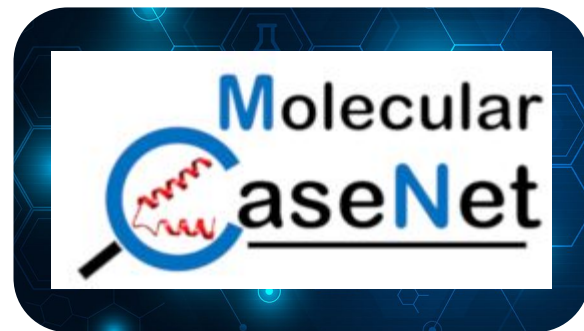


Molecular CaseNet:

An invitation to join this community
to Use and Develop Molecular Case Studies
at the Interface of Biology and Chemistry



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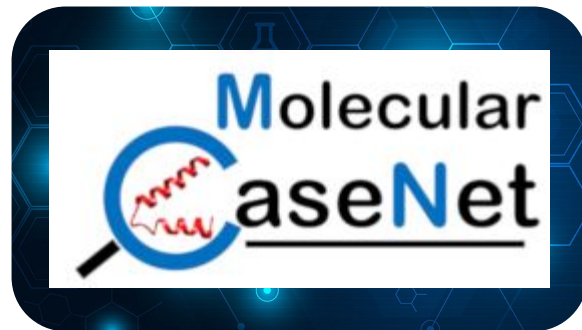


QUBES
A BioQUEST Project

This project is supported by the National Science Foundation - DBI 1827011; DBI 2018884

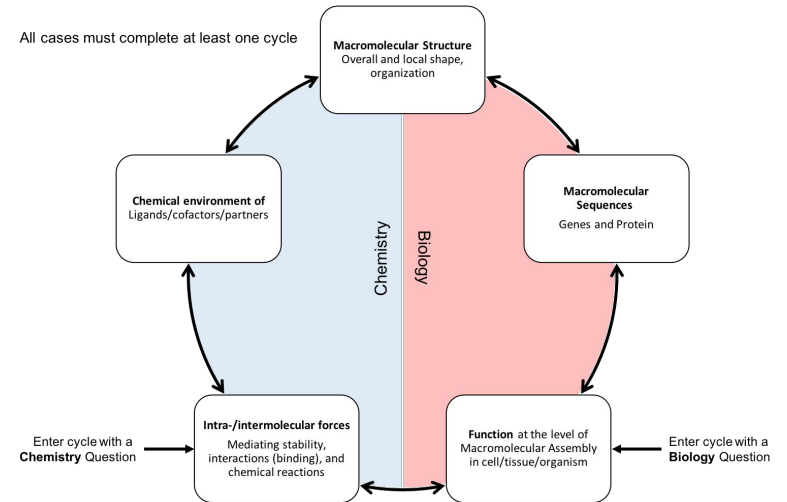
Outline

- The Molecular Case Study cycle
- Try a Molecular Case Study
- Develop your Molecular Case Study
- Invitation to join us



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Happy Blue Baby

Prior to case discussion (Homework): Read the news report (pdf) and answer the questions in the Preparation section		Resources to learn more: The scientific article
Question: What caused cyanosis in the happy blue baby?		
Biology	<i>Getting to Structure:</i>	Part 1: Grandma provides a clue
	<i>Molecular Exploration:</i>	Part 2: Molecular Basis of Cyanosis
	<i>Modeling:</i>	Part 3: A Happy ending ; Part 4: What causes the anemia?
	<i>Assessment:</i>	What if the mutation was present in adult hemoglobin?
Biochemistry	<i>Getting to Structure:</i>	Part 1: Grandma provides a clue
	<i>Molecular Exploration:</i>	Part 2: Molecular Basis of Cyanosis
	<i>Modeling:</i>	Part 3: A Happy ending ; Part 4: What causes the anemia? ; Part 5: Binding and Release
	<i>Assessment:</i>	What if the mutation was present in adult hemoglobin?

Happy Blue Baby

In 2008, Weiss (*Dr. Mitchell Weiss*) was rounding the wards at CHOP (*Children's Hospital of Philadelphia*) when he came across an unusual case. An infant from the Jersey Shore had just arrived at the hospital with an unexplained problem. Her skin had a purple-blue tinge, a condition called cyanosis, which indicates not enough oxygen-rich blood is reaching cells in the body.

"The list of things that can cause cyanosis is long," Weiss said. The neonatal intensive care unit at the hospital where the baby girl was born had done workups for the most common culprits, which included some frightening possibilities: congenital heart diseases, lung disorders. Everything was negative. Not only that, she was happy and alert, though slightly anemic.

