**Familial Partial Lipodystrophy, Dunnigan Variety**

Bradley University

**Part 2: The FPL2 Mutant**

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| ***Box 2: Storyline***  Now that we know the symptoms of FPL2 and a little background on what the disease is, let’s explore the molecule that was introduced in Part 1 that causes FPL2. Jill was able to diagnose herself reading scientific articles and spending hours researching genetics. Today, you will not have to do hours of research, but rather use a web-database visualization tool to explore and learn about the structure of Lamin A/C. |

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| **Background information: FPL2**  FPL2 causes affected individuals like Jill and Priscilla to experience abnormal degradation of adipose tissue. Lamin proteins function in the nucleus of cells by lining the inside of the cell membrane, allowing binding of other molecules. Mutations in LMNA, encoding lamin proteins A and C, are associated with this disease. Two potential explanations have been presented by the scientific community. The first involves breakdown of the cell nucleus due to mechanical and oxidative stress on the nuclear lamina’s mutated structure. The second hypothesizes aberrant gene expression in which lamin mutations affect binding to DNA or pro adipogenic transcription factors.  Read the introduction and sections 3.1, 3.3, and 3.4 in the discussion of the following article over the research of Magracheva, et al. to better understand the molecular basis of the disease: [Structure of the lamin A/C R482W mutant responsible for dominant familial partial lipodystrophy (FPLD)](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2705630/) |

**Explore the Web Database Visualization Tools on RCSB PDB.**

1. Click on the link (<https://www.rcsb.org/>) to explore the RCSB Protein Data Bank to examine the PDB 1IFR.

Question 1. Complete the following questions in the table using the structure summary page of the PDB: 1IFR

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| --- | --- |
| PDB | 1IFR |
| Title: |  |
| Authors: |  |
| Year of publication |  |
| Macromolecules (name--not ID #) |  |
| Small molecules (name--not ID #) |  |

1. In the 3D view tab of the RCSB page, manipulate the protein with Mol\* (the default program for viewing 3D images in RCSB)
   1. On the RCSB structure summary page of 1IFR, click on the 3D view “Structure”. This will take you to Mol\*, a molecular graphics visualization tool that allows you to interact with the molecule.
   2. The goal of this activity is to have you explore the structure and sequence of the wild type Lamin A/C protein as well as learn how to function Mol\*.
   3. To begin, click on the arrow (toggle selection mode) which will open a toolbar, located above the molecule. Across that toolbar will be a box labeled, “Residue”, click on “Residue” and change it to “Chain”.
   4. Click on Polymer in the right hand bar → (...) - Set Coloring → Residue Property → Sequence ID. This will create a rainbow coloration of the molecule. The purpose of labeling the protein in the rainbow coloration is to illustrate the sequence of the amino acids beginning with the N-terminus in blue and ending with the C-terminus in red.
   5. Add Labels for the macromolecule and small molecule(s) by clicking on measurements → click on the molecule/residue you would like to label → add (under measurements) → it will be labeled.

Question 2: Insert an image of the wild-type lamin A/C protein you created in Mol\*. Hide the water molecules. Identify and label the amino acid on the N-terminus and the amino acid on the C-terminus. (hint: view the residue #’s).

Answer:

1. Click on the link (<https://www.rcsb.org/>) to explore the RCSB Protein Data Bank to examine the PDB 3GEF.

Question 3. Complete the following questions in the table using the structure summary page of the PDB: 3GEF

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| PDB | 3GEF |
| Title: |  |
| Authors: |  |
| Year of publication |  |
| Macromolecules (name--not ID #) |  |
| Small molecules (name--not ID #) |  |

1. In the 3D view tab of the RCSB page, manipulate the protein with Mol\*
   1. On the RCSB structure summary page of 3GEF, click on the 3D view “Structure”.
   2. In toggle selection mode, select “Residue” for selection type in the upper toolbar. Highlight the mutated amino acid (W482). It may be easier to find the residue in the sequence box above the structure and select its one letter code.
   3. Change the color of the residue by selecting the paintbrush on the toolbar. → Choose a color that contrasts with the rest of the chain→ click “Apply Theme”.
   4. Label the residue and small molecule by clicking on measurements → click on the small molecule/residue → “Add” → “Label”.
   5. Change the structure of the amino acid to ball and stick.
      1. Press the cursor button to enter toggle mode, and select residue W482
      2. In the structure settings box to the right, select “Components” → “+ Add”
      3. Next to “Representation”, click <Create Later> and choose “Ball & Stick”
      4. Click “Create Component”
   6. Save an image of the resulting structure.
   7. The purpose of locating W482 is to visualize the amino acid mutation.
2. Zoom in on W482 to show its potential interactions with surrounding molecules.
   1. Exit toggle selection mode by clicking the toggle button (pointer) a second time.
   2. Select the residue in the sequence box to zoom in.

Question 4. Insert two images, 1. An image of the mutated Lamin A/C. 2. A zoomed in image to visualize the possible interactions between the surrounding molecules and W482.

Answer:

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| **Background Information:**  **If needed, use this source to help answer question 5.**  Amino Acid Biological Structures and Characteristics:[Amino acid properties (iarc.fr)](https://p53.iarc.fr/AAproperties.aspx) |

Question 5: Compare the amino acids involved in the mutation (structures and biological characteristics). Include images of the two amino acids. Why do you think the mutation causes a change in binding?

Answer: