Investigate and Innovate with CSIRO

Food Packaging and Waste

Year level: Years 5-6, 7-8
Duration: Teacher specified
Core concepts: Food packaging and circular economy

Teacher guide

Acknowledgement of Country

CSIRO acknowledges the Traditional Owners of the lands, seas and waters of the area that we live and work on across Australia. We acknowledge all Aboriginal and Torres Strait Islander peoples and their continuing connection to their culture and pay our respects to Elders past and present. CSIRO is committed to reconciliation and recognises that Aboriginal and Torres Strait Islander peoples have made contributions to all aspects of Australian life including culture, economy and science.

'Eternal Wisdom, Infinite Innovation'
artwork by Rachael Sarra, working with Gilimbaa.

Contents

Overview

Safety considerations:

- It is recommended to hold a class discussion regarding the possible risks and mitigation strategies prior to starting the activity.
- Appropriate PPE should be worn during this activity.
- ***Caution:*** *Some students may have food allergies. Although no produce is consumed, check for allergies to the selected fruit or vegetables. Students may also need to use scissors during the activity.*

Key learning goals:

Slide 3 in Food Packaging and Waste Classroom PowerPoint Presentation.

CSIRO research:

- CSIRO Blog - Waste not want not, top five tips for saving food
- CSIRO website - Novel extruded food products
- CSIRO website - Reducing the environmental impact of your diet
- CSIRO Double Helix Blog - Mopping up with food waste

Associated documents: Investigate and Innovate with CSIRO webpage

- Food Waste and Packaging - Student Workbook
- Food Waste and Packaging - Classroom PowerPoint Presentation (PPT)
- Australian Curriculum and Syllabus links and rubrics – Investigate and Innovate with CSIRO webpage

Icons:

Throughout the investigation you will see these icons (*below*) to highlight the type of activity and guidance recommended.

What is the LIA Framework?

The Australian Academy of Science Education Launch, Inquire, Act (LIA) framework helps us structure scientific investigations so that students:

- **Launch** by exploring and connecting to real-world phenomena,
- **Inquire** by investigating and analysing questions, and
- **Act** by applying, communicating and reflecting on our findings.

It's a way to learn science like real scientists do!

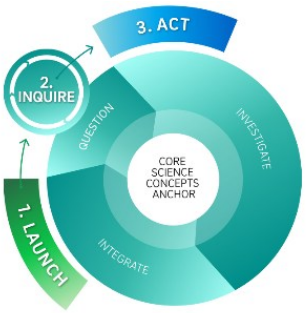

Figure 1 LIA Framework from the Australian Academy of Science.

PHASE 1: LAUNCH	**Purpose:** get curious, connect to the world, and ask a great question. **What you'll do:** Explore a phenomenon or scenario. Think about your own experience and ask: "What's going on here?". Identify what you already know and what you wonder about. Discuss why the topic matters. **Key questions:** • What do I see or experience? • What might be happening? • Why is this important?	Launch
PHASE 2: INQUIRE	**Purpose:** design and carry out an investigation to answer your question. **What you'll do:** Formulate a testable question. Plan your investigation: decide variables, controls, method. Collect data (measure, record, repeat). Graph and analyse results to spot trends or patterns. **Key questions:** • What variables will I change, and what will I measure? • How will I make it fair? • What do my results show?	Inquire
PHASE 3: ACT	**Purpose**: use your findings to communicate, reflect, and apply to the real world. **What you'll do:** Draw conclusions based on your evidence. Reflect on your method: what worked, what could you improve? Apply your understanding: how does your investigation link to real-life scientific research or technology? Share your findings through a poster, presentation, or video. **Key questions:** • What did I learn and why does it matter? • How could I do better next time? • How can this knowledge be used in the real world?	Act

Scientific Inquiry Continuum

The Scientific Inquiry Continuum describes the progression from teacher-directed to student-directed investigation. It supports educators in scaffolding investigation experiences so that students gradually develop the skills and confidence to think, question, and work like scientists.

This continuum is referenced throughout the investigation to help teachers identify the level of inquiry embedded in each activity. Educators are encouraged to move flexibly along the continuum based on students' prior knowledge, readiness, and learning context.

