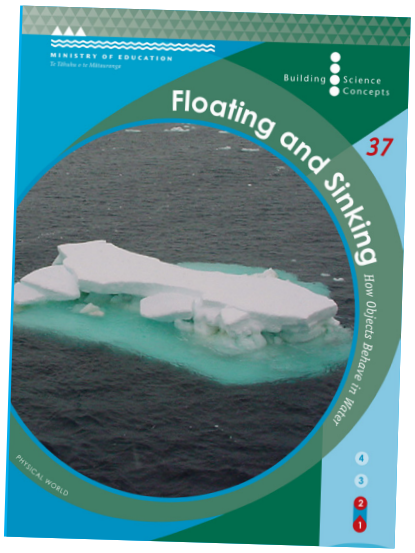
Example 9: Science, Physical World, Level 3 - Floating and sinking/buoyancy

FROM THE ONLINE RESOURCE *INCLUSIVE PRACTICE AND THE SCHOOL CURRICULUM*

This example shows how a teacher used differentiation and adaptation within an introductory lesson on floating and sinking/buoyancy to support all her students to explore key ideas in understanding and investigating in science. The focus was on students experimenting with a variety of objects to expand their understanding of floating/buoyancy and being able to justify their statements with evidence. They were also learning to take turns and to make points concisely in their explanations.

Task



The task involved activities from Building Science Concepts, Book 37, *Floating and Sinking*: *How Objects Behave in Water*; and Book 38, *Understanding Buoyancy: Why Objects Float or Sink* (available at Science Online).

The task was appropriate for students working in science at level 3 of the curriculum. With appropriate differentiations, students working within levels 1 and 2 could also achieve.

New Zealand Curriculum achievement objectives

- Explore everyday examples of physical phenomena (levels 1 and 2).
- Seek and describe simple patterns in physical phenomena (levels 1 and 2).
- Explore, describe, and represent patterns and trends for everyday examples of physical phenomena (level 3).

Opportunities to use and develop key competencies

The students were *managing self* and *relating to others* as they learned to work within groups independently of the teacher. They were *thinking* as they developed an understanding of the need to provide evidence to support scientific investigation and as they made and tested predictions about whether objects would float or sink, supporting their ideas with evidence.

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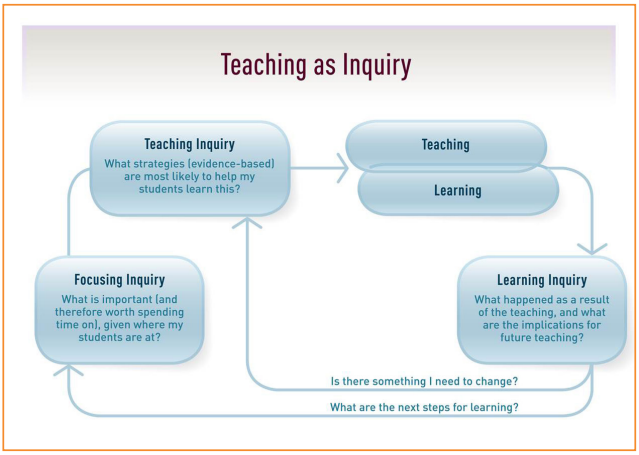
Class description

Mrs Phipps has a year 5 and 6 class.

- **Jamail** has English as a second language. Initially, his teachers thought he was struggling to learn English; however, a bilingual assessment has shown that his oral language level is similar in both languages. He knows some vocabulary, such as numbers, in English and not his first language. Jamail is an emergent reader and writer. He is learning to work with others. Unless learning activities are carefully planned to meet his needs, he observes but does not participate. Mrs Phipps and the learning support coordinator are currently making a referral to the Resource Teacher Learning and Behaviour service for additional support for Jamail.
- **Netty** arrived from Sāmoa two months ago. She attended school there and her mathematics shows she is working at level 3 for knowledge in that learning area. There are a number of Samoan-speaking students in the class and a Samoan-speaking teacher's aide at the school. Netty is confident speaking in her first language; she has been producing her written work in Samoan with the teacher's aide translating it to English for her. She is quickly learning the language skills required in social situations. She needs tasks in other learning areas to provide practical contexts to help develop her academic vocabulary and concepts such as comparing and classifying.
- **Ethan** attends school erratically and is often absent for a couple of days per week. He finds the morning transition from home to school challenging. He arrives hungry and often seems angry, does not have clothing appropriate to the weather, and does not have food for the day. In class he finds it hard to maintain attention and is easily distracted. His responses to tricky situations can vary from hitting out to running away. Some of the other students in the class are wary of him. He has good ball skills and plays with some of the boys on the field at break times, but this can turn into a fight if he gets hurt in any way. Mrs Phipps has been unable to engage him in any formal assessment, but her observations and formative assessments lead her to believe he is struggling with learning and is working within early level 2 of the curriculum.
- **Grace** has Down syndrome and is working within level 1 of the curriculum. She has high needs and receives additional support through the Ongoing Resourcing Scheme, which includes specialist teacher and teacher's aide time and specialist services from the local Ministry of Education office. Grace has an Individual Education Plan (IEP) that shows how she will access the classroom curriculum, the goals her team have agreed on, and the support she needs. She has difficulty with fine motor skills and needs particular support to process information as she has a minor hearing loss. She is learning to manage distractions and to return to her learning with minimum disruption to herself and others. Environmental factors, such as noise, can distract Grace; allowing her a break helps her refocus. Grace thrives on routine and structure, so any change to routines is best handled with pre-warnings. Her current interest is horses.

Teaching as inquiry



Mrs Phipps planned the lesson to ensure that all her students could understand the key ideas about floating and sinking and participate meaningfully in the scientific investigation. She provided a chart to introduce the ideas and to structure the investigation. In this lesson, the class was working in groups for up to twenty minutes to focus on problem solving together without teacher support. During this time, Mrs Phipps was able to work with a small group of students to check their understanding, scaffold the necessary language, and make connections with their prior experience. She planned differentiations and adaptations based on the strategies for this unit in 'Opportunities to learn at different levels' on Science Online. When all the groups began testing their predictions, she monitored their thinking and helped them focus on the key science concepts.

Focusing inquiry

What was important (and therefore worth spending time on), given where Mrs Phipps' students were at?

Mrs Phipps thought about the range of abilities in her class for working independently and collaboratively. From her observations of individual students and their reading and writing, she realised that certain students required one-to-one support to stay on task or access the content. She also considered what she could differentiate or adapt to help them work with others. She knew that the practical element in the lesson would be really beneficial in meeting the needs of all the students. It would support language learning and help develop the concepts of floating and sinking, particularly for the students working at levels 1 and 2 of the curriculum. Practical work would also be helpful to Netty, given she was a recent arrival in the country still learning English for communication. Mrs Phipps thought about how she could use her other Samoan language speakers to support Netty. Given that a basic science capability is to use evidence, Mrs Phipps knew that it was essential to put strategies in place to support her students to be able to use evidence to support their ideas.

Mrs Phipps knew that Ethan needed a lot of support to see himself as a capable learner, and she wanted to find any opportunity to show him he was. Her knowledge of Grace as a learner was informed by conversations with Grace and her parents. To support her in planning this unit, Mrs Phipps had involved members of Grace's wider IEP team (specialist teacher, teacher's aide, speech-language therapist, and Grace's mum) and together they had agreed on Grace's learning goals and the differentiations needed.

Read more about adapting supports so that all students can access the task and experience success.

Teaching inquiry *What teaching strategies (evidence-based) helped Mrs Phipps' students learn?*	Learning inquiry *What happened as a result of the teaching, and what were the implications for future teaching?*
Creating a supportive learning environment • Mrs Phipps had primed Grace for this science lesson, preparing her visual timetable the day before so Grace knew the routine. She had emailed her mum to let her know that Grace should bring two items to school to put in the water: one that was heavy and one that wasn't. • Grace's classmate Molly went over the daily timetable with Grace when she arrived. Grace put the pictorial timetable up on the class whiteboard alongside the written one. • Mrs Phipps began the topic by checking the students' understanding of floating and sinking. She did this by getting the students to fill in a pre-prepared chart (see following page) with their predictions, first individually and then sharing their ideas in their seating groups of four. She rearranged some of the seating to ensure that each group had a mix of abilities.	Mrs Phipps: *Grace's mum, Helena, is a great resource. Her mum knows her best, and I find if I ask Helena about things in advance, Grace really learns because we set her up for success. It was Helena who taught me that using Grace's special interests in class can have a positive effect on her learning.* Mrs Phipps: *I've noticed since I've had Grace in my class and the timetable is written and pictorial, this helps other students as well.* Mrs Phipps: *I felt I needed to scaffold the task and that it would accelerate Netty's learning to have support in her first language. So I swapped a few students and put Samaria (another Samoan-speaking student) with Netty's group. This meant that Netty worked collaboratively with Samaria and the other students instead of asking Nola, our Samoan-speaking teacher's aide, for help.*

The teacher prepared supports so that all students could access their prior knowledge in starting the task.

Teaching inquiry *What teaching strategies (evidence-based) helped Mrs Phipps' students learn?*	Learning inquiry *What happened as a result of the teaching, and what were the implications for future teaching?*
<table><tr><th>Statement</th><th>True or false?</th><th>What's your evidence?</th></tr><tr><td>All heavy objects sink</td><td></td><td></td></tr><tr><td>All rocks sink.</td><td></td><td></td></tr><tr><td>All wood floats.</td><td></td><td></td></tr><tr><td>Air trapped inside things helps them float.</td><td></td><td></td></tr></table> • Mrs Phipps had a more challenging activity for any student or group who was finished before the allocated time: *Come up with your own statement, e.g., 'Everything made of plastic will float.'* • While the class was completing the chart, Mrs Phipps worked with a group of students that included Jamail, Grace, and Ethan to complete the task. She has two teaching stations in her room and she chose the one where she could scan the rest of the class and where Ethan could take himself off for a quick break on the bean bag if he needed to.	Mrs Phipps: *I asked the class if anyone else wanted to work with me and the group at the teaching station. Piri chose to join us which was great as he and Ethan play rugby together during some lunch times and I know Ethan enjoys his company and looks up to him*
Scaffolding the language demands • Mrs Phipps introduced the task to the small group she was working with by scaffolding the language needed. She chose different objects (from materials of different sizes, shapes, and densities that she had provided or the students had brought in). She modelled the language: *The toy car is heavy, the scissors are heavy, the paperclip is not heavy.* • She had the students hold the objects and find more that they thought were heavy. She asked the students to label the objects, based on her example. • Some of the students who were working in their seating groups, including Netty and Samaria, chose to come over to the teaching station and observe the conversation and jokes about the heavy objects.	Mrs Phipps: *Jamail participated and contributed well in the small group when prompted, and he shared with a partner. He knew the names of some of the objects, so it was useful to have the students naming the materials to reinforce his understanding and language. He had learned about 'heavy' and 'light' in measurement in mathematics last term, so I was able to link this task to his knowledge in that learning area.* Mrs Phipps: *I asked Piri to go first as a model for the other students. He mimed not being able to pick up the scissors because they were so heavy. The other students laughed and did this with each heavy object they held and labelled.* Mrs Phipps: While Netty and Samaria were at the teaching station, I took the opportunity to demonstrate floating and sinking. I asked Samaria to translate 'all' (in 'All heavy objects sink') to Netty, as I did not think Netty understood 'all' in English. I could see Netty's face light up when Samaria explained it to her; she understood immediately. Netty and Samaria then went back to their desks and successfully completed the chart. I have to think about how I can use peers in other ways to support learning.

