# Learning Journey: Properties of materials – problem solving and reasoning

Age: 4-5
**Learning activities:** making connections, communicating explanations
**Creative dispositions:** ability to make connections, thinking skills
**Synergies**: play and exploration, reflection and reasoning, teacher scaffolding and involvement.
**Contextual factors***:* group work

## Background information

**School setting:** The school is a large multi-cultural school in London. Over 90% of the children are learning English as additional language. The Early Years Unit includes both Nursery (36 children) and Reception (60 children.) We operate a child initiated, free flow environment.
**School policy for science:** The Early Years Unit does not explicitly teach science as a subject but plans for science through play and exploration.
**Links to Early Years and Foundation Stage Curriculum:**
'Children know about similarities and differences in relation to places, objects, materials and living things.
They make observations of animals and plants and explain why some things occur, and talk about changes.'

# Setting the scene

## Focus

The focus of this project was on developing children's reflection and reasoning by underpinning key creative and explorative learning scenarios with scaffolding and questioning from a practitioner. I aimed to encourage children to make connections and communicate their ideas in particular their predictions and explanations.

## Rationale

Before the project the children showed that they were beginning to be creative and explorative learners in science in our early year unit. However, I observed that their independent learning was often silent, and therefore difficult to assess their scientific understanding. For that reason I wanted to encourage skills such as prediction, reasoning and making connections so that they are building on their scientific explorations in a significant and purposeful way.

## The implications for my planning and teaching

I aimed to foster scientific skills associated with problem solving and reflection and reasoning by offering the children different adult led, scaffolded activities to support them in developing and using these skills increasingly independently in their future explorations and investigations.

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## Outline of learning activities

**Starting point 1: Sorting objects** (magnetic / non-magnetic)
Children sort objects into magnetic and non-magnetic before testing their *predictions.*
**Starting point 2: Child initiated: Testing boats**
Children investigate whether the boats they have made will float or sink in a bucket of water.
**Activity 1: Floating and sinking**
Adult led activity investigating which objects float or sink.
**Activity 2: Problem solving: Egg dilemma**
Children investigate how to stop an egg breaking.

## Developing the Learning Journey

### Starting Point 1: Sorting objects into magnetic and non-magnetic

In groups of up to 6, children sorted objects into magnetic and non-magnetic before testing their *predictions.*

### Rationale

This activity was designed to introduce the children to predicting and to ascertain how much scaffolding is needed from an adult and what scientific skills and ideas the children were gaining through independent play and experiences outside school. I felt it was important for children to have the opportunity to predict and offer reasons before testing their ideas.

### Children's responses

Teacher questions
What is it made out of?
Why do you think it will attract/repel the object?

Beginning;
Child 1: It will not stick there is no magnet

After:
Child: it is cold and shiny. It is a metal.
Child: It don't feel cold. it won't stick because it is not metal.

### Teacher reflection and implications

My first question was crucial to ascertain if children have knowledge of materials and their properties. Some children did not, so I had to introduce vocabulary such as wood, plastic, metal. At first the children were excited to explore with the magnet and not keen to explain.

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Some found it difficult to offer ideas and reason and expressed limited ideas about magnets. I took this opportunity to model predicting - once modelled by me they were able to make connections with their previous knowledge and demonstrate effective reasoning.

**Next steps:** In future I need to model predicting and explain why predicting is important. Children did not have the correct terminology or scientific ideas to make predictions. Therefore, I would need to take a step back and introduce them before discussing prediction and reasoning.

At this point I led a small staff meeting for the rest of my team, highlighting the importance of teacher scaffolding and the significance of encouraging children to offer predictions and reasoning in their own explorative learning. Some of the staff were concerned that they did not know the terminology to use. We therefore discussed floating and sinking, magnetic and non-magnetic, reversible changes and living things, so that we could learn from each other and address any misconceptions we held. In hindsight, I should have provided a subject knowledge training session earlier. Once the staff understood the expectations of the level of scientific enquiry that I wished to document, the questioning from the team was much more open and encouraged the children to communicate their explanations during their play and exploration.