"So then they called us," Weiss said.

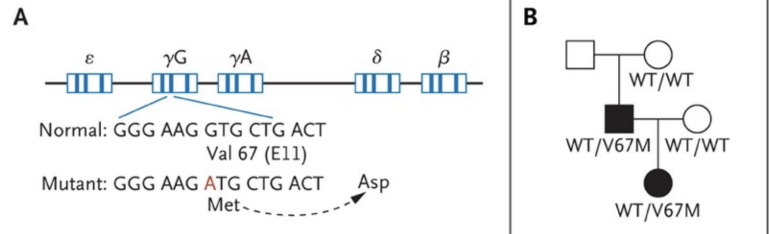
The most important clue came soon after.

"We're looking at this baby, and the grandmother comes up and says, 'My son had the same thing,'" said Weiss. The little girl's father was also born blue, said the grandmother. Doctors made a fuss and did a major evaluation. Nothing. Six months later, he was healthy

That was a eureka moment, Weiss said, because "when you hear that, you think of a fetal hemoglobin problem."

Q1. What symptoms did the newborn baby girl have when she was brought to the Children's Hospital of Philadelphia?

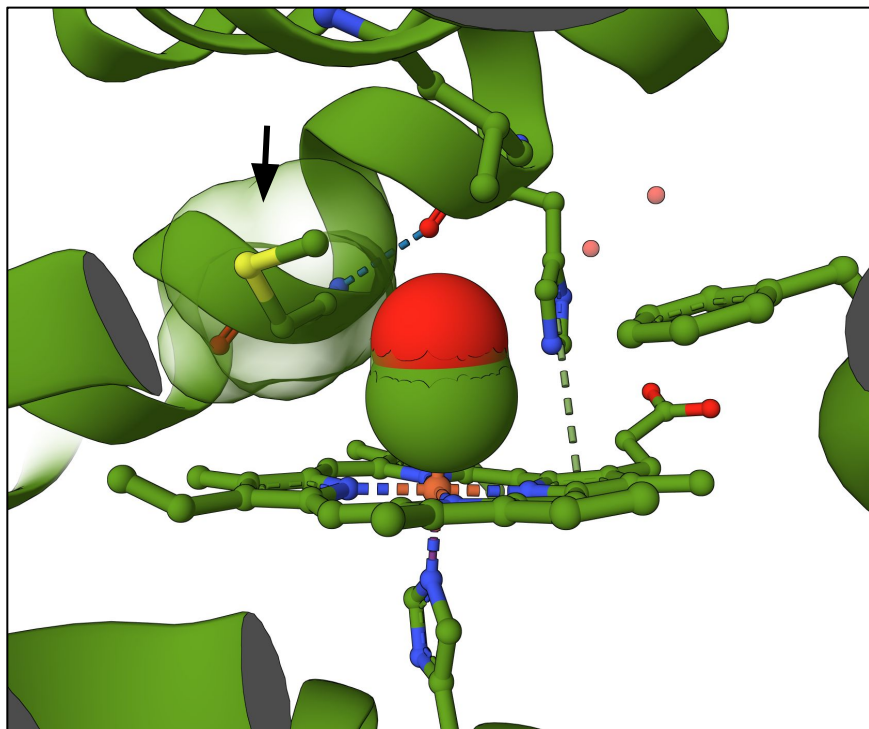
Q3. Based on the article what molecule(s) is/are affected? What was the diagnosis?



