www.NGSSLifeScience.com

Topic: Human Body Systems Disorder Project

Summary: Students will do a BLAST and learn about how the mutated protein affects cells, organs, and organ systems.

Goals & Objectives: Students will learn how to do an effective Internet search to research sickle cell disorder. Students will learn how to compare DNA code of real genes.

NGSS Standards: *LS1-1, LS1-2, LS1-3:* Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Time Length: 2-3 days

Prerequisite Knowledge: Protein synthesis and that mutations in the DNA can cause a change in the protein that is made.

Materials:

- Laptops with Internet access
- Preferred (students have a google account where two students can type on the same report at the same time)
- Handout of the project

Procedures:

1. Have every student do part 1, the BLAST. Once they get to part 1 step 10, students can work in groups of two to share / split the work.
2. Parts 1-4 usually takes two days. Students are supposed to use all of the website links provide along with Google searches. Teacher students how to an effective Internet search.
3. Once students are done with part 4, you can have them write on a separate paper a Claim Evidence Reasoning paragraph(s) answering the following question **"How do scientists really know that DNA codes for proteins and those proteins are represented in our traits?"**.

Editable DOCX File and Answer Key:

Available at www.ngsslifescience.com

Name: _____ Row: _____

Date:_____ Period:_____

Human Body Systems Disorder Project

Background:

Many human disorders are caused by mutations. Your goal in this research project is to learn about one. Through your research, you should gain insight on how important DNA is and how it actually really affects your body.

Assignment:

Working in groups of two with a computer, your goal is the find the actual DNA code that codes for a protein found inside your blood cells. Once you have found that DNA code, you need to compare it to mutant DNA that cause diseases in humans. Next, you will research how that mutant DNA affects the blood cells and how those cells affect its body system along with other body systems. Last, you will research how those body systems are used to keep you alive.

Internet Research:

Typing into Google / Bing a question is not the best way to do Internet research. Figure out the most important word(s) in the question and type that in for the search query. Find the most important word, then the next most important word(s). For example: *How many proteins make up hemoglobin? What are the two types?*

Search Query: hemoglobin protein

Bringing It All Together:

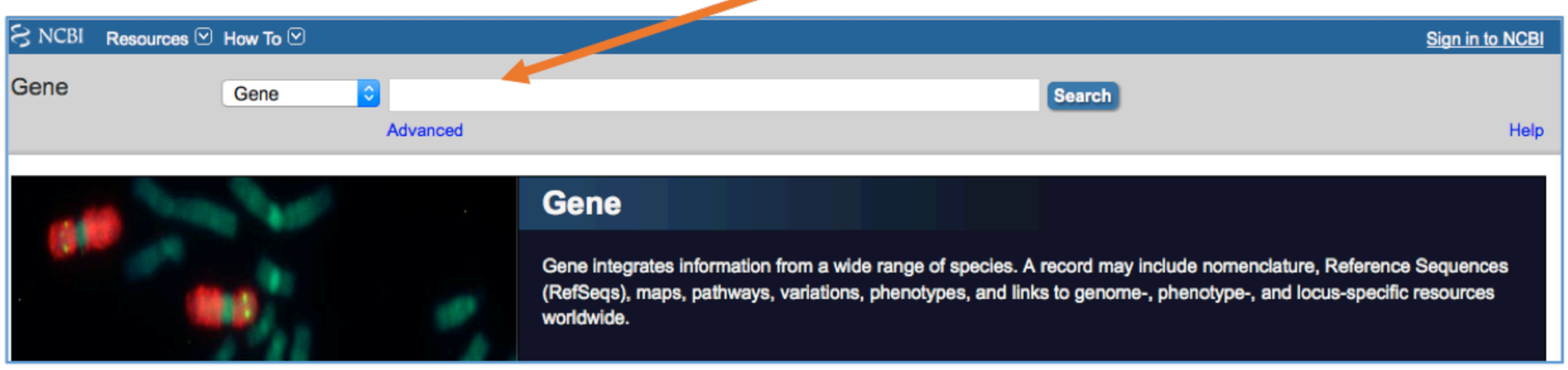
On the last page of the project, you will summarize all of the evidence you have collect to answer the question "**How does DNA affect your body to help keep you alive?**". This question will be answered on another day, but you get to use your evidence page when you go to answer this question. In order to answer this question, you need to make connections between DNA, proteins, cells, body systems, and homeostasis.

