PULSE EXPERIENTIAL TEAM ASSIGNMENT

Team #: 13

1. Title of your PULSE experiential assignment. *Provide a creative and informative title.*
Molecular Genetics: A Dive into Cystic Fibrosis
2. Please summarize your PULSE experiential assignment (max 300 words). *Provide a non-technical (lay) summary of your PULSE assignment. Prompts to think about: What is the topic? What is the format? Why did you choose this topic and format? The summary for lay audiences is a brief and accessible summary of the assignment that is used to explain complex ideas, technical writing and scientific terms to people who do not have prior knowledge of the subject (e.g., high school science level). This summary should include the importance, impact, and content of your assignment to a broader audience.* *[Team 23] is an example of an informative lay summary.]*
We chose Cystic Fibrosis as the topic, since cystic fibrosis is commonly talked about in university throughout different courses. The interactive module as the format helps learners stay interested while remaining informative. When students are more interactive in their learning, research finds that it keeps them engaged and encourages them to reflect on the topics learnt. Cystic fibrosis is a disorder that runs in families, CF damages the body's digestive system, lungs, and other organs.The cells that produce sweat, mucus, and digestive fluids are impacted by CF. These liquids, which are sometimes referred to as secretions, are typically thin and slick in order to shield and smooth the body's interior tubes and channels. However, a mutated gene makes the secretions thick and sticky in CF patients. Pathways are blocked by the secretions, particularly in the pancreas and lungs. This interactive learner's module is accessible to anyone as it is easy to navigate and use. We use various pictures to easily grasp the topic being taught by visualizing what is happening in our bodies. Extra links are also provided if the learner wants further insight or clarification. In addition, we incorporated questions to test learners and see if they understand the topic fully and make sure they are able to apply what they learn. Lastly, we also included case studies to apply multiple concepts at once and apply it to real world connections to remind learners that this is a real thing.
3. Provide up to 6 keywords relevant to your PULSE experiential assignment. *3-6 keywords are ideal.*
Informative Interactive Mutations Proteins Genes Ion Transport
4. Identify the course topic with which your PULSE assignment most aligns. *Refer to the various topics outlined under 'Course content and Schedule' in the syllabus (e.g. Inflammation).*

Molecular Genetics

5. What are the learning outcomes?
There should be a minimum of 2 learning outcomes for your assignments. For further information on learning outcomes, the Centre for Teaching and Learning offers information: https://teaching.uwo.ca/curriculum/coursedesign/learning-outcomes.html

By the end of this interactive learning module, students should be able to:

- Understand the molecular basis, mode of inheritance, and pathogenesis of cystic fibrosis.
- Classify the main mutations that cause cystic fibrosis.
- Understand symptoms, treatments, and current prognosis of cystic fibrosis.

6. Why did the team select the chosen topic and the medium? How will the topic and medium of choice help learners?

The interactive module helps learners stay interested while remaining informative. When students are more interactive in their learning, research finds that it keeps them engaged and encourages them to reflect on the topics learnt. The topic chosen was Cystic fibrosis because it is one of the more common topics taught in biology courses, and usually, we have personally seen CFTR being talked about across biology, biochemistry, genetics, etc.

7. Did the team use an artificial intelligence (AI) technology tool? If so, which AI technology tool(s) did the team use? What other technology tools did the team use? Is the technology tool novel? Is the team using this technology tool in a novel fashion? If the team did not use a technology tool, why did the team decide against using the technology tool(s)?
Please include details (e.g., for what purpose was the tool used for? Why was the tool the best tool to use for your assignment? Are there alternative tools that were considered?)

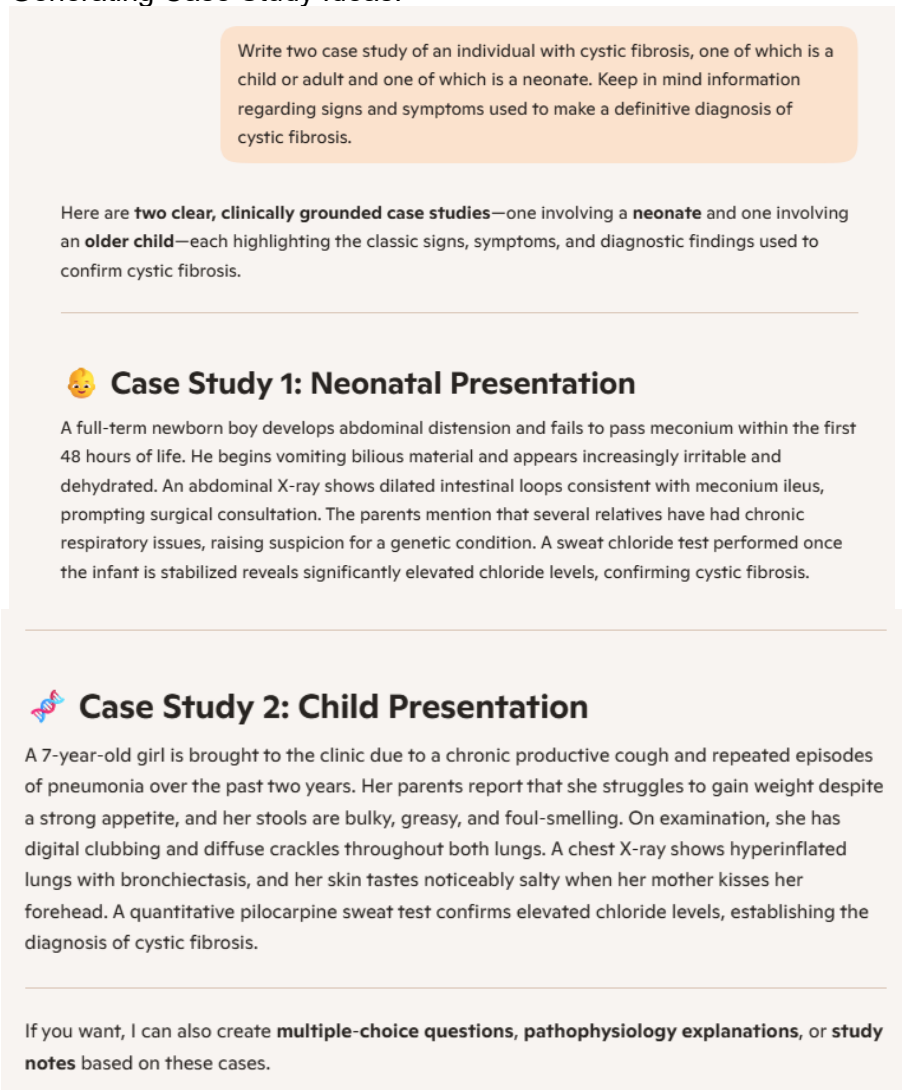
Yes, our team used Microsoft Copilot, an AI tool that was introduced in 2023 and is constantly being updated. We used this tool to help create the two case studies we included in our project.