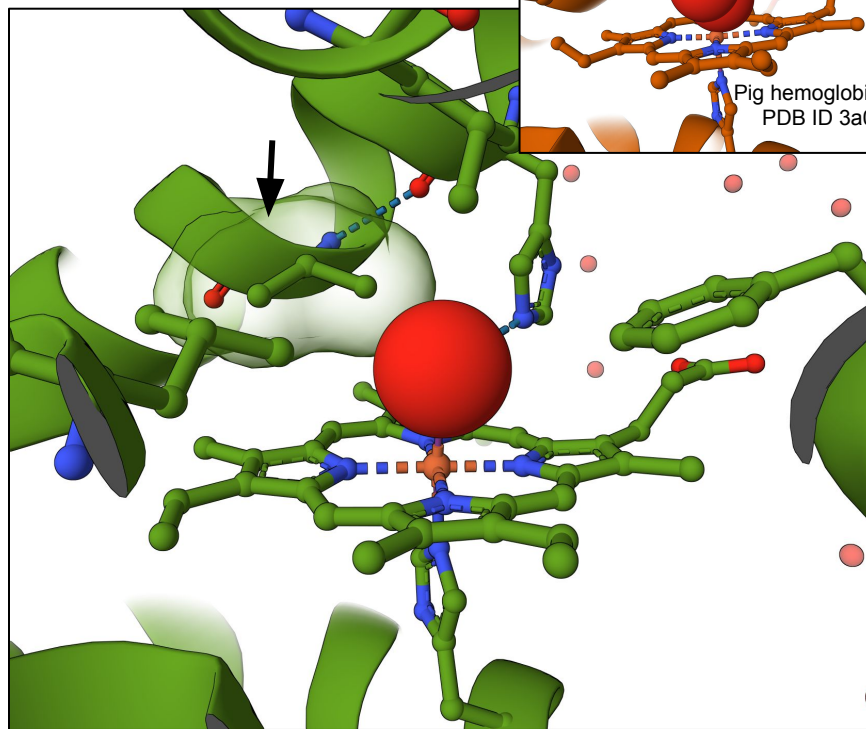
Let's Explore ...

- Go to www.rcsb.org
- Search for Toms River (top search box)
- In PDB entry identified - locate V67M
- Find a structure without the mutation
- Locate V67
- Compare structures
 - Side-by-side
 - Superposed
- Why was the baby blue?

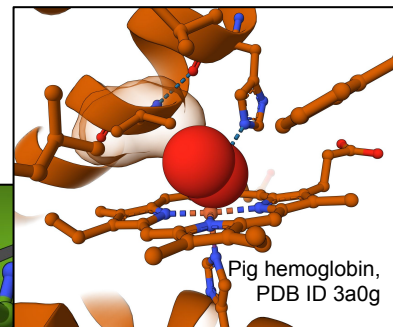
Mutant vs Native Hemoglobin γ



V67M in PDB ID 4mqk, chain B



V67 in PDB ID 4mqj, chain B



Happy Ending

- When the mutant Fetal Hemoglobin γ changes to Adult Hemoglobin β \rightarrow there is no mutation, hence cyanosis
 - Explore UniProt <https://www.uniprot.org/uniprotkb/P69892>
- Could the same mutation appear in Hemoglobin β ?


▶ Natural variant	VAR_079528 67	in Vigo; O ₂ affinity down 
▶ Natural variant	VAR_002961 67	in Chico; O ₂ affinity down; dbSNP:rs35939489 
▶ Natural variant	VAR_002962 68	in Sydney; unstable; dbSNP:rs33918343 
		in Bristol 
		Manual assertion based on experiment ⁱ
		A novel silent posttranslational mechanism converts methionine to aspartate in hemoglobin Bristol (beta 67[E11] Val-Met->Asp).
▶ Natural variant	VAR_035240 68	Rees D.C., Rochette J., Schofield C., Green B., Morris M., Parker N.E., Sasaki H., Tanaka A., Ohba Y., Clegg J.B.
		 PubMed   Europe PMC  Blood 88:341-348 (1996)

Review Case and Learning Objectives

- ASBMB
 - Structure and Function
 - 3. Structure and function are related
 - 4. Macromolecular interactions
 - 7. The structure (and hence function) of macromolecules is governed by foundational principles of chemistry and physics
 - Scientific Skills
 - 2. Accessing, comprehending and communicating science
- (MSN) Systems in the Curriculum
 - Biochemistry
 - Impact of intramolecular interactions on protein structure, folding, influence on biological function
 - Intermolecular interactions of biopolymers and influence of polymer primary, secondary, and tertiary structure (DNA, RNA, proteins, etc.)
- NIBLSE
 - Find retrieve and organize various types of bioinformatics data
 - Explore and/or model biological interactions, networks, and data interactions using bioinformatics
- BioMolViz
 - Alternate Renderings
 - Ligands and modifications
 - Macromolecular assemblies
 - Molecular interactions
 - Structure Function Relationships
- BioCore
 - Information Flow
 - Structure and Function

Adaptations

Adaptations

07 Jun 2021 5:41 pm		Happy Blue Baby v 1.0 Adapted by Didem Vardar-Ulu Adapted from	Diff
18 May 2021 7:46 pm		Happy Blue Baby: MCQs for large class Adapted by "KP" Kristen Procko Adapted from	Diff
14 Jun 2020 4:47 pm		The Happy Blue Baby Hemoglobin v 1.0 Adapted by Kasandra Riley (She/Her) Adapted from	Diff

How would you adapt this case?