With your colleagues, discuss: How can you support **all** your students to draw on their prior knowledge during tasks in science?

The teacher provided materials and support to ensure that students understood key language for the task.

With your colleagues, discuss: How do you support **all** students to identify and understand the key scientific language in the tasks you set them?

Teaching inquiry *What teaching strategies (evidence-based) helped Mrs Phipps' students learn?*	Learning inquiry *What happened as a result of the teaching, and what were the implications for future teaching?*
Providing multiple opportunities to learn • In her small group, Mrs Phipps asked the students to choose four heavy objects and predict whether they would float or sink. She let them test their predictions straight away.	Mrs Phipps: *Most students in the small group needed a concrete experience from the outset. This was the reason for them testing their predictions straight away. When they rejoined their classmates later in the lesson, they would have a repeated opportunity in a different context, providing another opportunity to learn.* *Grace used her horse toys as some of the materials for floating and sinking. This helped her engage and she was less concerned with the noise of the class. I'll look at how I might be able to use other things she is really interested in to help her focus.*
• She then used the chart and the statement 'All heavy objects sink', which she had drawn up on a large sheet of paper. The group completed this collaboratively, also answering 'What's your evidence?' on the chart. Photos were taken to add later.	
• Mrs Phipps gave Ethan and Piri the choice of working with their seating group or with her group at the teaching station to complete the chart. Ethan initially wandered away from the teaching station, but returned when he saw that Piri had chosen to stay with the small group and Mrs Phipps.	Mrs Phipps: *Ethan's behaviour escalates when he thinks he is being made to do something. I was confident that his curiosity and motivation to work with Piri would get the better of him and he would join us. Once he did, I was able to engage him in trialling the objects in the water. I had to ignore the water splashing all over the place. This was really difficult, but I knew that any comment about the splashing would escalate the behaviour.*
Making connections to prior learning and experience • Mrs Phipps made links between students' knowledge of fishing and the relevance of this to the topic of floating and sinking.	Mrs Phipps: *When it came to the statement 'All rocks sink', Piri picked up the pumice and explained to the group that it was a rock and that in the olden days people used pumice for floats when fishing. He said his koro had told him. Ethan was captivated! I hadn't realised he was so interested in fishing. Piri didn't know the Māori word for pumice, so I asked him and Ethan to look it up on the computer.*

The teacher allowed students repeated opportunities to use materials to investigate their ideas.

With your colleagues, discuss: How can you ensure that **all** students have sufficient opportunities to practise and respond to content?

The teacher picked up on students' prior knowledge and made links with it to help them access the task.

Teaching inquiry *What teaching strategies (evidence-based) helped Mrs Phipps' students learn?*	Learning inquiry *What happened as a result of the teaching, and what were the implications for future teaching?*
• Mrs Phipps built on Piri's comments about pumice to move on to discuss a later linked statement on the chart – 'Air trapped inside things helps them float'. She used practical materials to consolidate students' ideas. They floated an inflated balloon and the pumice. They talked about the pumice and decided that perhaps it had air in it too.	Mrs Phipps: *Ethan related this to the modern fishing floats that are plastic with air inside them. He also talked about the old fashioned glass ones. Ethan and Piri found a picture on the Internet to share with the class.* *I said to the boys, "I was trying to figure out a way to show air inside things, and you really helped me."* *Ethan surpassed my expectations. He usually doesn't engage and share like this: it was a real teachable moment, and I knew I needed to listen to him and make the most of this opportunity to build his confidence and his relationships with other students. It made me realise how important it is to go off on a tangent sometimes. Who knew that a conversation about fishing would help all the students' understand objects with air inside them?*
Facilitating shared learning • Once the seating groups had completed their charts, the class came together and shared some of their predictions, then worked in their groups again to test them and gather their evidence.	
• The students in Mrs Phipps' small group then joined their usual seating groups. She supported some to compare their predictions with others in their group and hoped they would test them together.	Mrs Phipps: *I noticed Netty using some English and gestures to share with her group that she thought Maisie's train would sink. I asked her, "What makes you think so?" Samaria translated Netty's response in Samoan: "It is heavy and it will fill up with water".*
• Mrs Phipps was then able to move around, look at each group's chart, and ask questions of both individuals and groups. She modelled questions that would encourage the students to ask and answer questions within the group: – *How do you know that?* – *What makes you think so?* – *How could you check that?* – *So an example of this would be …?* – *Can you think of an example when this wouldn't work?*	Mrs Phipps: *I noticed Jamail sharing his predictions in his seating group. I really have to prepare him for participating like this and to deliberately create opportunities. I am going to help him set a goal around sharing his ideas.*

