1. These slides are from our previous talk in 2019, but we keep them on to remind us of the challenge here.
2. These are only larger brains—we now have a full description of some invertebrates like the C. elegans and the leech.
3. Neurons are complex, and different properties give them different electrophysiological properties.
4. For example, complex morphologies mean compartmentalization of current, different conductances, capacitances and so on.
5. Passive and active ion channels whose activity can depend on the potential difference across the cell membrane.
6. Inputs at different parts of the tree can cause the neuron to behave differently.
7. More and more information suggests that glia (support cells) play an important role in neuronal signalling and learning

1. The most recent estimate puts the number of neurons in the human brain at 86B.
2. Experiments provide us with direct information.
3. They study the brain at different levels.
4. There's no right level. It depends on the question being investigated.

1. There is so much data out there now, as we embrace Open Science.
2. Models/theory are necessary for:
3. combining independent experimental results into unified theories
4. exploring these complex systems across wider range of conditions
5. generating new testable hypotheses
6. RNNs are appropriate for lots of projects, for example.
7. So are whole brain neural mass models.
8. But, to really understand the underlying mechanisms that give rise to emergent behaviour, we must model the brain at biophysically detailed levels.

1. The figure shows a simplified model life cycle. Can be much more complex in practice.
2. Lots of tools out there for each step.
3. But there's are issues—fragmentation, lack of interoperability, so many APIs.

1. Standards allow the representation of data and models in specific, agreed formats.
2. They're not neuroscience specific, of course—even programming languages have standards.
3. More importantly, if one knows what the data is going to look like, one can then develop tools and APIs around it.
4. And instead of everyone writing a tool for their own standard, every tool anyone writes for the one standard can be used with everyone's data.

1. In neuroscience, we're fortunate enough to not have the issue of having too many standards.
2. There are only a few standards in biophysically detailed modelling, and as we'll see, we ensure that these few remain interoperable.