Part 1: Gene Look-up Direction:

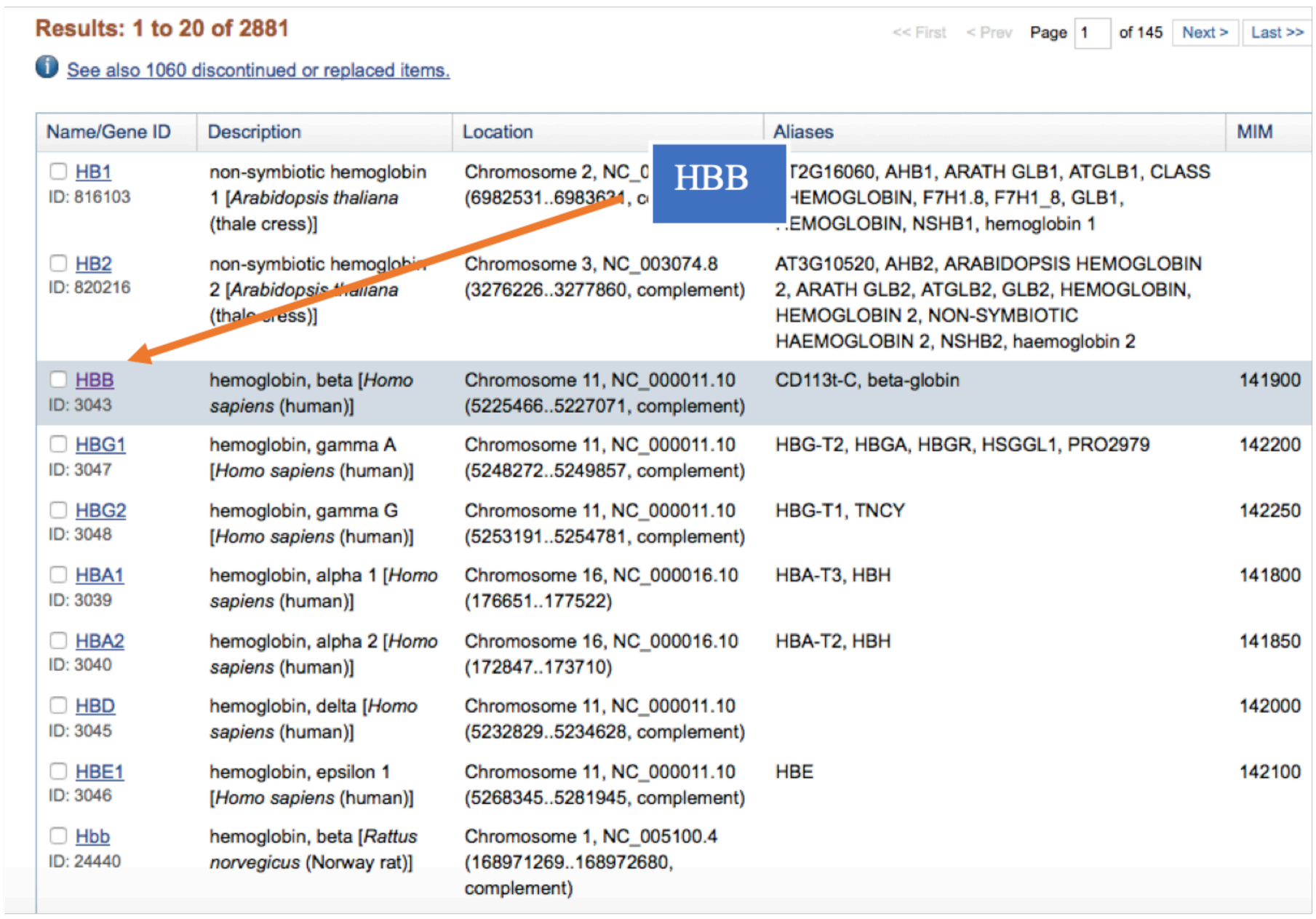
1. Go to the website below to look up a gene.