8. How is your PULSE experiential assignment innovative and/or novel?
Describe what about the PULSE assignment is innovative/novel. Is there a particular component or content that is innovative/novel? How is it different from other content that already exists?

The interactive module helps incorporate “learn as you go,” as we incorporate different questions after the learner goes through a topic. As well as case studies to keep them engaged and use their critical thinking skills to develop more understanding. These interactive case studies are different from just test questions on different topics.

9. If you use an AI tool, please copy and paste the prompt(s)/question(s) used along with the output(s)/answer(s) from the AI tool.
The response here is to allow others to replicate the team’s work. If the prompts/outputs are lengthy (over 1 page), please attach it as a separate document and note below [Please see attached document].

Generating Case Study Ideas:



Write two case study of an individual with cystic fibrosis, one of which is a child or adult and one of which is a neonate. Keep in mind information regarding signs and symptoms used to make a definitive diagnosis of cystic fibrosis.

Here are **two clear, clinically grounded case studies**—one involving a **neonate** and one involving an **older child**—each highlighting the classic signs, symptoms, and diagnostic findings used to confirm cystic fibrosis.

👶 Case Study 1: Neonatal Presentation

A full-term newborn boy develops abdominal distension and fails to pass meconium within the first 48 hours of life. He begins vomiting bilious material and appears increasingly irritable and dehydrated. An abdominal X-ray shows dilated intestinal loops consistent with meconium ileus, prompting surgical consultation. The parents mention that several relatives have had chronic respiratory issues, raising suspicion for a genetic condition. A sweat chloride test performed once the infant is stabilized reveals significantly elevated chloride levels, confirming cystic fibrosis.

🧬 Case Study 2: Child Presentation

A 7-year-old girl is brought to the clinic due to a chronic productive cough and repeated episodes of pneumonia over the past two years. Her parents report that she struggles to gain weight despite a strong appetite, and her stools are bulky, greasy, and foul-smelling. On examination, she has digital clubbing and diffuse crackles throughout both lungs. A chest X-ray shows hyperinflated lungs with bronchiectasis, and her skin tastes noticeably salty when her mother kisses her forehead. A quantitative pilocarpine sweat test confirms elevated chloride levels, establishing the diagnosis of cystic fibrosis.

If you want, I can also create **multiple-choice questions**, **pathophysiology explanations**, or **study notes** based on these cases.

Based on these prompts, additional research was done to confirm accuracy. Results were also based on what was mentioned throughout the interactive module.

10. If you did not use an AI tool, please attach a copy of the team's notes to the assignment.
The response here is to allow others to observe the 'behind the scenes' team's work.

[student initial]'s notes:

What is it?

- Progressive autosomal recessive genetic disorder.
    - Fully genetic disease: environment or external factors do not play a role in causing the disease.
- Primarily affects the lungs and pancreas.
- "Cystic fibrosis (CF) is the most common, fatal, genetic disease affecting children and young adults in Canada" (https://cysticfibrosis.ca/about-cystic-fibrosis).

Kumar V, Abbas AK, Aster JC. Robbins Basic Pathology. 10th ed. Philadelphia, Pennsylvania Elsevier; 2018.

- Various levels of disease severity, lots of different mutations and types
- Basically any organ that uses Cl- channels with the CFTR, can also have effects on ion homeostasis. Mucus is an issue → respiratory challenges, especially clearing bacteria → infections
- Great images to describe the disease mechanism. Also includes some info about pancreas/liver comorbidities.

Romero-Martínez BS, Sommer B, Solís-Chagoyán H, Calixto E, Aquino-Gálvez A, Jaimez R, et al. Estrogenic Modulation of Ionic Channels, Pumps and Exchangers in Airway Smooth Muscle. International Journal of Molecular Sciences [Internet]. 2023 Jan 1;24(9):7879. Available from: https://www.mdpi.com/1422-0067/24/9/7879#

- Great image about the ion channels, potentially to be used in like introducing this idea to non-scientific audience
- Intro to the different kinds of channels, transporters, symporters etc
- Reads more like a textbook than an article, looks like secondary source

amandasaunders320. Cystic Fibrosis | The Autopsy Book [Internet]. The Autopsy Book. 2025. Available from: https://theautopsybook.com/cystic-fibrosis/

- Caused by cftr mutation, chromosome 7
- Newborn screening for the disease, heel prick test
- Details about internal/external examination of organs at the time of autopsy, looking for specific disease markers → cause of death

Cystic Fibrosis, Pancreas [Internet]. Basicmedical Key. 2016. Available from: https://basicmedicalkey.com/cystic-fibrosis-pancreas/

- Massive information engine, lots of pages in different tissues, one about CF
- Great images, I like the histology slide of CF pancreas, would be good to put in the project
- Should look into more info about the islet cells and how they're affected by disease specifically.

CFTR Mutations | [Internet]. Available from: https://cffamilyconnection.org/cftr-mutations/

- Really impactful website, I didn't really know that support for families involved in CF was so big. Emphasis on support and information/education.
- Type of mutations shown, layman audience target, looks great for describing the type of mutations

Cystic Fibrosis Foundation. Types of CFTR Mutations [Internet]. Cystic Fibrosis Foundation. 2023. Available from: https://www.cff.org/research-clinical-trials/types-cftr-mutations and https://www.cff.org/intro-cf/about-cystic-fibrosis

- Info about each type of mutation, what mutation specifically (#) and examples, in a layman style
- Type i, ii, iii, iv mutations present. Examples of each, nonsense/stop-codon mutations included in there.
- Emphasis on processing → protein to membrane, ER, folding, degradation etc

Cirrhosis in Cystic Fibrosis [Internet]. Webpathology.com. 2024. Available from: https://www.webpathology.com/images/gastrointestinal/liver/cirrhosis/42935

- Gross images of a bunch of different organ systems
- Interesting that cirrhosis would be an impact of CF, I thought it would just cause some ion transport issues. A good example of how it impacts the body systemically → lipid metabolism?
- The image of the liver is good here to describe the complications. Complications specifically identified at the time of autopsy.

Moore C, Moore C. Real Stories: Recognizing and Reducing the Burden of Cystic Fibrosis Treatments | Cystic Fibrosis News Today [Internet]. Available from: https://cysticfibrosisnewstoday.com/news/cysticlife-unleashus-org-article-1/

- CF median prognosis is increasing
- Lots of new medical treatments are coming out, improve life expectance
- Does not include non-western countries. What is the prognosis there, and what is the diagnosis rate? Are people just not getting diagnosed and passing away from “respiratory infections?”
- Emphasis on cause of death from respiratory complications → treatments aim to help with that
- Quality of life with these patients may be lower, treatments are uncomfortable and take up huge chunks of time.
- Discuss how to improve quality of life, give treatment while not spending hours per day with the vibrating vests on
- Interviews patients with CF which is valuable, talking about how it impacts their life.