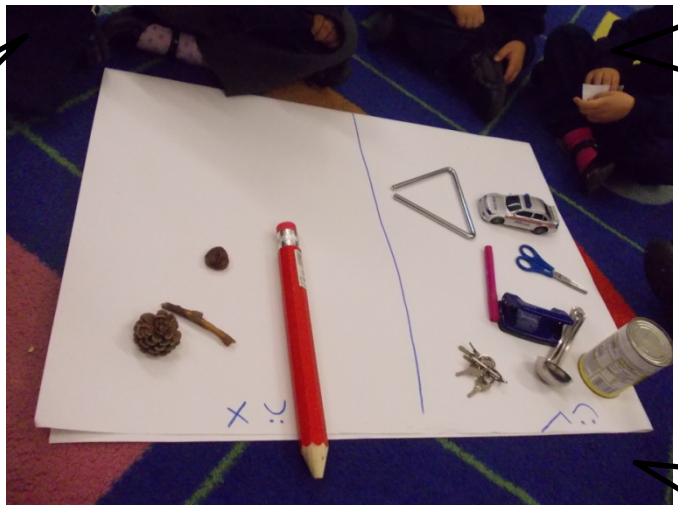
## Starting point 1 continued: Modelling a prediction

I explained a prediction is what we think will happen. After each child made a prediction I praised them or repeated their response using the word predict. This led to the children either using the word predict or the sentence starter 'I think that…..' Then we sorted the objects into the two groups. I gave the children the opportunity to move any of the objects over.

## Rationale

I realised the children may or may not have heard terminology such as prediction before. I believe it is important to introduce children to all scientific vocabulary however difficult the words.

Teacher: 'H predicted that the can would attract/stick because it is shiny.' 'So what do you predict will happen?'



The scissors… Ab- 'it don't feel cold, it won't stick because it is not metal. (holding the handle) Am-but no! This is shiny! (pointing to the blades) I think this will stick'

One child noticed that the plastic felt tip pen was on the wrong side "the pink pen! It is not metal it will not stick because it is plastic"

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## Children's responses

Children offered ideas such as '*it is blue, there is a magnet inside'*. They also made connections with their own life experiences, such as; '*my dad's keys don't stick to the door'* or '*there is food inside'* (can of food).

## Teacher reflection and implications

Sorting prompted discussion that allowed me to assess children's reasoning. I asked the children to place the scissors where they should go. They were happy to put them on the magnetic side '*only if you touch the shiny side*.'

It will be important to build positively on the children's predictions - they should feel confident in their ideas and understand that it is OK to be wrong or to say '*I don't know*.'

## Starting point 2: Testing boats

Two girls had made boats and came up to show me. I asked '*Do you think your boats will float?'* They said a resounding *'yes*'. I asked '*But how do you know. Have you tested them*?' They were not sure how they could test their boats so I filled up a bucket of water and they dropped them in! This led to talking about the concept of floating and sinking and the properties of the materials the boats were made of.

## Rationale

I was interested to observe what children do or make independently that could lead to a scientific enquiry.

At first the most common reason for a boat to float was because it was small. Some children did not know the terminology for sink. One child's response was, 'float at the bottom.' Other children shrugged their shoulders.

After some discussion they were able to understand better why an object floats or sinks. '*Look this is super super light! It will float float float!'*

## Children's responses

The excitement of this experiment brought a lot of other children around and made them curious to see if they could make a boat that would float.

## Teacher reflection and implications

When children shrug their shoulders it can be a sign that they are not confident to make suggestions, perhaps they do not have the experiences to make connections or the vocabulary to suggest a reason. Therefore, unlike previously where I held back, I allowed the children to explore whilst I scaffolded the language and gave them explanations to use.

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I feel because of the structure of the day and expectations for the Reception children a lot of this meaningful exploration may be missed or cannot be properly scaffolded due to daily restrictions. I need to allow children quality time to explore.

## Starting point 2 continued: Follow up investigations on boats

Initially this activity was with just 2 girls. However, once the bucket of water was available, more children were interested in our experiment and went off to make their own boats!

## Rationale

Through my scaffolding I wanted to harness the children's curiosity and motivation which was demonstrated in their play and exploration to promote reflection and reasoning. I therefore provided an activity which would allow the children to make connections as they played.

