens, pencils and writing paper are generally required every session.
- Students may like to bring a note pad to record their observations and ideas.
- A group usually refers to 2 - 4 students.

Activity	Material	Amount	Where can I find it?
All sessions	PowerPoint Slides* (digital, or printed)	1 per coordinator	Coordinator Package
All sessions	Printed PowerPoint* Slide Notes	1 per coordinator	Coordinator Package
All sessions	Printed Lesson Plan	1 per coordinator	Coordinator Package
All sessions	Printed Module 1 Risk Assessment	1	Coordinator Package
All sessions	Computer, Data Projector, Screen	1	Venue
Activity 5.3.1 "Acid + Base" 120 minute, 2 x 60 minute sessions	1 clear glass bottle / jar (wide mouth)	1	Recycled
	White vinegar	1 cup	supermarket
	Washing up liquid	3 squirts	supermarket
	Food colouring	3 drops	supermarket
	Mixing bowl	1	Supermarket / recycled
	Paper towel	2 sheets	supermarket
	Rubber bands	2	Supermarket / stationary store
Activity 5.3.2 "pH Testing" 120 minute, 2 x 60 minute, 90 minute and 75 minute sessions	Plastic cups	8 per group	Supermarket / recycled
	Lemon juice	30 ml of each liquid per group	Supermarket
	White vinegar		
	Brown vinegar		
	lemonade		
	Coca-Cola		Supermarket / venue
	water		Supermarket
	milk		
	Liquid soap	8 per group	Pool shop, pharmacy, online (see link next page)

Required Materials List Continues on Next Page

* PowerPoint Slides have been provided as a Master Set for a 120 minute (or 2 x 60 minute) session duration. Hide/ omit slides as noted in lesson plans for delivery of shorter sessions.

Note: Some listed materials, for example jars, vinegar, lemonade appear for multiple experiments. Review the experiments you plan to include, and the required materials for efficiencies, prior to sourcing materials for your session.

Activity	Material	Amount	Where can I find it?
Challenge 5.3: Tablet Coating	Skittles, 2 – 3 packets	3 - 5 per group	supermarket
	Plastic cups	3 per team, plus 2 for control	Supermarket, recycled
All sessions	Lemon juice	$\frac{3}{4}$ cup per test station	Supermarket
	Lemonade	$\frac{1}{4}$ cup per test station	Supermarket
	Stop watch / timer	1 per group	Sports store, venue clock, watch, phone
	Plastic spoons	4 per team	Supermarket
	Flour	$\frac{1}{2}$ cup per team	Supermarket
	Corn flour	$\frac{1}{2}$ cup per team	Supermarket
	Vegetable oil (canola)	30 ml per team	Supermarket
	Honey (optional)	1 tea spoon per team	Supermarket
	water	Access for team	venue
	Sugar	$\frac{1}{3}$ cup per team	Supermarket

Online shopping links:

<https://www.madaboutscience.com.au/shop/universal-ph-test-paper.html>

100 strips from \$5 (5 cents each)

<https://www.madaboutscience.com.au/shop/ph-indicator-test-strip-paper.html>

200 strips from \$10 (5 cents each)