Schenke, Laila. *Molecular Genetics Slideshow*. PATHOLOGY3500, FW 2025. Accessed April 8, 2026. https://westernu.brightspace.com/d2l/home.

- Allelic heterogeneity
- Variable expressivity

- Details about all the different types of mutations, mode of inheritance.
- CF from a single mutation, not a group of mutations. Rate of carrier state in western countries also discussed

LabMedica International. Biomarkers Evaluated for Lung Disease Severity in Cystic Fibrosis [Internet]. Labmedica.com. LabMedica International; 2020. Available from: https://www.labmedica.com/clinical-chemistry/articles/294783074/biomarkers-evaluated-for-lung-disease-severity-in-cystic-fibrosis.html

- Great image about where the CFTR is on Chromosome 7, need to cross reference this with certified sources to make sure that's true
- Connect with ideas about how it's only one mutation, where many ones are multi-gene related. Makes CF unique in that way.
- Has a paywall, limiting information coming from this unless you can pay for it, there are more reputable sources out there, so no further information

iwat1929. Respiratory medicine pulmonology healthcare concept. [Internet]. Designed by Freepik. Freepik online.; 2026 [cited 2026 Apr 1]. Available from: https://www.freepik.com/free-vector/respiratory-medicine-pulmonology-healthcare-concept-doctors-check-human-tuberculosis-pneumonia-lungs-with-magnifying-glass-make-x-ray-medical-pulmonological-care-vector-illustration_12332952.htm#fromView=search&page=1&position=11&uuid=a520074a-f703-4fa2-8ccd-c831aeb08cb5&query=Lung+pathology

- Cute cartoon picture of lungs with two scientists. Probably good for introduction slides or something

[student initial]'s notes:

Slide 1: Symptoms
Depending on the organ affected and the severity of the condition, there can be different symptoms that the patient may experience. Symptoms can appear later in somebody's life and become better and worse over time.

Respiratory symptoms can include: a cough that brings up thick mucus and won't go away, wheezing, fatigue, repeated lung infection, irritated and swollen nasal passages, stuffy nose, repeated sinus infections.

Digestive symptoms: Foul-smelling, greasy stools, poor weight gain and growth-blocked intestines, ongoing or severe constipation

Slide 2:

- Patients who are diagnosed until later like until their adulthood often have milder symptoms or experience symptoms that are not typical
- These include: pancreatitis, infertility, and repeated bouts of pneumonia

- Making an appointment with your doctor is one of the first steps and if you are experiencing heavy breathing or fingernails/lips turn blue or grey.

Make an interactive question with placing digestive vs respiratory symptoms
https://www.mayoclinic.org/diseases-conditions/cystic-fibrosis/symptoms-causes/syc-20353700

https://cysticfibrosis.ca/highly-effective-modulators
https://pmc.ncbi.nlm.nih.gov/articles/PMC10391283/
https://cysticfibrosis.ca/canadian-cf-treatment-options
- Using various information to explain cf treatment options
- explain the different modulators and the different types and how they work
- Therapies seem the most popular so i will use those

https://cysticfibrosis.ca/news/planting-the-seeds-of-progress-325000-for-innovative-cystic-fibrosis-research
- Wanted to understand more of the research happening in cystic fibrosis

https://cysticfibrosis.ca/resource/vitamins-and-cystic-fibrosis
- We always talk about drugs but never about the things we eat
- Natural supplements improve our health by a lot

https://go.drugbank.com/drugs/DB08820
- Talk about the main modulator that I chose being kyledeco

[student initial]'s notes:

Case studies:
- Modified Case Study #1:
    - A 7-year-old girl has a chronic productive cough and frequent pneumonia episodes over the past two years.
    - She has difficulty gaining weight despite a normal appetite.
    - She has bulky, greasy, and foul-smelling stools.
    - Her parents report salty-tasting skin when they kiss her.
    - A quantitative pilocarpine sweat test confirms elevated chloride levels.
    - Modified from Microsoft Copilot.
- Modified Case Study #2:
    - A newborn develops abdominal distension and failure to pass stool within the first 48 hours of life (meconium ileus).
    - Over the course of the next few days, he began vomiting bilious material due to intestinal obstruction.
    - An abdominal X-ray shows twisted intestinal loops (volvulus).
    - He has difficulty gaining weight.
    - Genetic testing reveals a homozygous F508del mutation in the CFTR

gene.
    - Modified from Microsoft Copilot.

Pathogenesis:

- CFTR in the lungs moves chloride ions from inside to outside the cell.
- Cl- move outside, and bring Na+ (which brings water outside).
- Moving water out is vital to ensure mucus remains moist so that cilia in the lungs can sweep back and forth to clear debris.
    - From: https://www.cff.org/research-clinical-trials/basics-cftr-protein
- CF: decreased chloride secretion and increased sodium and water reabsorption in the airways, leading to dehydration of the mucus layer coating epithelial cells, defective mucociliary action, and mucous plugging.
- CFTR lof in sweat duct leads to increased [Cl] and [Na] in sweat.
- Respiratory: abnormally thick mucus (airway obstruction).
- GI + pancreas: pancreatic + cystic duct and intestinal lumen secretions thicken.
    - From: Robbins Pathology textbook.

Diagnostic criteria:

- Two conditions:
    - One of these: clinical symptoms consistent with CF in at least one organ system, positive newborn screen, or having a sibling with CF.
    - Also: evidence of CFTR dysfunction (any of the following):
- Elevated sweat chloride (≥60 mmol/L).
    - Pilocarpine sweat test: gold-standard test for cystic fibrosis.
- Autosomal recessive inheritance.
- Abnormal nasal potential difference (NPD).
    - From: https://www.rarediseaseadvisor.com/disease-info-pages/cystic-fibrosis-diagnosis/

Test-your-knowledge questions:

- Include questions from the following topics, using outlined research: mode of inheritance, etiology, pathogenesis, signs and symptoms (2 questions: one for teenager/adult and one for newborn - some different signs and symptoms present), complications, treatment options, and prognosis (8 questions total).

11. How did the team ensure the veracity of the information presented in the PULSE assignment?

The response should highlight how the team has ensured that the information presented in the assignment is evidence-based and not spreading misinformation. You should specifically mention which databases (if any) or textbook materials you used, and how you kept track of the sources/references for each claim. If AI provided you with false information, please describe how the team has fact-checked the AI response and the legitimate (scientific) sources you used. A reference document should be provided in the reference section (15. References) below. Please ensure to include in-text citations in your assignment where applicable.

During this project, the team used lecture notes, the "Robbins Basic Pathology" course textbook, reputable web sources, and AI tools. To ensure the veracity of the information, multiple-choice question content adapted from AI was verified with the other sources used (i.e., lecture notes, textbooks, and reputable websites). Any portion that was unclear or unaligned with the course material was edited to reflect the PULSE assignment objectives. We used the lecture slides as well, presented by an accredited Molecular Geneticist and university professor. As we went along, we added each source to our notes, and completed the annotated bibliography, specifically looking for the following information: type of source, credibility of author/website/article, how up to date the information is, when it was updated, etc. All the information pulled from external sources were referenced within the learning module, had notes associated with each, and included in the references and annotated bibliography.

12. Write a meaningful team reflection about the PULSE session (max 250 words).
Prompts to help your team write the reflection: Were there any team/individual biases that surfaced when creating content for the assignment? Did the team implement any practices to ensure the content was equitable, diverse, and/or inclusive? How has the PULSE assignment helped with the team's learning? If the team had to estimate, how long did the assignment take? What worked well for your team? What would the team do differently next time? What were the opportunities and challenges with creating the PULSE assignment to help others' learning? Were there any barriers or limitations?

There were no teammate biases during the whole project. We made sure to regularly meet and disperse work amongst ourselves. We always helped each other out and met up when it was best for everyone. As well as always checking in and creating mini due dates helped us stay on track. Some challenges were figuring out how to use the software Genially as none of us have used it previously. One issue as well was picking and choosing what to include into our learning module as there are a lot of topics and subtopics to do with Cystic Fibrosis. This way we tried our best and included things we would think learners would find most interesting and easy to understand. For the length of the assignment, it took each team member about a week to complete their parts. For next time maybe organizing better what we were going to include to not add too much information for learners. In addition maybe adding more audio learning in order to keep it diverse for different learning strategies. There are rooms for improvement to make the source more accessible for all students (i.e. low vision, where more audio/videos/captioning could be provided). The assignment took longer than anticipated, especially with the annotated bibliography, but we worked well, communicated and split responsibilities accordingly. We learned more about the disease itself, secondary medical research, and now have a better understanding of how to analyze sources critically to ensure we don't spread misinformation.

13. Write the contributions of individual team members using unique initials.
Example: All team members contributed to the design of the prompts used in the technology tool, ChatGPT (GPT-3.5). T.K and T.K2 fact checked the information presented by ChatGPT using published literature on PubMed (PMID 29211319, 32477271). Y.Z finalized and formatted the final infographic and compiled the prompts and outputs. P.E was involved in…

[student initial]-> contributed to symptoms, treatments and studies currently being done on the topic. As well, she helped to write the background questions such 2,3,4,6,8 and 12.

[student initial]-> Wrote the interactive module sections on the introduction, mutation types/classes, complications, mode of inheritance, as well as general editing and formatting of the interactive module.

[student initial] -> Worked on case studies, diagnostic criteria, and did the integrative test-your-knowledge questions, dispersed throughout the module. Also helped with the pathogenesis portion. Did a lot of work to generally edit the learning module, make sure sections are cohesive and look well put together, theme/font/sizing are appropriate, etc.

All team members worked individually on their own notes, citations, annotated bibliography corresponding to the sources they used, and collaborated to otherwise complete this assignment template document.

14. Other comments (Optional)
Any comments the team would like to let the coordinator and/or TAs know.

You can access the Learning Module here:
https://view.genially.com/69811f790500403aeb20c087

You will have to click on the buttons integrated within the module to progress through it. Buttons are highlighted, and may have arrows, circles or other annotations that draw your attention through it. If you would like to go back to the previous section, go back to the table of contents at the beginning of the module, or you can press the home button at the top of some slides. Please let us know if you have any difficulties accessing it.

15. References
Please provide a numbered reference list with Nature citation style. [Please feel free to use citation management software (i.e., free citation manager, e.g., Zotero and Mendeley)]

1. Microsoft Copilot: Your AI Companion [Internet]. [cited 2026 Apr 12]. Available from: https://copilot.microsoft.com/
2. iwat1929. Respiratory medicine pulmonology healthcare concept. Freepik. https://www.freepik.com/free-vector/respiratory-medicine-pulmonology-healthcare-concept-doctors-check-human-tuberculosis-pneumonia-lungs-with-magnifying-glass-make-x-ray-medical-pulmonological-care-vector-illustration_12332952.htm (2026).
3. About Cystic Fibrosis [Internet]. [cited 2026 Apr 13]. Available from: https://cysticfibrosis.ca/about-cystic-fibrosis
4. Kumar, V., Abbas, A. K. & Aster, J. C. Robbins Basic Pathology 10th edn (Elsevier, Philadelphia, 2018).
5. Cystic Fibrosis Foundation. Types of CFTR mutations. https://www.cff.org/research-clinical-trials/types-cftr-mutations(2023).
6. Schenke, L. Molecular Genetics Slideshow. PATHOLOGY3500, FW 2025. Western University Brightspace (accessed 8 April 2026).
7. LabMedica International. Biomarkers evaluated for lung disease severity in cystic fibrosis. https://www.labmedica.com/clinical-chemistry/articles/294783074/biomarkers-evaluated-for-lung-disease-severity-in-cystic-fibrosis.html (2020).

8. CF Family Connection. CFTR mutations. https://cffamilyconnection.org/cftr-mutations/ (2026).
9. Bitesized immunology: Pathogens & disease [Internet]. [cited 2026 Apr 12]. Available from: https://www.immunology.org/public-information/bitesized-immunology/pathogens-disease/microbial-infection-cystic-fibrosis
10. Grasemann H, Ratjen F. Cystic Fibrosis. New England Journal of Medicine. 2023 Nov 2;389(18):1693–707. doi:10.1056/nejmra2216474
11. Mayo Clinic. Cystic fibrosis: Symptoms and causes. https://www.mayoclinic.org/diseases-conditions/cystic-fibrosis/symptoms-causes/syc-20353700 (2026).
12. amandasaunders320. Cystic fibrosis | The Autopsy Book. https://theautopsybook.com/cystic-fibrosis/ (2025).
13. Basic Medical Key. Cystic fibrosis, pancreas. https://basicmedicalkey.com/cystic-fibrosis-pancreas/ (2016).
14. WebPathology. Cirrhosis in cystic fibrosis. https://www.webpathology.com/images/gastrointestinal/liver/cirrhosis/42935 (2024).
15. Sweat Test: About Your Child's Test [Internet]. [cited 2026 Apr 12]. Available from: https://myhealth.alberta.ca/Health/aftercareinformation/pages/conditions.aspx?hwid=aci4512
16. Dhingra H. Cystic Fibrosis Diagnosis [Internet]. 2022 [cited 2026 Apr 12]. Available from: https://www.rarediseaseadvisor.com/disease-info-pages/cystic-fibrosis-diagnosis/
17. [Internet]. [cited 2026 Apr 13]. Available from: https://respiratory-therapy.com/disorders-diseases/chronic-pulmonary-disorders/cystic-fibrosis/cftr-modulators-cystic-fibrosis-care/
18. Cystic Fibrosis Canada. Canadian CF treatment options. https://cysticfibrosis.ca/canadian-cf-treatment-options (2026).
19. Dwight, M., Allgood, S. D., Riggle, M. & Franks, N. P. CFTR modulators: transformative therapies for cystic fibrosis. Curr. Opin. Pharmacol. 72, 102489 (2023).
20. CFTR Modulator Therapies [Internet]. [cited 2026 Apr 13]. Available from: https://www.cff.org/managing-cf/cftr-modulator-therapies
21. Cystic Fibrosis Canada. Highly effective modulators. https://cysticfibrosis.ca/highly-effective-modulators (2026).
22. Vertex Pharmaceuticals Incorporated. How KALYDECO works. KALYDECO. https://www.kalydeco.com/how-kalydeco-works (2026).
23. DrugBank. Ivacaftor. https://go.drugbank.com/drugs/DB08820 (2026).
24. Cystic Fibrosis Canada. Vitamins and cystic fibrosis. https://cysticfibrosis.ca/resource/vitamins-and-cystic-fibrosis (2026).
25. Cystic Fibrosis Canada. Planting the seeds of progress: $325,000 for innovative cystic fibrosis research. https://cysticfibrosis.ca/news/planting-the-seeds-of-progress-325000-for-innovative-cystic-fibrosis-research (2026).
26. Moore, C. Real stories: recognizing and reducing the burden of cystic fibrosis treatments. Cystic Fibrosis News Today. https://cysticfibrosisnewstoday.com/news/cysticlife-unleashus-org-article-1/ (2026).
27. What is cystic fibrosis? [Internet]. 2025 [cited 2026 Apr 12]. Available from: https://my.clevelandclinic.org/health/diseases/9358-cystic-fibrosis

16. Annotated Bibliography

An annotated bibliography is a list of sources (books, articles, websites, etc.) that you used for your project. Each entry has two parts:

1. *Citation – written in the required citation style (same formatting and order as the Nature citation style in your list of references).*
2. *Annotation – a short paragraph that summarizes, evaluates, and explains how the source is useful for your assignment.*

Why do this?

- *Helps you keep track of your research.*
- *Show your instructor you read and understood your sources.*
- *Develops critical thinking by requiring you to evaluate the quality and relevance of each source.*

Write the annotation (about 150–200 words each)

- *Summary: Briefly describe the main argument or purpose of the source.*
- *Evaluation: Comment on the credibility, strengths, or weaknesses of the source.*
- *Relevance: Explain how you will use this source in your assignment.*

Kumar V, Abbas AK, Aster JC. Robbins Basic Pathology. 10th ed. Philadelphia, Pennsylvania Elsevier; 2018.

This textbook was an instrumental part of this PULSE Team Assignment, and a lot of information was pulled from it to create the interactive learning module. As a part of the course's optional readings for PATH3500, this is a reputable scientific textbook that contains lots of information and reading about the content covered in the course, including useful reference images to solidify topics and concepts. The main purpose of this source is to provide sufficient background information into the disease of Cystic Fibrosis, the etiology, mode of inheritance and pathogenesis. This textbook is written by several authors, who have a medical degree (MD) and extensive clinical and teaching experience. Taken as an educational resource, this is a highly reputable source from expert authors and used all around the world, and is reliable to accurately convey the introduction of Cystic Fibrosis in this assignment.

Romero-Martínez BS, Sommer B, Solís-Chagoyán H, Calixto E, Aquino-Gálvez A, Jaimez R, et al. Estrogenic Modulation of Ionic Channels, Pumps and Exchangers in Airway Smooth Muscle. International Journal of Molecular Sciences [Internet]. 2023 Jan 1;24(9):7879. Available from: https://www.mdpi.com/1422-0067/24/9/7879#

From this source, an image was taken (Figure 1), and inputted into the interactive module. The purpose of this image is in the introduction, to introduce the role of different membrane proteins such as channels and exchangers to a layman audience. This emphasizes the importance of such proteins, and why Cystic Fibrosis can be devastating to human functioning. We chose this image specifically because it contains information about channels, exchangers and pumps, along with what kind of molecules they transport and the mechanisms of each. This figure was included in a paper published in the International Journal of Molecular Sciences, with the first author being a pharmacology researcher at a university in Mexico City. While the source is published open access, it was published in 2023, which indicates that it is new and remains fairly accurate to our current understanding of these ion transporters. Overall,

this figure comes from a strong background, reputable author and journal, and contains up-to-date information that can be used to introduce the concept of ion transporters to a layman audience.

Mayo Clinic. Cystic fibrosis: Symptoms and causes. https://www.mayoclinic.org/diseases-conditions/cystic-fibrosis/symptoms-causes/syc-20353700 (2026).

The source offers a general description of cystic fibrosis and clarifies that it is a genetic condition that results from a defect in a certain gene, which interferes with normal functioning of the ion channel responsible for regulating the balance of salts between the interior of the cell and its surroundings. Moreover, it is stated that this condition leads to accumulation of a sticky substance in the respiratory and digestive systems, as well as other body organs. Apart from this, the symptoms of cystic fibrosis in terms of both respiratory and gastrointestinal problems are described, such as frequent coughing, pneumonia, slow weight gain, and greasy stool. This source is very credible since Mayo Clinic is renowned as an extremely reputable medical organization. Its primary advantage consists in providing easily understandable information. This source will be used in my paper to provide a brief introduction to the topic and explain the fundamental causes and symptoms of cystic fibrosis.

Cystic Fibrosis Canada. Highly effective modulators. https://cysticfibrosis.ca/highly-effective-modulators (2026).

This source talks about highly effective modulator treatment, especially the Trikafta medication, and its importance in the treatment of cystic fibrosis. It mentions that the medicine works very effectively for the majority of people with one or two copies of the F508del gene mutation and gives the results associated with improved access in Canada – reduced cases of severe lung damage, lower hospitalization rate and mortality rate as well as longer life expectancy. Modulation therapy is presented as a huge step towards treating the cause rather than managing symptoms. This source can be considered reliable since it was created by Cystic Fibrosis Canada, a national organization which is focused on educating people and providing help to those affected by the illness. This source will be incorporated into the treatment chapter of the assignment.

Dwight, M., Allgood, S. D., Riggle, M. & Franks, N. P. CFTR modulators: transformative therapies for cystic fibrosis. Curr. Opin. Pharmacol. 72, 102489 (2023).

In this paper, the author contends that CFTR modulators have revolutionized the treatment of cystic fibrosis by correcting the underlying genetic fault rather than merely treating its symptoms. The review highlights how modulators have evolved as part of the overall progression in CF treatment techniques and goes on to demonstrate how modulators improve patients' lung health, quality of life, and mortality rates. In doing so, the article presents modulators as one of the key achievements in CF care throughout history. This source is among the best available in the bibliography since it is a peer-reviewed journal article published via PubMed Central. The primary advantage of this source lies in its depth; it offers a scholarly analysis of the significance of modulators for the patient population and medical science. A possible limitation is that, being a review, it does not offer new data but summarizes literature.

Relevance: This source will be used as a reference in the discussion of current CF treatment and prognosis. It fits the explanation of the fact that modulators correct the malfunctioning CFTR protein, which is consistent with my modulator's presentation.

