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**Sickle Cell Anemia**

Nicholas has sickle cell disease.

Watch his video (<https://www.youtube.com/watch?v=iKQmQHh4E2w>) to learn how he manages to live a reasonably active and normal life.

*Q1. After watching the video list any two symptoms of sickle cell disease that Nicholas routinely experiences?*

This activity focuses on exploring the literature, molecular structures and other data to develop and tell a molecular story explaining the basis of the disease and its symptoms. Use the following steps :

1. Ask a question – this is the theme for the molecular storytelling
2. Build model based on literature review – what will you explore in the PDB
3. Investigate - Query/Browse PDB; Select PDB entries; Visualize
4. Analyze - Explore interactions; Compare Structures
5. Construct molecular explanations for original question
6. Develop argument - relate structure to bioinformatics information (go back to the literature to see if the molecular explanation makes sense)
7. Communicate - Tell a Molecular Story with Illustrations

**Overview:**

This activity focuses on a clinical condition, sickle cell disease, and provides an opportunity to explore and understand the molecular basis for this disease and its symptoms.

**Learning Goals:**

1. Define a question/topic for exploration at a molecular level
2. Explore the literature to find out about the topic
3. Query the RCSB PDB website to find specific structure(s) for exploration.
4. Explore relevant molecular structures to develop a molecular story explaining the topic.

 **Guided Molecular Storytelling**:

1. Ask a clear question - that will guide your molecular explorations:

e.g. What is the molecular basis for sickle cell anemia? Explain the main symptoms at a molecular level.

1. Build a model:

Search for information about sickle cell anemia and try to identify its cause(s) and main symptom(s). Initial explorations may be conducted as follows:

1. online – using your favorite search engine (Google, Bing etc.)
2. in reliable public data resources – that archive information about human health and disease
3. in text books – that you or your library owns; or check the NCBI bookshelf (online) at <http://www.ncbi.nlm.nih.gov/books>
4. in review articles – you can search for these using the NCBI PubMed (online) at <http://www.ncbi.nlm.nih.gov/pubmed>

*Q2. What is sickle cell anemia? What is its major cause and symptoms? Where did you get this information – list sources.*

*Q3. What molecules are involved in this disease? What molecule(s) would you like to explore in the PDB?*

1. Investigate:

Search for your molecule(s) of interest in the PDB using known properties – e.g. molecule name, disease name, mutation, presence of ligand etc.

*Q4. List the PDB ID and Structure titles for up to 5 structures in the PDB that are relevant to answering the initial question.*

*Q5. How did you perform the search on the RCSB PDB website? List your search options and any logic that you used to refine your search results.*

Visualize the PDB entries that you identified – independently. If necessary and appropriate, superpose the structures to explore the structure-function relationships.

*Q6. What does/do your molecule(s) of interest look like? Is there anything unusual in the structure of the molecule(s) you are exploring?*

1. Analyze:

Sickle Cell Anemia is caused by a specific mutation. Focus on the areas in the vicinity of the mutation to explore the interactions.

*Q7. List the residues involved in the molecular interactions that are unique to individuals with Sickle Cell Anemia.*

1. Molecular explanations:

Based on the images included above and your explorations of the molecular structures – develop and explanation for the molecular basis for Sickle Cell Anemia.

*Q8. What are the main differences between the molecule you are exploring in healthy individuals compared to that in individuals with Sickle Cell Anemia. Illustrate your answer with 1-2 illustrations based on your structural explorations.*

1. Argument:

*Q9. What changes at the molecular level lead to “sickling” of the red blood cells? Substantiate your answer with at least one additional fact or observation about individuals with this condition.*

*Q10. Based on your understanding of the molecular basis of sickle cell anemia – propose a treatment approach for it.*

**Complete the following questions for HW:**

1. Communicate:

*Q11. Describe the molecular basis for Sickle Cell Anemia based on your explorations. Include an introduction, molecular explanation for symptoms of the disease and a few sentences about treatments and future directions, based on your explorations (molecular and other).*

**Extension and Enrichment:**

*Q12: The hemoglobin A1C (A1C) test can be unreliable for diagnosing or monitoring diabetes and prediabetes in people with inherited hemoglobin variants, such as sickle cell disease. Describe the connections between sickle cell anemia and Diabetes monitoring and why the test results may be unreliable.*