A Collection of Goodies

What else would you like to see here?

Learn more about ...

- **Concepts**

- [Biological Macromolecules](#) - e.g., Amino acids and other biomolecular building blocks, Proteins, covalent and non-covalent interactions

- **Tools for ...**

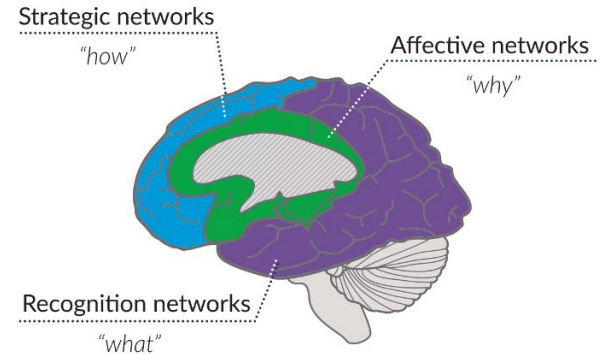
- [Molecular Visualization](#) - e.g., Mol*, UCSF Chimera, iCn3D, Jmol, PyMol
- [Exploring the Proteins Data Bank](#) - What is in [RCSB.org](#)? How to use this data?
- [Exploring Bioinformatics Data Resources](#) - Querying and integrating information from sequence, structure, and function data resources

- **Case Studies**

- [About Case Studies](#) - General information
- [The Molecular Case Study Cycle](#) - What all Molecular Case Studies must complete
- [Developing and Using Molecular Case Studies](#) [**New Pipeline** - available now with documentation (March 2023)]

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<https://www.cast.org/products-services/resources/2018/udl-learning-brain-neuroscience>

Authoring a Molecular Case Study

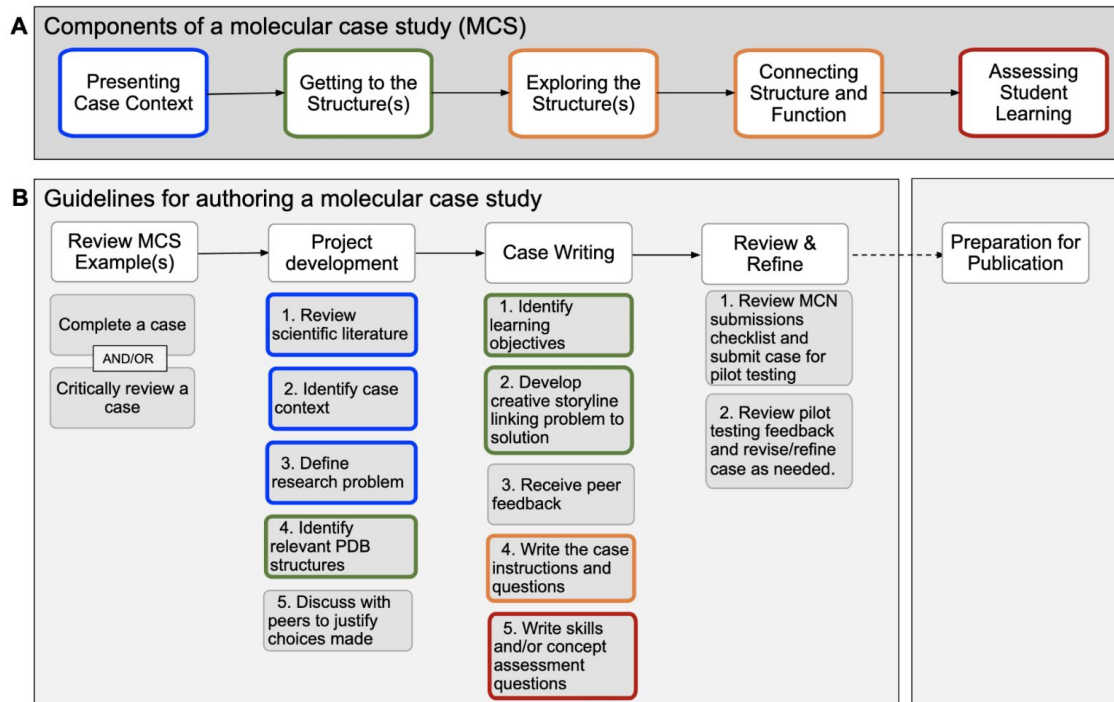
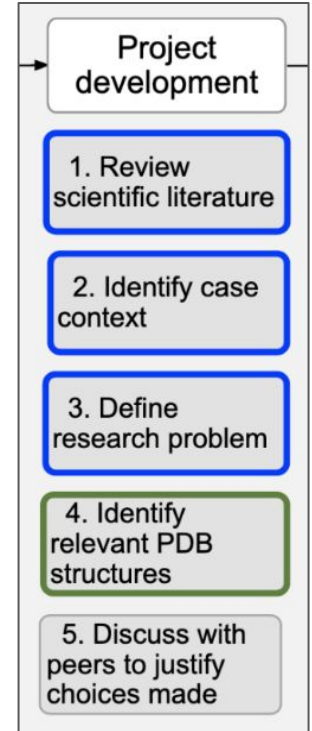