Cystic Fibrosis Canada. Canadian CF treatment options. https://cysticfibrosis.ca/canadian-cf-treatment-options (2026).

This source highlights the various types of therapies utilized in the management of cystic fibrosis in Canada. In this context, CF treatment is presented as an interdisciplinary daily process that involves different forms of intervention, including airway clearance, inhalation medications, antibiotic therapy, pancreatic enzyme replacement, and other treatments. This website suggests that there is more than one form of treatment of CF; it emphasizes the need for an integrated therapeutic approach. This is a reputable source as it provides information about CF from a Canadian perspective. The key advantage of this particular source is its comprehensive coverage of the treatment process as it happens in reality. The key disadvantage of this source is its lack of scientific depth, as it does not go into details of underlying physiological processes. This source will be incorporated into the treatment section of the presentation to demonstrate that CF treatment does not depend solely on CFTR modulators. This information fits perfectly with the presentation as it covers multiple treatment methods.

Cystic Fibrosis Canada. Planting the seeds of progress: $325,000 for innovative cystic fibrosis research. https://cysticfibrosis.ca/news/planting-the-seeds-of-progress-325000-for-innovative-cystic-fibrosis-research (2026).

This article describes the grant of $325,000 for seven early-stage research projects from Cystic Fibrosis Canada. It discusses that despite recent advancements in cystic fibrosis that have increased lifespan and quality of life, the disease still poses a significant health burden and thus requires constant innovations. The text emphasizes that current achievements are not a reason to stop researching since complications, treatment burden, and unfulfilled patient needs remain issues.This source can be considered credible as it is based on the organization's activities. The greatest strength of this source lies in its relevance; it demonstrates the importance of research into cystic fibrosis despite modulator breakthroughs. The weakness of this resource is that it does not contain a peer-reviewed study; therefore, it is not reliable regarding evidence on mechanisms of action or effectiveness. This source will be helpful for the section when about improvements in treatment while discussing further steps.

Cystic Fibrosis Canada. Vitamins and cystic fibrosis. https://cysticfibrosis.ca/resource/vitamins-and-cystic-fibrosis(2026).

The given webpage elaborates on the importance of vitamins for individuals with cystic fibrosis since their pancreas may cause problems with fat absorption, which leads to poor absorption of vitamins A, D, E, and K. Moreover, despite the administration of pancreatic enzymes, patients can develop deficiencies even if they take supplements. The webpage illustrates the connection between gastro-intestinal tract issues and CF and underlines that supportive treatment plays an essential role in treatment. It is an excellent source of education provided by a reputable national CF organization. Its main advantage lies in the fact that the

webpage establishes a clear link between malabsorption and pancreatic problems in terms of the practical aspects of CF management. Its major disadvantage consists of being too simplified and failing to discuss the issue from a biochemical or pathophysiologic perspective. This source will be used for writing about supportive treatment of CF.

DrugBank. Ivacaftor. https://go.drugbank.com/drugs/DB08820 (2026).

The drug mentioned in this source is ivacaftor, which goes by brand names such as Kalydeco or VX-770. What makes this drug interesting is its position among CFTR modulators since it is one of the pioneering drugs in this category. From my standpoint, this drug should be viewed as a potentiator that promotes the opening probability of the chloride channel, making it a good example of a targeted treatment approach. The DrugBank database is a trustworthy source for the purposes of identifying a drug and understanding the nature of its action. The key advantage of this database is accurate classification and naming of the drug, while its limitation can be associated with insufficient depth. Information from this source will be included in the "modulator" section of the presentation in order to explain the role of Kalydeco in the development of CF treatments.

amandasaunders320. Cystic Fibrosis | The Autopsy Book [Internet]. The Autopsy Book. 2025. Available from: https://theautopsybook.com/cystic-fibrosis/

The Autopsy Book is an online open access website aimed to provide learning resources about autopsies. The purpose of this resource is to provide images and reference material to students, including resident doctors, that may not be available unless completing an autopsy in person. This website is managed by a team of medical doctors, with work created by medical students, researchers, and otherwise knowledgeable persons in each field, and therefore a credible and valuable source for this project. It contains pages with various organ systems, including images of various organs in the gross state or on slides, in a diseased state, with examination details associated with the images. This resource is particularly useful for this project, as it supports the section regarding complications. The complications associated with Cystic Fibrosis have high correlation to patient death; thus examining their organs, particularly in the affected tissues, can identify severe cases of these complications. One of these images was used in the “complications” study, with additional information on how that respiratory complication can cause problems in a patient's daily functioning, and contributing to overall organ failure.

Cystic Fibrosis, Pancreas [Internet]. Basicmedical Key. 2016. Available from: https://basicmedicalkey.com/cystic-fibrosis-pancreas/

The “Basic Medical Key” is a resource online that is a massive search engine with anything associated in biomedical science. It is continuously updated, and contains thousands of resources associated with science learning, medicine and is a large database. It claims to have been written by experts for reference to clinicians and students, but no specific authors, or their qualifications are provided. Since this is simply an image being examined, this is only a weakness of the course; further checks into credibility should be conducted if large amounts of information are synthesized from this source. Taken from this resource is a pathology slide image of a pancreas that has been affected by Cystic Fibrosis. The caption describes that

pancreatic atrophy has occurred in this patient, resulting in remaining islet cells contained by adipose tissue. This resource stood out to me because it included this additional information and arrows pointing to these exact locations described within the image. One of the strengths is that it allows a student, or observer, to identify the diseased aspects of the tissue and compare it to the diseased state nearby. This specific image was used in the complications part of the learning module, in pointing out exactly what complications arise in the pancreas from Cystic Fibrosis, and how this looks on a histology slide.

CFTR Mutations | [Internet]. Available from: https://cffamilyconnection.org/cftr-mutations/

The Cystic Fibrosis Family Connection (CFFC) is a non-profit organization that aims to provide information, assist and support patients and their families affected by Cystic Fibrosis. Individuals involved in this organization are solely volunteers who have a connection to CF in some way or are patients themselves. One large strength is that it is carried by a group of individuals who care a lot about the condition and providing resources for others, and lots of information is collected in a digestible and layman way, such that the information is easy to understand. However, the authors to this site lack any medical credibility beyond their personal experience, which can be a weakness, although they may have expertise into one topic over another (ie. A patient with a Type I mutation themselves would know a lot about the Type I mutation from their personal experience. Information from this website was used in excess in the introduction sections, discussing the different mutant types of disease, as well as layman-targeted images to help people learn about the condition. It's a fantastic resource to use in the introduction to a non-scientific audience specifically, and vital to the introduction in our project.

