1. What is the cellular membrane made of?
2. How do active transporters and ion channels work to move charged molecules inside the cell?
3. If a cell membrane is only permeable for K+ and has a higher concentration inside of the cell than outside, what would be the direction of the diffusion gradient?
    a. If the intracellular concentration of K+ is 155mM and the extracellular concentration of K+ is 4mM, what would be the Nernst potential for this membrane at 37 degrees?
4. According to the Goldmann equation, which ions are crucial to determine the membrane potential?
5. List the steps that generate an action potential and the ionic conductance involved in each step.
6. What is graded potential, and how is it different from the action potential?
7. How can action potentials travel long distances?
8. What is the difference between intracellular and extracellular recordings?
9. What are the voltage clamp and current clamp? What is the main difference between the two methods?
10. What is a patch clamp, and what are the different ways of recording?
11. What are the different types of gated channels?
12. Which cells produce the myelin sheath?
13. Multiple sclerosis is a neurological disease in which myelin loss occurs. What would be the consequences of this loss?
14. What are the nodes of Ranvier, and what is their purpose?
15. Why is an action potential considered an “all-or-none” event? What would happen if the threshold potential is not reached?
16. What happens to the resting membrane potential if extracellular sodium (Na^+) levels are drastically reduced? How would this affect the generation of an action potential?
17. What would happen to action potential propagation if voltage-gated sodium channels were blocked (e.g., by a toxin like tetrodotoxin)? How would this affect the nervous system function?
18. In epilepsy, neurons exhibit hyperexcitability and hypersynchrony, leading to excessive action potential firing. What changes in ion channel function or synaptic activity might explain this, and how could these changes disrupt the balance between excitation and inhibition in the brain?
19. Discussion question: In neuroscience experiments, we often activate or silence particular groups of neurons to try to understand the consequences. Let’s work out how this could be done genetically in simple organisms. (connecting the previous lectures, our knowledge of DNA regulatory regions, and what we now know about action potentials and how they affect activity).