Figure 1: A. The main components of a molecular case study; B. Guidelines for authoring a molecular case study

Why?

- Select your topic
- Why is this important?
- Define a research question?

- Are relevant structures present in the PDB? Identify them.



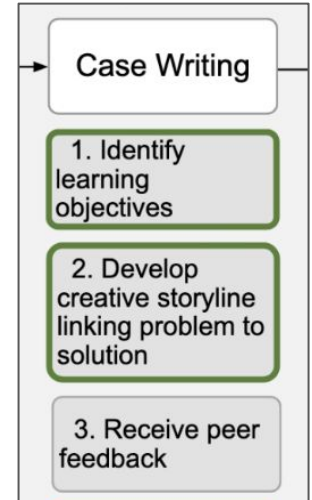
Share your “Why?”



What ?

- Develop a creative storyline
- Identify learning objectives
 - [ASBMB Foundational concepts](#)
 - [Macromolecular, Supramolecular, and Nanoscale \(MSN\) Systems in the Curriculum](#)
 - [NIBLSE Bioinformatics Core Competencies](#)
 - [BioMolViz Framework](#)
 - [BioCore Guide](#)

- Write case instructions
- Write Assessment

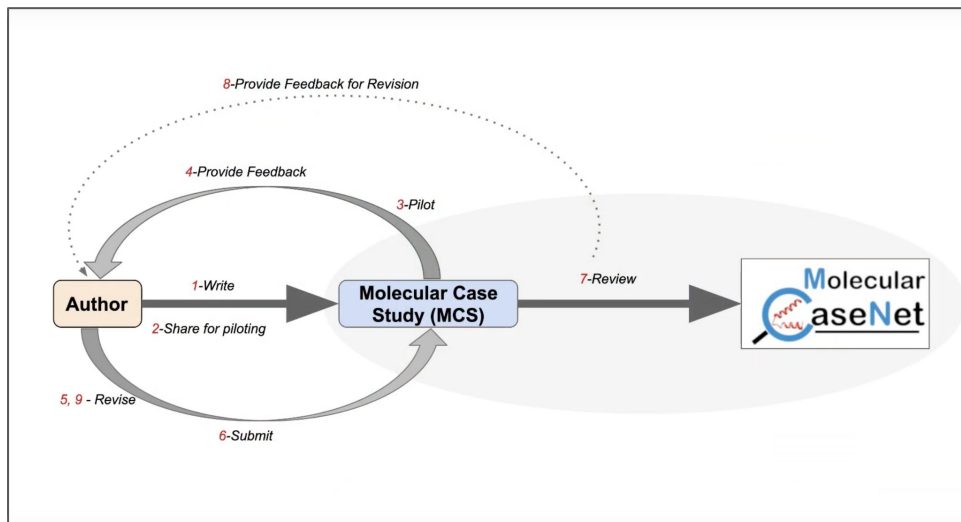


Share your “What?”

- Email me your brainstorming results: sdutta@rcsb.rutgers.edu

How ?

- Write case instructions
- Write skills and knowledge assessment
- Write the Teaching Notes document



4. Write the case instructions and questions

5. Write skills and/or concept assessment questions

Outline

- The Molecular Case Study cycle
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 - Use published case studies or case studies for piloting at <https://molecular-casenet.rcsb.org/>
 - as part of Cohort 3 to develop your own MCS
 - Begin in Sep./Oct. 2023
 - Expectation: Participate in 3 virtual sessions to write a draft for piloting
 - Brainstorming
 - Writing
 - Getting the MCS Teaching Ready
 - Pilot case study and prepare to publish



Summary

- The Molecular Case Study Cycle
 - A quick review of key elements
- Try a Molecular Case Study
 - Happy Blue Baby
- Develop your Molecular Case Study
 - Creating an outline for your MCS
- Invitation to join us
 - Use published or draft cases
 - Develop your own cases
 - Engage your students in writing case studies