Cystic Fibrosis Foundation. Types of CFTR Mutations [Internet]. Cystic Fibrosis Foundation. 2023. Available from: https://www.cff.org/research-clinical-trials/types-cftr-mutations and https://www.cff.org/intro-cf/about-cystic-fibrosis

The Cystic Fibrosis Foundation is an organization that was founded in 1955, and since has been advocating for a cure for the condition. They do work in advocating for people with the condition, helping them build a community for support and have efforts around the world. It is led by a team of medical professionals, doctors and researchers that are knowledgeable about the condition, and also has staff that may not have this level of expertise, which is both a strength and limitation. One strength that this website has is a disclaimer at the bottom of the page suggesting that readers should consult a medical professional for more information, which is important in limiting the misinformation that can spread on the internet. This resource has a lot of information, in depth, about the variety of mutations associated with CF. It was used to help explain and introduce the different mutations, as well as characteristics of each class of mutation, in the interactive learning module. It also has examples of the different possible mutations associated with each class, and examples of drugs that could target those specific mutations, as well as the rationale behind each. It also includes the link to other resources that patients and their families can reference for more information. We used this resource extensively to explain all the different types of mutations corresponding to this disease.

Cirrhosis in Cystic Fibrosis [Internet]. Webpathology.com. 2024. Available from: https://www.webpathology.com/images/gastrointestinal/liver/cirrhosis/42935

WebPathology is an online resource providing pathological images and gross findings in any organ system. Each section in the online resource is run by a medical doctor. One strength of this source is that it accepts images and case studies from anyone, and after being reviewed by their team, posted online. It has very specific sections and subsections, making it easy to navigate for users looking for specific images and information. This is valuable because it includes the perspectives and images from clinicians around the world, but is still reviewed by medical experts, as long as the images are true to the submitter's word. One strength of this is that it is open access and acknowledges the various experiences of medical experts worldwide, but is also dependent on a submitter's honesty, which is a major drawback. Taken from this source was an image and caption of a cirrhotic liver caused by CF. Shown post-autopsy, the caption described nodules in the liver caused by the disease, and the severity of this onto a patient's life, specifically from CF. It was included in the complication section of the interactive learning module, as it's a significant cause of death in CF patients and resulting in liver issues and later failure due to the diseased state.

Moore C, Moore C. Real Stories: Recognizing and Reducing the Burden of Cystic Fibrosis Treatments | Cystic Fibrosis News Today [Internet]. Available from: https://cysticfibrosisnewstoday.com/news/cysticlife-unleashus-org-article-1/

This website is a news-site specific for Cystic Fibrosis related articles, information and news. The purpose of this resource is to communicate scientific information to a layman audience, particularly those affected by CF. The author for this article is not a medical professional, but a columnist who has experience in the research and science sectors of the new-site. While this is a drawback, the article investigated is about social behaviour associated with CF, not the scientific information itself. The Bionews website also claims that it attempts to ensure that the information provided is true, easy to digest and trustworthy through editorial policies. This source is useful because it discusses the prognosis, and what life looks like with CF. A graph showing the life expectancy of CF patients was taken from the source, and further illustrates that increasing medical advances positively contribute to extending the life expectancy of these patients.

Schenke, Laila. *Molecular Genetics Slideshow*. PATHOLOGY3500, FW 2025. Accessed April 8, 2026. https://westernu.brightspace.com/d2l/home.

This source is the lecture notes presented during the Pathology 3500 lectures in Section B, presented by Dr. Laila Schenke. She is a molecular geneticist in London ON, and teaches in the Pathology department at Western University. Dr. Schenke is a research professional and has an FCCMG certification. Not only was this information present in class, but it was also hand-selected by a professional and in the field, to present in an understandable and digestible way to pre-medical students in the course. This source was used to convey the molecular genetics behind Cystic Fibrosis, and describe the mode of inheritance. Because CF is very common, there are large numbers of people worldwide who carry the gene; this is essential to the etiology of the condition and how it gets passed along from parent to child. Additionally, the terms of "allelic heterogeneity" and "variable expressivity" are introduced, which are important because they alter disease presentation and severity across a patient's life. Overall, this is a

very useful and credible source, essential to describing the etiology of CF in the interactive learning module.

LabMedica International. Biomarkers Evaluated for Lung Disease Severity in Cystic Fibrosis [Internet]. Labmedica.com. LabMedica International; 2020. Available from: https://www.labmedica.com/clinical-chemistry/articles/294783074/biomarkers-evaluated-for-lung-disease-severity-in-cystic-fibrosis.html

LabMedica is an international news outlet that releases articles about medicine. This specific article is about Cystic Fibrosis and how the genetic component influences disease severity. The purpose of this source is to describe to a layman audience about the molecular genetics of the disease in a digestible way. From this source, we took an image of the Chromosome 7, where the CFTR gene is located. While introducing the mode of inheritance and molecular genetics behind the condition, we thought it would be helpful to also have an image to help learners understand where this gene is local to other essential genes, in a more general context. It accompanies slides describing allelic heterogeneity and variable expressivity to remind learners that while the gene is on a singular chromosome, there are also different levels of severity of the condition and can change from patient to patient. However, it's unclear if the author(s) of this site have any medical or scientific credibility. However, the risk associated with this is low because we only used one image from it, and the fact that the CFTR gene is located on Chromosome 7 was verified by a peer-reviewed article, so the risk of misinformation from simply this image is low.

iwat1929. Respiratory medicine pulmonology healthcare concept. [Internet]. Designed by Freepik. Freepik online.; 2026 [cited 2026 Apr 1]. Available from: https://www.freepik.com/free-vector/respiratory-medicine-pulmonology-healthcare-concept-doctors-check-human-tuberculosis-pneumonia-lungs-with-magnifying-glass-make-x-ray-medical-pulmonological-care-vector-illustration_12332952.htm#fromView=search&page=1&position=11&uuid=a520074a-f703-4fa2-8ccd-c831aeb08cb5&query=Lung+pathology

This source is simply an image on website FreePik, which provides free, online images for users, and includes AI tools. This image was created by user "iwat1929" and depicts two cartoon scientists investigating a pair of lungs, with a magnifying glass and a set of radiology images. While the identity of the author, and the credibility are unknown, this was simply used as a reference image. It's included in the interactive learning module introductory section, to emphasize the large impact that Cystic Fibrosis has on a patient's lung. While CF does have large impacts in other organ systems, the general population usually is only aware of respiratory issues; we included this at the beginning to tie a learner's understanding of how lungs work with the disease, and then can later apply that understanding to other organ systems as the module progresses. It's unclear the credibility of the artist, or if any AI tools were used in its creation. However, this image was simply a supporting resource in our project, and does not convey any scientific or medical information, so is not misleading in any way to the learner's understanding.

Vertex Pharmaceuticals Incorporated. How KALYDECO works. KALYDECO. https://www.kalydeco.com/how-kalydeco-works (2026).