To explore the concept further, please complete 'The Power of Inquiry and Explicit Teaching: A Dual Approach to Teaching and Learning' e-Module linked here.

Scientific Inquiry Continuum

Limited Inquiry

Also referred to as closed or confirmation, can be used for novice learners that may need more structure and scaffolding when introducing new learning concepts. The teacher provides the question(s), method(s), and expected results. Students confirm known principles through structured activities.

Structured Inquiry

Ideal for learners who can manage investigations with guidance. The teacher provides the question and method, but students collect and interpret their own data to reach conclusions

Guided Inquiry

Supports students developing independence and ownership of their learning. Promoted higher order thinking and critical analysis. The teacher provides the question(s), but students design and carry their own methods, collect data and draw conclusions.

Open Inquiry

Student designed and are highly successful once students are proficient in managing independent learning or when a concept needs to be extended for students beyond the key outcomes.

The slides and activities throughout this investigation are labelled with icons that indicate the corresponding inquiry stage. These markers are intended as a guide only. Please use professional judgment to adapt, combine, or re-sequence activities to suit the learners and curriculum goals.

Classroom PowerPoint (PPT) presentation guide

In the PPT, activities correspond with a specific stage or stages of the Scientific Inquiry Continuum and the Australian Academy of Science Education Launch, Inquire, Act (LIA) Framework to guide teachers and students through a food packaging and waste investigation.

Consult the equipment lists (Investigation: Better packaging - Page #12) provided in each investigation and adjust resource quantities according to student or group numbers.

Inquiry and Framework stages	**Slide #** *Classroom PowerPoint Presentation (PPT)* **Page #** *(Student Workbook)*	**Teacher guidance**	**Student guidance**
	Slide 2 **Page 3**	Teacher reference slide – Scientific Inquiry Continuum, LIA Framework and icon explanation.	Student reference sheet – Launch, Inquire, Act (LIA) framework and icon explanation.
	Slide 3	Learning Objectives – each colour represents the stage of the Scientific Inquiry Continuum.	
Limited, Structured, Guided - Launch	**Slide 4** **Page 4**	*Launch phase – Formative assessment* - Lead the initial discussion on 'Food Packaging and Waste' by encouraging a whole class discussion, think-pair-share and independent recording of prior knowledge on Page 4.	*Launch phase* - Students record initial thoughts/prior knowledge in workbook. Refer to Page 3 to explore 'Launch Phase' in more detail, if required.
	Slides 5-8	Explore ways we package a variety of items through a whole-class discussion. Record initial thoughts on the board. Refer to presenter notes for discussion starters.	Participate in whole-class discussion.
	Slide 9 **Page 5**	*Formative assessment* - Guide students to complete the 'Food Packaging and Waste' pre-investigation knowledge	Complete Page 5 'Food packaging and waste 'Attempt 1' at the beginning of the

		assessment on Page 5. Students will then complete the same activity at the end of the investigation to compare their knowledge. Possible answers can be found in the Classroom Presentation presenter notes.	investigation and 'Attempt 2' at the end of the investigation.
	Slide 10 **Page 6**	Lead a class brainstorming session and pose the questions on Slide 10 to the students Instruct the students to complete the graphic organiser activity on Page 6.	Students participate in the brainstorming session and complete the graphic organiser on Page 6.
	Slide 11 **Page 7**	Explore the different types of packaging they have seen at the supermarket and discuss the different types using the image on Slide 11. This exercise is to prepare the students about the various types of packaging for their own design. **Note:** Polystyrene is the raw material (polymer). Styrofoam is a branded product specifically a closed-cell extruded polystyrene (XPS). Instruct students to complete the 'Compare and Contrast' activity on Page 7.	Students to complete the 'Compare and Contrast' activity on Page 7.
	Slide 12	Watch the video 'Aussie scientists working to create sustainable packing from food waste – ABC News' Refer to presenter notes for extension discussion questions..	Watch the video 'Aussie scientists working to create sustainable packing from food waste – ABC News'