## Children's responses

Teacher: What does floating mean?
H-It mean it in the up and when something don't float it on the bottom.

HA-Sink because it is long
H-All boats float. They always do

## Teacher reflection and implications

The children loved the free choice, open ended nature of this child led activity. However, because of the buzz of the children it was difficult for me, as the teacher to properly scaffold and model the correct terminology to each of the children. Instead, I allowed the children to investigate for themselves.
To make the most of children's curiosity, I will plan a follow up activity that is more adult led so that I have the time to introduce the key concepts and scientific vocabulary.

## Activity 1: Adult led investigations on floating and sinking.

I used a simple sorting activity to find out which objects would float and which would sink. It is important to make sure any water tank being used can be filled deep enough to allow objects to sink!

## Rationale:

I decided from the children's responses in the last activity that they needed an adult led, scaffolded activity. I needed to ensure there was enough time to scaffold the

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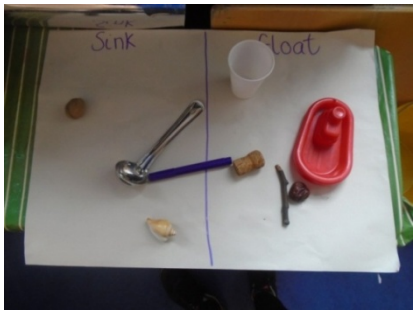
new scientific concepts. I decided to make the focus of this activity about reasoning rather than prediction to support children's progress.

## Children's responses




**Reasons for object to float/sink before teacher scaffolding**
R-It very strong
HA-A little rock wont sink because..push it down
A-Float.Not shiny
HA-Float it don't sink because it is flat
H-Stick sink they cant float, it is straight.

**Reasons for object to float/ sink after scaffolding**
N-it can even float, if it is not heavy to carry, the water will push it up.
RG-it sinks because so much water will push it down
Y-because the rock is heavy the rock is going down.
N-it can float, inside not heavy it float
RY-the purple one is light it will float
A-it doesn't have any air
RY-the stick is full of light so it float

## Teacher reflection and implications

Looking back at these two different activities I realise that, whilst child initiated learning is a great starting point to begin scientific enquiry, adult led activities can play a role in supporting children in developing creative dispositions such as problem solving, reasoning and reflection.

## Activity 2 Problem solving Egg Dilemma

Miss Willis came in with a dilemma and asked the children to help her. When she cycles into school in the morning the egg she has in her bag always cracks! Could the children make her something to keep her egg safe?
The children were given a lot of different junk modelling resources and told to construct something for the egg.

## Rationale

This was an opportunity to observe children's motivation and curiosity, their scientific skills, in particular their problem solving and reflection and reasoning. I wanted to find out if children could make connections from the previous enquiry and use their new skills to problem solve.

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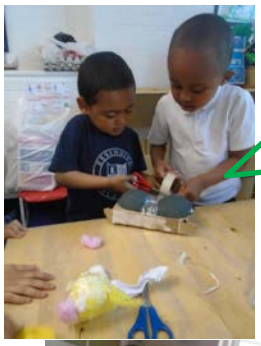
## Children's responses



"I can use a pipe cleaner to put it in to make it safe. I need a soft landing."

F-im making a bed for my egg.

D- I can use a pipe cleaner to put it in to make it safe. I need a soft landing.

Y-Im going to put some of this (cotton wool) and make it safe. I will put something good and big at the top so it won't fall out, if it come from under it (if there was not a bottom to the tube) it wouldn't be safe, it is falling in my hand (demonstrated).

## Teacher reflection and implications

**Role of the adult**

It was evident that the children knew that they wanted to incorporate something soft in their 'egg protector' but did not know why. All the children searched for boxes and cotton wool/material or bubble wrap. I thought I would let them construct first and then ask questions and elicit ideas. However, after observing the first group, I decided to start by showing them what happens when I dropped the egg on the table, so that I could scaffold the language. From that I was able to start the dialogue of reasoning and introduced the idea of a soft landing and keeping the egg protected with the correct materials.

With the right 'problem' **all** children will be engaged and show curiosity, thinking skills, ability to come up with something new and in some cases the ability to work together.