This source outlines the pharmacodynamic action of the drug Kalydeco that affects mutations of the CFTR protein in people suffering from cystic fibrosis. Based on this source, the drug works as an activator that facilitates the opening of CFTR channels and their prolonged presence in the cells. Thus, when the process of chloride movement is facilitated within the cell, the flow of water molecules becomes easier too, preventing dehydration of mucus and secretions in people with cystic fibrosis. The most significant point of this source, in my opinion, lies in the provision of the diagram illustrating Kalydeco's mechanism of action in patients with certain mutations. The reliability of the data contained in this source is rather high because it is provided in the official website of the drug Kalydeco, which is developed by Vertex Pharmaceuticals. Advantages and disadvantages of this source can be represented by visual information delivery and marketing nature of the information delivered by a pharmaceutical company, correspondingly. This resource is important order to talk about Kalydeco as a CFTR potentiator. This source will help provide an illustration describing the mechanism of action of the medicine.

Microsoft Copilot: Your AI Companion [Internet]. [cited 2026 Apr 12]. Available from: https://copilot.microsoft.com/

Microsoft Copilot is a generative AI tool that is able to perform actions like answer questions, provide summaries, create images, and brainstorm ideas. It is used for educational, professional, and general purposes. Microsoft has many Copilot assistants, including Microsoft 365, Microsoft 365 Copilot license, Microsoft Copilot, Microsoft Security Copilot, GitHub Copilot, and Microsoft Copilot Studio. Since Microsoft Copilot is a free version, some features like measuring analytics and optimization for work tasks are not available. However, it was created by Microsoft, a reliable and secure company that has been operating for decades. Microsoft Copilot AI was introduced in 2023 and has been updated regularly, increasing its functionality. However, since it is an AI tool, it can be prone to mistakes, especially in an educational context, and this was taken into consideration during this project. Our group used this tool to generate the two cystic fibrosis case studies. We cross-checked the information Microsoft Copilot gave us with other sources that are more reputable, and altered the information slightly to make it more professional and accurate.

Dhingra H. Cystic Fibrosis Diagnosis [Internet]. 2022 [cited 2026 Apr 12]. Available from: https://www.rarediseaseadvisor.com/disease-info-pages/cystic-fibrosis-diagnosis/

Rare Disease Advisor is a source of medical news, which also includes information on specific research studies and medical diseases like cystic fibrosis. Specifically, the website overviews cystic fibrosis, describing topics like epidemiology, etiology, prognosis, diagnosis, testing, treatment, comorbidities, and complications. This source is relatively credible. Its scientific writers have had significant professional education (i.e., PHD, Master's in Public Health, Doctor of Physical Therapy, etc). It also has medical physician reviewers, editorial staff, and support staff who ensure accuracy before releasing an article and make this site more credible. It is important to note that what staff reviewed, which article is not mentioned, which takes away from its credibility slightly. However, the cystic fibrosis article was written by Harshi Dhingra, a licensed medical doctor with specialization in Pathology. This corresponds to our course and our project. As well, this article is written in simple language that can be easily

understood. We used this site to describe the diagnostic criteria for cystic fibrosis.

Sweat Test: About Your Child's Test [Internet]. [cited 2026 Apr 12]. Available from: https://myhealth.alberta.ca/Health/aftercareinformation/pages/conditions.aspx?hwid=aci4512My

Health Alberta is a highly trusted and credible health information source that was developed by the Government of Alberta and Alberta Health Services (AHS). It includes information relating to health conditions, healthy living, medicines, tests, treatments, resources, and healthcare facilities. The posted content is reviewed, developed, and updated by individuals who belong to Clinical System Improvement teams and the knowledgebase provider WebMD Ignite. The content is easy to understand and provides relatively detailed information. However, it was designed for the general community, and there is minimal scientific or pathological connection (i.e. limited information on pathogenesis). We used this site to obtain the sweat test image for the diagnostic criteria slide in our interactive module. We also cross-checked the information obtained from the Rare Disease Advisor website on diagnostic criteria, since we believe this is more reliable and accurate. This website provided much more detail on what the patient would experience having a sweat test, and focused less on the mechanism of how the sweat test works.

Grasemann H, Ratjen F. Cystic Fibrosis. New England Journal of Medicine. 2023 Nov 2;389(18):1693–707. doi:10.1056/nejmra2216474

The New England Journal of Medicine (NEJM) is a highly credible peer-reviewed journal that is written by medical experts in a range of fields, including genetics (which relates to cystic fibrosis, a genetic condition). This journal has been publishing articles for over 200 years and has reached international members of the medical community. Its role is to present findings in a clinically useful and novel format that can aid in better patient outcomes. The specific study on cystic fibrosis is very detailed, covering many relevant concepts like genetics, physiology, pathology, clinical signs and symptoms, treatments, and recent research advances. However, it does contain highly scientific language that may be difficult to read for those without a science background or less proficiency in the English language. We used this study to obtain the second pathogenesis image for our interactive module. We also used some information from this article for the pathogenesis of cystic fibrosis.

What is cystic fibrosis? [Internet]. 2025 [cited 2026 Apr 12]. Available from: https://my.clevelandclinic.org/health/diseases/9358-cystic-fibrosis

The Cleveland Clinic is a nonprofit academic medical center founded in 1921. Its current CEO and President is Tom Mihaljevic, MD. There are over 300 locations, with its primary address located in Cleveland, Ohio. It encompasses many medical specialties and focuses on both clinical research and community education. Not only that, it offers adult and pediatric care services, virtual care, appointment and personal health information, as well as education on diseases, management information, and novel research. The specific article on cystic fibrosis goes over causes, symptoms, diagnosis, testing, management, prognosis, and frequently asked questions. The Cleveland Clinic is a well-known and reputable medical center, making it very credible. The article is also easy to read, with simple language and in-depth explanations. However, it only goes over an overview of cystic fibrosis and includes surface-level pathological

information, making it more suitable for the general community. This article was used to describe the prognosis of cystic fibrosis.

Bitesized immunology: Pathogens & disease [Internet]. [cited 2026 Apr 12]. Available from: https://www.immunology.org/public-information/bitesized-immunology/pathogens-disease/microbial-infection-cystic-fibrosis

The British Society for Immunology (BSI) is a leading immunology charity organization based in the UK and has over 4000 current members. This society allows members to meet with immunologists, get up-to-date research and education updates, and network with like-minded individuals at various levels. BSI also has the BiteSized Immunology resource, which is designed to create a comprehensive guide to the immune system. It is led by knowledgeable individuals like post-graduate students and medical doctors from various UK universities (i.e. University of Edinburgh, University of Oxford, etc). The article on cystic fibrosis was written by Paul J. Buchanan, Queen's University Belfast, UK. It goes over the pathophysiology of cystic fibrosis and provides details on bacterial infections that can result, as well as complications like chronic lung infections. It is a credible website, as it is produced by individuals with a scientific background in immunology and the medical field. However, since BSI is related to immunology, it focuses primarily on this topic and less on other topics important for this project. This article was used to obtain the first pathogenesis image for our interactive module. This was also used to determine certain complications of cystic fibrosis (i.e., lung infections).