



RESEARCH EXPERIENCE FOR TEACHERS

Developed by:
Christopher H. Sikich, Philadelphia High School for Girls

NERVOUS SYSTEM: Molecular Motors, Autophagosomes, and Huntington's Disease

NOTE: (see Supplemental materials at end)

GOALS:

- *Understand about molecular motors.
- *Understand what autophagosomes are and their importance.
- *Understand what Huntington's Disease is.
- *Understand the hypothesized molecular cause of Huntington's Disease.

PART 1 : MOLECULAR MOTORS

**GO TO: https://en.wikipedia.org/wiki/Molecular_motor

1. What is a molecular motor?
2. Do they need energy?

**GO TO: https://en.wikipedia.org/wiki/Motor_protein

3. What are motor proteins?
4. What are two types of microtubule motors?

**GO TO: <https://www.ncbi.nlm.nih.gov/books/NBK21724/>

5. Of actin and myosin, what is the motor, what are the tracks, and what is the energy source?

**GO TO: <https://www.youtube.com/watch?v=y-uuk4Pr2i8>

6. This is kinesin. Describe in your own words how it moves.

**GO TO: <https://www.youtube.com/watch?v=-7AQVbrmzFw>

7. How does dynein move in your own words?
8. Out of kinesin and dynein, which one do you think is walking forwards? Backwards? Why do you say this?

PART 2: AUTOPHAGOSOMES

9. What is a lysosome? (HINT: You learned about it in biology!)

**GO TO: <https://www.merriam-webster.com/medical/autophagosome>

10. What is an autophagosome?

11. What is autophagy?

**GO TO: <http://www.tifr.res.in/~roop/NaturesNanotech.htm>

12. Scroll down the page to the diagram with autophagosomes. Explain what they do and their importance?

**GO TO THE VIDEO ATTACHED TO THE ASSIGNMENT.

13. What do you see, in your own words?

14. What is this actually?

PART 3: HUNTINGTON'S DISEASE

**GO TO: <https://hdsa.org/what-is-hd/overview-of-huntingtons-disease/>

15. What is Huntington's disease (HD)?

16. What are its symptoms?

17. What type of genetic disorder is it? Dominant? Recessive? Autosomal? Sex-linked?

**GO TO: <https://ghr.nlm.nih.gov/gene/HTT>

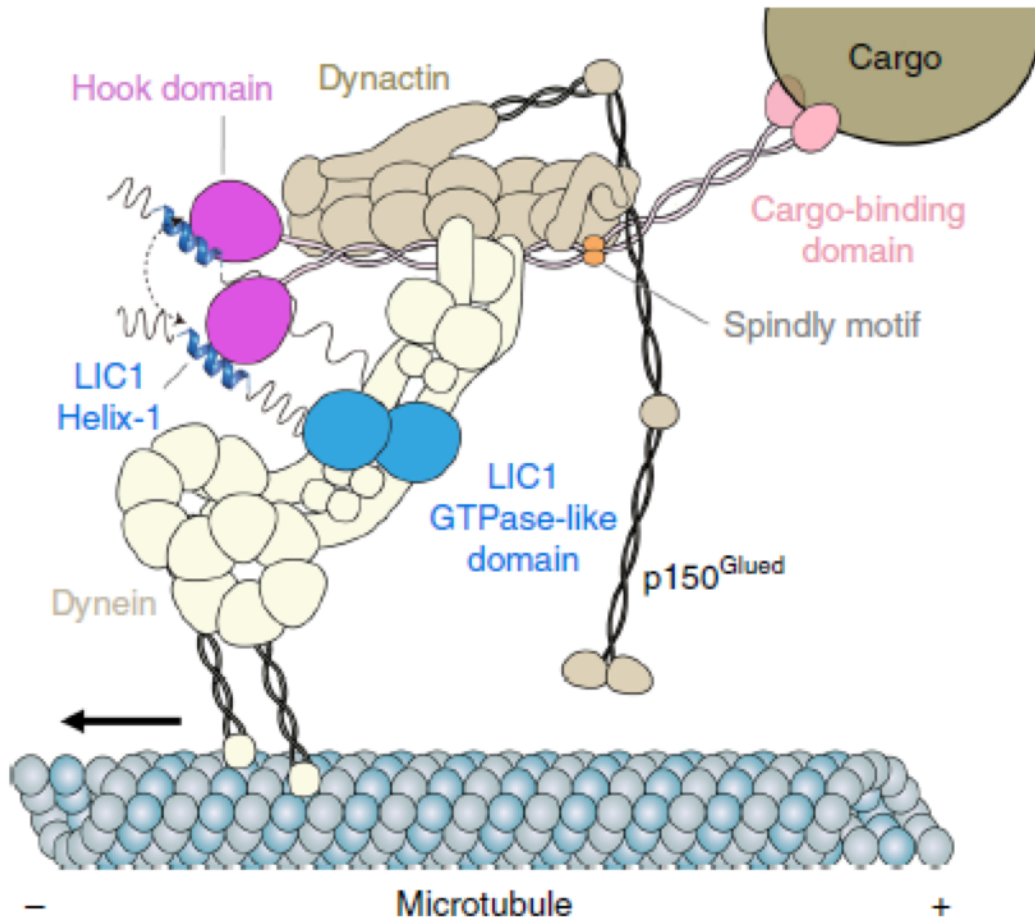
18. What is the HTT gene's importance?

19. Do we fully know what the **huntingtin protein** does?

20. What happens if the **huntingtin** protein is missing?

PART 4: MOLECULAR MOTORS AND HUNTINGTON'S DISEASE

Examine this IMAGE of dynein.:



21. Notice how complex the dynein is. What do you think would happen if one part of the dynein was damaged or missing?
22. **Huntingtin** helps with dynein. So if the **huntingtin** protein is missing or damaged, what would happen to dynein? The whole process of autophagy?
23. What does this tell you about how important mutations are?
24. Compare something in the real world to how this malfunction occurs.

Acknowledgements

The contents of these digital library curricula were developed by teacher participants in the Research Experience for Teachers program at the Center for Engineering MechanoBiology under National Science Foundation STC grant no. (CMMI): 15-48571. However, these contents do not necessarily represent the policies of the National Science Foundation, and you should not assume endorsement by the federal government.

Supplemental materials

NERVOUS SYSTEM:

Molecular Motors, Autophagosomes, and Huntington's Disease

BACKGROUND TO LESSON

This lesson was delivered in an ANATOMY and PHYSIOLOGY class as part of a unit on the NERVOUS SYSTEM. It was used to reveal to students a part of how the nervous system works at a molecular level and to also connect it to a disease of the nervous system. It was intended to be a one day lesson, with an introduction/starter/do now done at the beginning about proteins and the cytoskeleton, to stir up what they remember from biology, which nearly half of the students had not had for 3 years since they were seniors and they take biology freshmen year. Students need computer access to do this as it is set up now. I had them do PART 1 first independently and then went over some of the concepts they learned there. They then did PART 2 and we reviewed that as well. The same was done for PART 3 and then students would finish PART 4 for the end of class and homework.

Also, the video attached was taken from a microscope and shows the movement of dynein.

LESSON REFLECTION

The intended one day for the lesson was too ambitious, as the hope for immediate review of cell parts and proteins took longer than expected. In hindsight, for a normal class with one period of school a day, PART 1 AND 2 could be done on one day and PART 3 AND 4 on the second day or they could do PART 1 for homework on the previous day to set them up for the lesson with PARTS 2-4.