# Investigating Moments - Teacher notes

**Equipment:** - a selection of metre rulers
- selection of masses including at least five $100\ g$ and $10\ g$ masses totalling $200\ g$
- Blu-tac
- Play-Doh
- Optional: some lengths of string for attaching rulers together

These investigations work well with students working in pairs. The above equipment needs to be available for each pair. Following the initial experiment there are a series of prompt questions to encourage students to think more deeply about what they have discovered. Students should also be encouraged to ask their own questions and explore these.

**Practical notes:**

- A student can use their finger to balance the ruler but for increased accuracy they may wish to use some sort of wedge or block instead. An effective alternative is to use the edge of a table.
- Masses can be attached to the rulers by using Blu-tac.
- Rulers can be attached to each through the use of Blu-tac or by tying a piece of string around them.

**Investigation 1: Balancing a ruler**

This investigation could be used with students who are yet to meet the theory of moments and be a way in to exploring and generating the theory. It provides an opportunity for students to think through the assumptions they make during the modelling process (for example, the beam is uniform, the mass is a particle, etc.) and also confront some of the issues of experimental approaches such as the accuracy of measurements.

You may need to encourage students to try several numerical cases in order to build up a data set. Plotting a graph of distance of support from the end of the beam, $d$, against the total of the masses supported by the beam, $m$, leads to some interesting models being produced.

**Investigation 2: Beam balance**

This investigation is split into two complementary parts. The first provides students with an opportunity to apply their knowledge of the theory of moments and explore various solutions for a specific problem as well as a solution for general masses. The second part offers the opportunity for students to begin to use the theory to problem solve.

Adapted from activities of the same name in 'Mechanics in Action' (1990)

# Investigating Moments - Student sheet

**Investigation 1: Balancing a ruler**

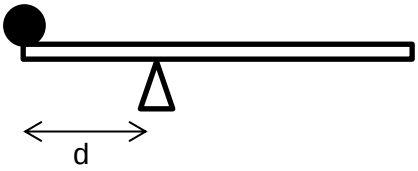
**Equipment:** - a number of metre rulers

- at least five $100\ g$ masses

- Blu-tac

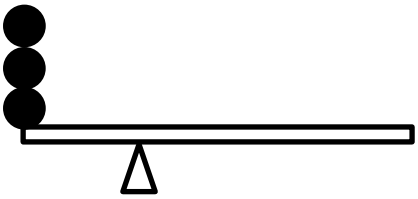
1. A ruler will usually balance at its midpoint. Check that this is true for your ruler.

2. Attach a $100\ g$ mass to the end of the ruler. Where does the ruler balance now?




Q: Can you predict where the ruler will balance when $200\ g$ is placed on the end of it? What about when using $300\ g$? Continue to investigate until you have a conjecture that you can test with a prediction.

Q: Can you explain what is happening?



**Some further points to explore:**

What happens when you have a number of rulers stuck together?

What happens when you place masses at various points along the length of the ruler?

**Investigation 2: Beam balance**

**Equipment:** - a metre rule

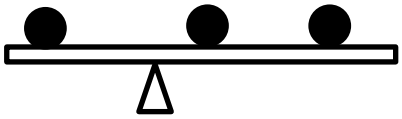
- $40\ g$, $70\ g$ and $90\ g$ masses

- Blu-tac

- a small and a large lump of Play-Doh or similar

**Part A:**

Place the $40\ g$, $70\ g$ and $90\ g$ on a beam (metre ruler)



Q: Can you do this and make the beam balance?

Q: Is there more than one way of doing this? How many ways can you find?

Q: What about if the masses were $x$, $y$ and $z$?

**Part B:**

Using five $10\ g$ masses and the beam can you find the masses of the small and large lumps of Play-Doh?

Q: How large a mass can you measure?

Q: How small a mass can you measure?

Q: How accurate can you be in these measurements?

**Some further points to explore:**

Q: Can you find the mass of the beam using the equipment above?

Q: Can you place two $10\ g$ masses on adjacent numbers on one side of the metre rule and then balance these using three $10\ g$ masses on the other side?