Limited, Structured, Guided – Inquire	**Slide 13** **Page 3**	*Inquire Phase* – Explain the purpose of the inquire phase to design and carry out an investigation to answer the focus question.	Refer to Page 3 to explore 'Inquire Phase' in more detail, if required.
	Slides 14-22 **Pages 8-9**	Explore the Question Formulation Technique (QFT) process with your students. Explain 'Rules for generating questions' on slide 15. Show the students the food packaging images (Slide 16) as stimulus for generating a focus question. Complete the phases of the QFT (Instructions on each slide and presenter notes): 1. Produce – Slide 17 (Optional – use sticky notes for this activity). 2. Improve - Slide 18 3. What makes a good question? - Slide 19 4. Refine – Slide 20 5. Prioritise – Slide 21 6. Focus question breakdown - Slide 22 (See presenter notes for focus question example).	Students independently, with a partner and/or in groups of 3-4 complete Page 8 – Investigation focus question activity during the "Produce' phase of the QFT. Students complete Page 9 with their group to identify a focus question.
	Slides 23-26 **Pages 9-13**	Guide students to complete the investigation – Food packaging. Start with the introduction of the investigation (Slide 23). Refer to the presentation notes for possible questions and answers. Explore Slides 24 -25 to continue the pre-design of the investigation. Refer to the presentation notes for more guidance. Give your students ample class time to construct their packaging. Slide 26 – Demonstrate how to complete the three different tests: drop test, carry test, and crush test (Instructions in student workbook	Students record their focus question, variables and prediction (Pages 10-11) and work through investigation (Pages 12-16). Students also keep a detailed 'Process Diary' (Pages 18-23) throughout the investigation. Students can also record their results/findings (Page 17) to inform them of the next phase of the investigation.

		Pages 15-16) and record data. Students can record their findings on Page 17 of the student workbook. **Note**: instructions to calculate the percentage damaged/undamaged can be found in the presenter notes on Slide 26.	
	Slide 27- 30 **Pages 24-26**	Lead whole-class discussion comparing analysis of results and discussion (Slides 27-28). Support the students through the evaluation questions and conclusion on Slides 29-30. Guide the students to compare their initial prediction (Page 11) to the results of their investigation. Instruct the students to complete the analysis, discussion, evaluation and conclusion questions on Pages 24-26.	Students complete the analysis, discussion, evaluation and conclusion questions on Pages 24-26.
Limited, Structured, Guided - Act	**Slide 31** **Page 3**	*Act Phase* – Explain the purpose of the act phase as using the findings to communicate, reflect, and apply to the real world.	Refer to Page 3 to explore the 'Act Phase' in more detail, if required.
	Slides 32-34 **Page 27-28**	Watch video, 'We Ask Children: What is a circular economy?' on Slide 32 and lead discussion about the circular economy. Slide 33 –discuss a real-world example of the circular economy by identifying recycling opportunities at the school (see presenter notes for more information and guidance). Students to complete the activity on Page 27. Slide 34 – Lead the activity for students to get into small groups, identify a focus area at the school and answer the questions on Page 28 in the student workbook. *Summative Assessment* - Guide students to complete the 'Food packaging and waste' post-	Participate in whole-class discussion and small group investigation. Complete Pages 27-28. Complete 'Attempt 2' of the 'Food Packaging and waste' post-investigation knowledge assessment on Page 5.

		investigation knowledge assessment on Page 5. Students can compare their knowledge.	
	Slide 35 **Pages 29-30**	*Summative Assessment* – Introduce the 'Grassroots campaign' topic to the students – Create a school campaign to promote a circular economy Explain how the students can present their campaign and communicate their initiative (Slide 35). Students can use Pages 29-30 to plan their presentations.	Students will plan a 'Grassroots campaign' and use Page 29-30 to plan ideas.
	Slide 36 **Page 31-32**	Using the 'Grassroots campaign' information, students will now prepare a presentation to share with the class. Allow students time to plan, prepare and present their campaigns.	Students to complete Pages 31-32 to plan their presentations.
	Slide 37 **Pages 33-34**	Instruct the students to complete the Investigation Reflection pages independently.	Students to complete the Investigation Reflection pages independently (Pages 33-34).
	Slide 38 **Page 47**	Glossary – teacher to determine whether students populate the glossary independently or through explicit instruction.	Students to complete glossary on Page 47.

