How high am I?

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Adapted from Back to Front Maths

Did you know that you are the same number of handprints high as the children in your class?

This rather surprising fact sets up a great investigation, which can be conducted from Foundation level all the way up to formal statistical analysis beyond high school.

You will need:

- To be able to lie on the ground comfortably
- A whiteboard or similar to record findings
- Receipt roll will be helpful, particularly for the "extending prompts" section
- Photocopying a child's hand is useful for the "enabling prompts" section

Background

Many different studies have shown that the length of a hand is directly related to height[1]. While the real formulas are relative complex and involve accounting for age, a useful estimate is that people are usually between 9 and 10 hands high.

Launch the problem and make conjectures:

Hold your hand out in front of you and ask students how many of your hands high they think you are. Record conjectures on the board. If students don't want to guess, try deliberately suggesting numbers that are far to large or far to small (e.g., 2, 300) – this tends to make kids giggle and correct you to a more reasonable level.

Watch out for

- Estimations that are far too high (e.g., 80). This may mean that students do not understand that quantity.

Make a plan:

Ask how you could work it out, and take suggestions. Lie down on the floor and use something to mark the position of your head and feet (e.g., a ruler placed at your head when your feet touch the wall).

Mess with the plan to clarify:

Begin measuring your height with your hands… but deliberately demonstrate doing it incorrectly and have students correct your technique.

[1] Examples: https://jmedsci.com/index.php/Jmedsci/article/download/11/9
https://www.abc.net.au/science/articles/2012/03/30/3465827.htm

- Begin a long way from the ruler and leave large gaps between your hands
- Crunch your hands up into fists instead of having them stretched properly
- Overlap your hands
- Go end to end, but on a very crooked path
- Clarify the instructions on how to measure fairly to come to an agreement.

Watch out for
- Anyone who doesn't recognise the problem of gaps, overlaps and going on a crooked path.

Begin carrying out the plan:
Begin properly measuring with your hands, having the students count how many. At some point, pause, and see if students just keep counting. When they realise, you will need to start again.

Watch out for
- Counting without quantity
- Conjectures that are still far too high even after you have got to 6 hands in length.

Start again, but stop when you are about 6 hands in, so that you are over half way. Pause, and look up at the conjectures on the board. Ask if any of them need to change. Record any changes.

Carry out the plan, then relaunch with a new problem:
Measure your length properly and record it on the board. It is fine to write "9 and a bit" or similar. Pay attention to how students describe the bit (e.g., almost 10, 9 and a half/quarter, sometimes they say "point" something because they have heard of decimal numbers).

Next, stand the shortest child in the class beside you and state,

"Guess what? You and I are the same number of hands high!"

This usually provokes a big reaction, with children immediately arguing that that can't be the case and the child must be much fewer handprints high. They will want to test it out immediately, so let them repeat the measuring process and work out that you were right.

Pose the question: do you think you will be 9 and a bit hands high too?

Explore:
Students make a conjecture about their own height, then work with a partner to check and record their findings on the board. Look for outliers and check them together.

Watch out for
- Students who stick with their guess, then measure wrongly just to make it fit!

Extending prompts and further exploration:
1. Ask whether the child will be 9 of your hand prints high. Create a two-way table where each person in a group of 3-4 can measure each other person with their

hands. This is also fun to do with parents at home. For older children, some of the numbers can be used to predict missing numbers.
2. Use receipt roll to make a ruler, with the child's hand being the unit. Draw a line to mark the end of the hand and write 1… Use the ruler to measure the length of various things in your class.
3. Make a ruler of your hands so that the children can measure their own heights with your hands.

Enabling prompts:
1. Use chalk to mark the end of each hand print.
2. Photocopy a child's hand and cut it out. Make multiple copies. Use receipt roll to create a length that is the same as the child. Have the children stick their own hand prints on to their receipt roll to figure out how high they are. Number the hands if needed.

Adapting to a lower level:
- Use receipt roll to create a length that is the same as the child. Ask the child to find things that are shorter and longer than they are.
- Directly compare the length of the receipt roll for 3 children.

Adapting to a higher level:
- For upper primary and higher: use centimetres, and create a dot plot with hand length on the x axis and height on the y axis. Draw a line of best fit (+/- create an equation for the line).
- Calculate mean, median and mode. Have each child divide their height by their hand length and then compare the results.
- For much older students, using callipers and measuring height more accurately allows for discussion of error margins, and also for considerations of standard deviation and other statistical considerations across the population. Several studies give formulas that include age as a variable which would be interesting to explore.

Important measuring principles to work out:
- To decide what object is the longest we need a way of comparing them. Sometimes we can line them up next to each other to see (Direct comparison), but sometimes they can't be moved. When we can't move objects, we can use a "go between" to indirectly compare them (Indirect comparison). For example, if we cut a piece of string to be the length of the white board, we could compare the string to the length of a different wall to decide which was longer.
- Measuring needs to go from the start of an object to the end – you can't start part way along or miss out a bit (e.g., start from the head of the bed and go to the foot rather than half way along)
- An alternative is to use some kind of units or **measuring objects** (e.g., as shoes, hand prints, blocks or pens, or in this case our hands)

- The measuring objects should always be the same size as each other (e.g., you can't use different sized shoes, you should use the same size shoes or use the one shoe and move it along the length while counting)
- The measuring objects should align straight along the edge (e.g., go straight across the bottom of the wall, not on a wavy line)
- The measuring objects shouldn't overlap each other or have gaps between them (e.g., put them end to end without spaces between them)
- If the measuring object that you use is big, you won't need as many of them to measure the whole length of an object, but you might end up with a gap at the end
- If the measuring object you use is small, you will have a lot more of them in the same length compared to measuring with a big object
- You can't compare lengths of objects unless you know how big the measuring object was. For example: if we were measuring height with hand prints, two people might be the same number of handprints high, even if one was significantly taller. Note: this leads into using standard measurements.