

## Big and Small Masterclass

**Thanks for helping with this Masterclass session! Your support is much appreciated.**

The session leader should be able to tell you more about the content of the session, and exactly how they'd like you to help, but this sheet should give you some basic information you may find useful. If any of this seems obvious to you, that's great!

In general, for Masterclass sessions:

- While the session leader is talking to the group, don't interrupt them or distract the students unless something is wrong that needs fixing urgently. You should also watch and pay attention to what they're saying, to set a good example.
- If things need handing out to the students, wait for the session leader to signal you to do this, as it can distract the students if you start to hand things out before they're ready.
- If the students are given a task to work on, you should circulate the room to talk to the students. Wait until they've had a chance to tackle the problem before you interrupt them, and encourage anyone who looks like they haven't started yet.
- Try not to give away the answers to the students, especially if they're working on the problem and about to discover it for themselves - if they are really struggling, you can give them a hint or suggest where they might start looking.

### **In this session:**

This workshop is an exploration of estimation, large numbers, and how we can use the notation of powers of 10 to record and manipulate large numbers.

The main activities are:

1. Estimation activity - What's bigger or smaller than me?
2. Big Numbers and Zeroes worksheet activity
3. Ping-pong balls in a bucket estimation activity
4. Hundreds-and-thousands estimation activity
5. "How many words in a book?" activity
6. Powers of ten - video

***There is a great deal more background information available on a separate sheet, if you would like more detail. Please ask the session leader if you'd like to see it.***

**Thanks again for your help with this session! If you have any other questions, please ask the session leader.**

### **In this session:**

These are the main activities from the session - between some there are whole-group discussions and estimation activities with the speaker and class, which don't involve the students working independently, so you won't need to go round and talk to them - but you could help by suggesting ideas/answers if the students are unsure and nobody is putting their hand up!

### **Estimation activity - What's bigger or smaller than me?**

We'll ask the students to come up with examples of things they are bigger than, and things they are smaller than. They should be encouraged to be imaginative without getting silly, and to come up with plenty of examples for each. Anyone making good progress could be asked to estimate how much bigger or smaller things are - how many copies of you could fit into the bigger thing, and how many copies of the smaller thing would fit into the space you take up? They may not be able to give exact

answers to this, so at this stage you can accept answers like 'a lot', if the student seems to be taking it seriously and can't work out an answer. You should also emphasise that it's ok if they don't know the answer exactly - they're estimating, which means coming up with a guess.

## Big Numbers and Zeroes worksheet activity

We'll give the students a worksheet with a list of numbers which needs to be filled in, to reinforce the idea of counting the number of zeroes on the end of a number to see how big it is. There's space for students to write their own examples at the bottom, if they finish early.

You could ask strong students if they know what a googol is (1 with 100 zeroes after it), which they can add to the list, although they probably won't have time or space to write all the zeroes...

They may not know the names of all the numbers exactly (a million is 6 zeroes, and a billion is 9 zeroes, and in between the names are made up of 'ten'/'a hundred' times those). Help the students with spelling and grammar if needed, to make sure they know these number names and how to write them properly.

In this session we won't necessarily address the idea of a number with zeroes on the end that doesn't start with a 1, so if anyone comes up with examples that don't have a 1 at the start, this isn't wrong but they won't be able to multiply them together in the same way without a little explanation.

Later, once we've discussed the notation ' $10^n$ ' to indicate powers of ten, there'll be a chance for students to fill in this for each entry on the sheet - the space down the right hand side can be used for this.

## Ping-pong balls in a bucket estimation activity

We're asking the students to work out how they might estimate the number of ping-pong balls that fit in a bucket, and the most common answer is to model the bucket as a cylinder, and count the number of balls in one layer at the bottom of the bucket, then multiply by the number of balls that fit up the side of the bucket.

This will most likely give an underestimate, and in the discussion afterwards we'll explore why this estimate was too small.

Some students may come up with other methods for estimation, and as long as they would work they're valid answers too - you can have a discussion with them about it.



## Hundreds-and-thousands estimation activity



Next we'll do another estimation task, with a more hands-on approach - dividing a tub of 'hundreds and thousands' sprinkles between the students. Each student will be given a small spoonful of sprinkles, on a piece of paper. Make sure the students are careful not to spill their sprinkles all over the table or floor, and that afterwards they're all cleaned up and tidied away carefully. Folding the piece of paper in half may make it easier to pour them back into the tub.

Discourage the students from eating the sprinkles - you could explain (even if this isn't true) that they might have been used for this activity by others previously, so they will have been handled by other people's fingers...

They'll be asked to divide the spoonful into smaller piles, then divide each of the piles again, until they have a pile small enough to count - then multiply by the number of piles. This method will only work if each pile is divided every time - if they split them in half, then split one of the halves in half, they'll have three piles but they won't all be the same size, so keep an eye on whether the students realise

this. It's ok if they don't split all the piles, as long as they realise that a bigger one counts for two smaller ones.

Once each student has an estimate for how many sprinkles were in their spoonful, we'll need to collect and total all these numbers, so make sure they have it written down somewhere clearly so they can call it out to the speaker at the front while they type all the numbers into a calculator.

### **"How many words in a book?" activity**

We'll ask the students to estimate how many words are in a book, by counting how many words are on a small sample of newspaper and then multiplying up. The speaker will have an example book they can hold up to give a number of pages, and the rough dimensions of the text on the page, which they can write on the board.



Each student should be able to work out a separate estimate for the total number of words in the book, and we'll compare these afterwards to see how much variation there is and what a rough average might be. Students may need help working out what proportion of a page their rectangle of text would take up, although it should hopefully be a simple ratio such as a quarter.

Students may be unsure what to do with words that are cut off on the edges of the sheet - should these half-words be counted as a word, or as half a word, and what if you don't know what the whole word was? Discuss these ideas with the students, and work out with them what they should do.

### **Powers of ten - video**

We'll finish the session by watching a video about powers of ten, and how the scale increases as you zoom out from a 1 metre circle on the ground to looking at the whole galaxy. This should be a chance for students to calm down after a busy session.

If there's time, the video can be followed by a repeat of the initial 'what's bigger or smaller than me' worksheet to see if the ideas from the session have created any new thoughts in the students' minds.