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Without encouragement, a lot of the children went back inside to change the design of their egg protector if their egg broke in the fall. I think this was because it was a fun and meaningful investigation. They were so proud if the egg didn't break and were desperate to show Miss Willis!

## Children's progress: prediction and reasoning skills

**Child H**

Assessed through observations and an 'interview' looking back at some pictures in his learning journal.

**Beginning of the year**

H is an inquisitive child but does not offer explanations and reasoning in his play. He shows limited understanding of scientific concepts and vocabulary.

He is not confident to offer explanations.

- "It will stick because it is shiny!"
- "All boats float they always do."

**End of the year**

H is confident to predict and offer explanations in his own play and in adult led activities. He is now using a wider range of scientific terminology to reason and support his predictions.

- "A spoon, its made of metal. Its so shiny. When its shiny it sticks and if its not shiny it don't stick. But sometimes if its shiny it don't stick!"
- "Oh no my boat sink. It was broken. The water come in and it sink. The plastic boat the water came in and it still float. Maybe because the water was not strong to push it down!"
- "It was my car that went the longest! It was so fast because the ramp was so high high high! But you remember when the plank was on the carpet it stopped! I think it was too bumpy."

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**Child D**

**Beginning of the year**

D is a very curious boy who has few areas of learning that he engages in. He has extensive knowledge of dinosaurs and volcanoes and will mainly be observed either drawing or role playing with small world dinosaurs. He had severe communication problems in Nursery and would make up or babble sentences.
D is not confident of offer explanations for the initial investigations and would sometimes just shrug his shoulders when asked to explain.

**End of the year**

D is much more confident to try new activities and to use his new prediction and reasoning skills in the free flow environment. He has developed a thirst for enquiry and investigations and considers himself to be a 'little scientist.'

- (Magnets) "Only stick to metal. Last time I found a metal and it stuck too. It was the scissors remember?!"
- "If something is not heavy the water can carry it. The water is much bigger than the boat you know! It float because it has no holes. If it has holes the water will push it down. It gets so heavy."
- "Mine broke because it had a hard landing. I changed it and it didn't break. There was soft things in there. I put lots of angle of the edge to make it strong and stay. Do you know what the softest things in the world? Blankets, mash, marshmallows and gummy worms."

## Overall reflections

### Children's progress

- Predicting is becoming natural in adult led activities, and more significantly, in children's own scientific enquiry.
- The children have been seen to be questioning their surroundings more. This is due to greater modelling of questions by adults than before the project.

### My role as a teacher

It is important

- to scaffold both child initiated and adult lead learning.

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- not to underestimate the importance of the adult scaffolding the learning by introducing new ideas and concepts, modelling questioning and reasoning and also modelling scientific investigation.
- to teach scientific concepts explicitly in a meaningful way.
- to facilitate children's curiosity in the world with an enabling environment.
- to use open ended questions to draw out reasoning and prediction.

### Reflections in relation to curriculum dimensions - vulnerable spider web

- **The classroom environment** should be a stimulating and open ended, engaging environment. With opportunities for children to pursue their own interests through open ended resources and making links to first hand experiences either at school or home.
- **Materials and resources**- Children should have access to a wide range of open ended resources, such as natural materials as well as resources that are specifically used for scientific investigations, such as magnets, scales, electrical circuits.
- **Learning activities** - should be both adult led and child initiated. It is important not to underestimate the importance of both for scientific enquiry and creativity.
- **Time and location**- It is important to remember that scientific enquiry can occur in any situation as long as the adult scaffolding is purposeful. I have discovered over the year that the most meaningful and in depth scientific activities do take time. It is important for the children's confidence to allow them to time to discover and make mistakes in a safe environment.

### Next steps

- To continue scaffolding the children's scientific enquiry through their child initiated play.
- Allow and encourage the children to revisit prior adult led investigations to see how and if they conduct their own scientific investigations.

## Reflection questions for the reader

- In what ways do you foster opportunities for children to make their own decisions in investigations?
- How do you support children in expressing their ideas and questions?
- What aspects of the classroom environment are important in encouraging children's reflection and reasoning?



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