With your colleagues, discuss: How can you build on students' prior knowledge to help **all** your students access learning tasks?

Students worked in groups to test their predictions using materials.

Teaching inquiry *What teaching strategies (evidence-based) helped Mrs Phipps' students learn?*	Learning inquiry *What happened as a result of the teaching, and what were the implications for future teaching?*
• Grace got over-excited by the activity and started skipping around the room. Mrs Phipps asked one of the students to approach Grace and bring her back to the task.	Mrs Phipps: *It was a busy lesson – the students were moving around quite a lot and bowls of water were being filled and splashed. I think it got too much for Grace. I've learnt that when this happens it works well to give her a short movement break and have a peer re-direct her. Grace is transitioning to intermediate next year, and it's strategies like this that teachers at her new school should know about.*
Assessing to recognise learning • In this lesson, Mrs Phipps was assessing the students' ability to give explanations supported by evidence that is based on observations of the natural world. • As she observed the students, Mrs Phipps was asking herself: – *Can students talk about the science concepts we've been exploring?* – *Can students provide evidence to support a statement?* – *Can they explain how their evidence supports the statement?*	Mrs Phipps: *In assessing the learning, I based my observation on a combination of:* – *the statements the students had written on their sheets* – *reflections students had made in conversations when they were testing their predictions* – *discussions I had with individuals.* Mrs Phipps: *Netty has an understanding of the science concepts as long as she has some language support. The practical, hands-on element is essential and is really enhanced with a classmate's support. The combination of peer language support with a practical task optimises the learning, so I will try this strategy in other areas of the curriculum.*
• Mrs Phipps' particular focus in this lesson for Jamail and Grace was whether Jamail had retained the concept of 'heavy' and 'light' from mathematics in the previous term and whether Grace was developing an understanding of the concepts 'heavy' and 'not heavy'.	Mrs Phipps: *By the end of the lesson, Grace had an understanding of 'heavy' and 'not heavy'. She sorted items into two groups and said of one, "These heavy. They sink." She took a photo of the items with her iPad.* *She didn't appear to understand the idea of air trapped inside objects. I think I'll have to get some more objects where she can see the space inside, like a clear plastic container with the lid on.* *She can show understanding through what she does, so I need to be able to create practical tasks and activities throughout this unit so she can demonstrate what she is learning.*

With your colleagues, discuss: How do you support **all** your students to work and learn with their peers?

The teacher used observation and reflective questions to assess learning and plan next steps.

With your colleagues, discuss: How do you ensure meaningful assessment to celebrate learning for **all** your students?

Next steps

Now that you have explored this example, work with colleagues to:

- consider the challenges and opportunities in relation to inclusion for *your* students
- decide on the next steps in your science teaching to ensure *all* your students are participating, learning, and achieving
- plan for a future meeting to review the impact of your next steps and what *now* needs to happen.

Recommended resources

Strategies to develop capability in using evidence at different curriculum levels can be found on Science Online.