Additional resources

	Slide # *Classroom PowerPoint Presentation (PPT)* **Page #** *(Student Workbook)*	**Teacher guidance**	**Student guidance**
Open Inquiry	**Pages 36-46**	For students engaging in the Open Inquiry for food packaging and waste, provide the 'Science Investigation Planner' pages to guide them through their independent investigation.	Independently work through the 'Science Investigation Planner' pages to explore the food packaging and waste topic.
Optional Supplemental Resources	**Pages 18-23**	Process Diary – Optional	
	Page 35	Take it further – Optional extension activities	
	Pages 48-52	Page 48 – Notes Pages 49-50 – Research Journal Page 51 – Graph paper (5mm) Page 52 – Graph paper (10mm)	

Formative and summative assessments

FOR REFERENCE: (CLASSROOM PPT SLIDE #/STUDENT WORKBOOK PAGE #)

Formative

- About the topic (Slide 4/Page 4) – Assess students' initial ideas, experience, and any connections they may have about 'Food packaging and waste'.
- Food packaging and waste pre and post assessment (Slide 9/Page 5) to assess changes in student understanding before and after the investigation

Summative

- Grassroots campaign (Slide 35/Page 29-30) and student presentation (Slide 36/Pages 31-32-22) can be used to assess students learning. Refer to the 'Investigate and Innovate with CSIRO Australian Curriculum and Syllabus links and rubrics' document for assessment guidance.

EXAMPLE – Food Packaging and Waste – Lesson overview

Teachers can use this example unit of work to guide their planning.

Week / Lesson	Lesson Duration	LIA Phase	Food Packaging and Waste Focus	Student Instruction	Teacher Instruction
Week 1 – Lesson 1	60 min	Launch	Context: Food waste & packaging systems	Engage with images/videos of fruit packaging. Discuss where food waste occurs and complete a short pre-diagnostic quiz.	Introduce the unit context (food waste, transport, sustainability). Facilitate discussion and record prior knowledge.
Week 1 – Lesson 2	60 min	Launch	Forces & damage during transport	Explore how fruit gets damaged (dropping, crushing, shaking). Identify real-life examples from lunchboxes or shops.	Explicitly teach basic forces and how impacts cause bruising and damage. Link to transport scenarios.
Week 2 – Lesson 3	60 min	Launch → Inquire	Focus question & predictions	Develop or refine the inquiry question: What packaging best protects fruit during transport? Make predictions with reasoning.	Model how to turn a real-world problem into a testable question. Support prediction writing.
Week 3 – Lesson 4	60 min	Inquire	Planning a reproducible test	Identify independent, dependent, and controlled variables. Draft a testing method for drop, carry, or crush tests.	Teach fair testing explicitly. Provide feedback on variables, safety, and reproducibility.
Week 4 – Lesson 5	60 min	Inquire	Materials & design features	Investigate material properties (cushioning, strength, flexibility). Brainstorm packaging design ideas and sketch prototypes.	Guide material exploration. Prompt students to consider trade-offs (protection, cost, sustainability).
Week 5 – Lesson 6	60 min	Inquire	Prototype construction	Build packaging prototypes using provided materials. Refine designs based on constraints and criteria.	Supervise construction. Ensure safe tool use. Ask probing questions about design decisions.
Week 6 – Lesson 7	60 min	Inquire	Testing & data collection	Conduct controlled tests (drop, carry, crush). Record qualitative and quantitative data in tables.	Oversee testing, ensure consistency and safety. Support accurate measurement and recording.

Week 7 – Lesson 8	60 min	Inquire	Data analysis & representations	Calculate percentages damaged/not damaged. Create graphs or annotated tables to show results.	Teach data analysis and graphing. Model how to identify patterns and trends.
Week 8 – Lesson 9	60 min	Act	Evaluation & redesign	Evaluate design effectiveness. Identify weaknesses and propose improvements. Redesign or annotate changes.	Facilitate reflection using evidence. Encourage justification using data and scientific reasoning.
Week 9 – Lesson 10	60 min	Act	Circular economy & communication	Develop a proposal for a more sustainable/circular packaging solution. Communicate findings via poster, presentation, or pitch.	Guide students in linking findings to sustainability and circular economy principles. Support communication to an authentic audience.

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