http://www.ncbi.nlm.nih.gov/gene/

2. In the search box, type hemoglobin.

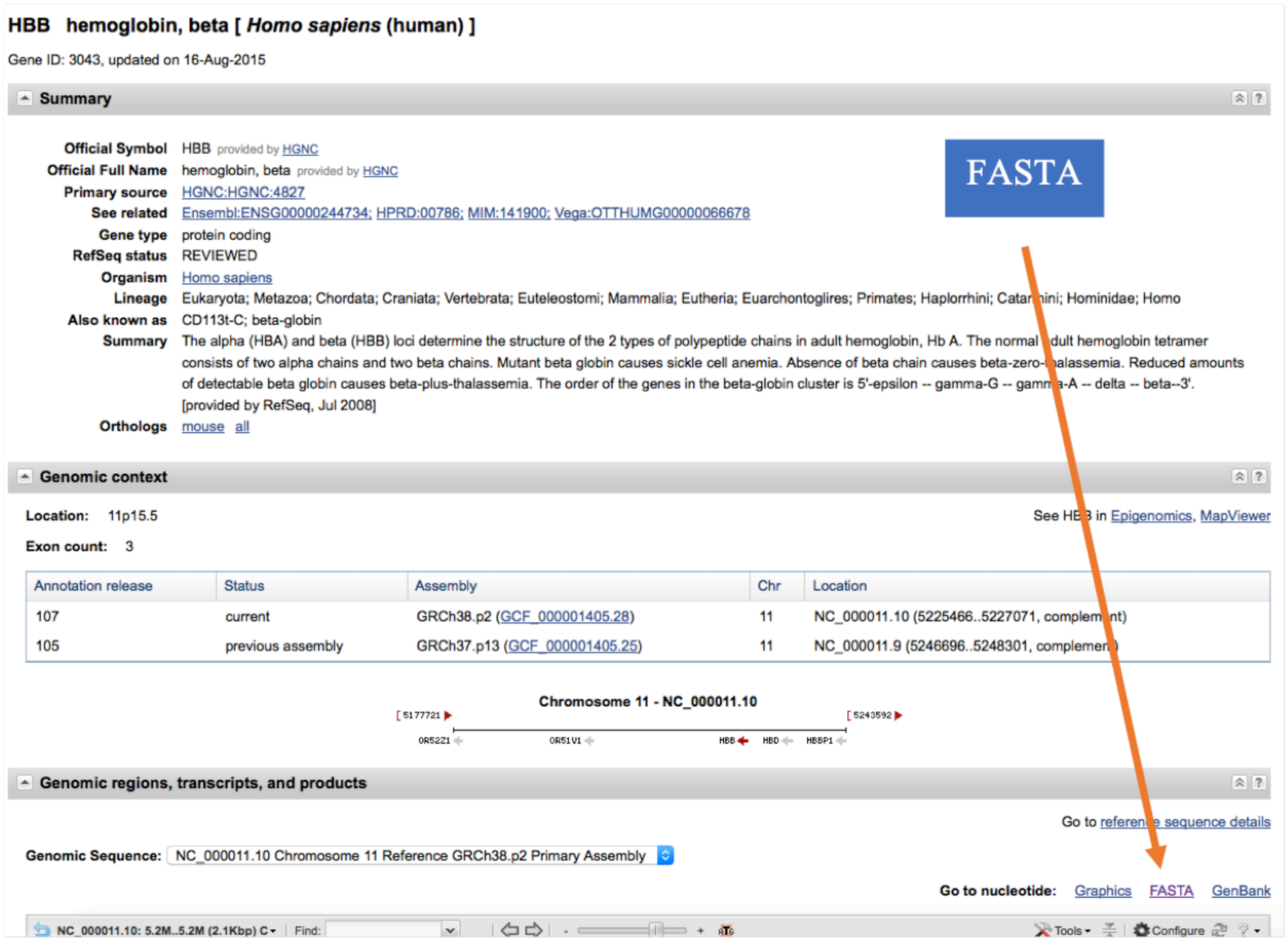


3. In the search results, click on the HBB link.

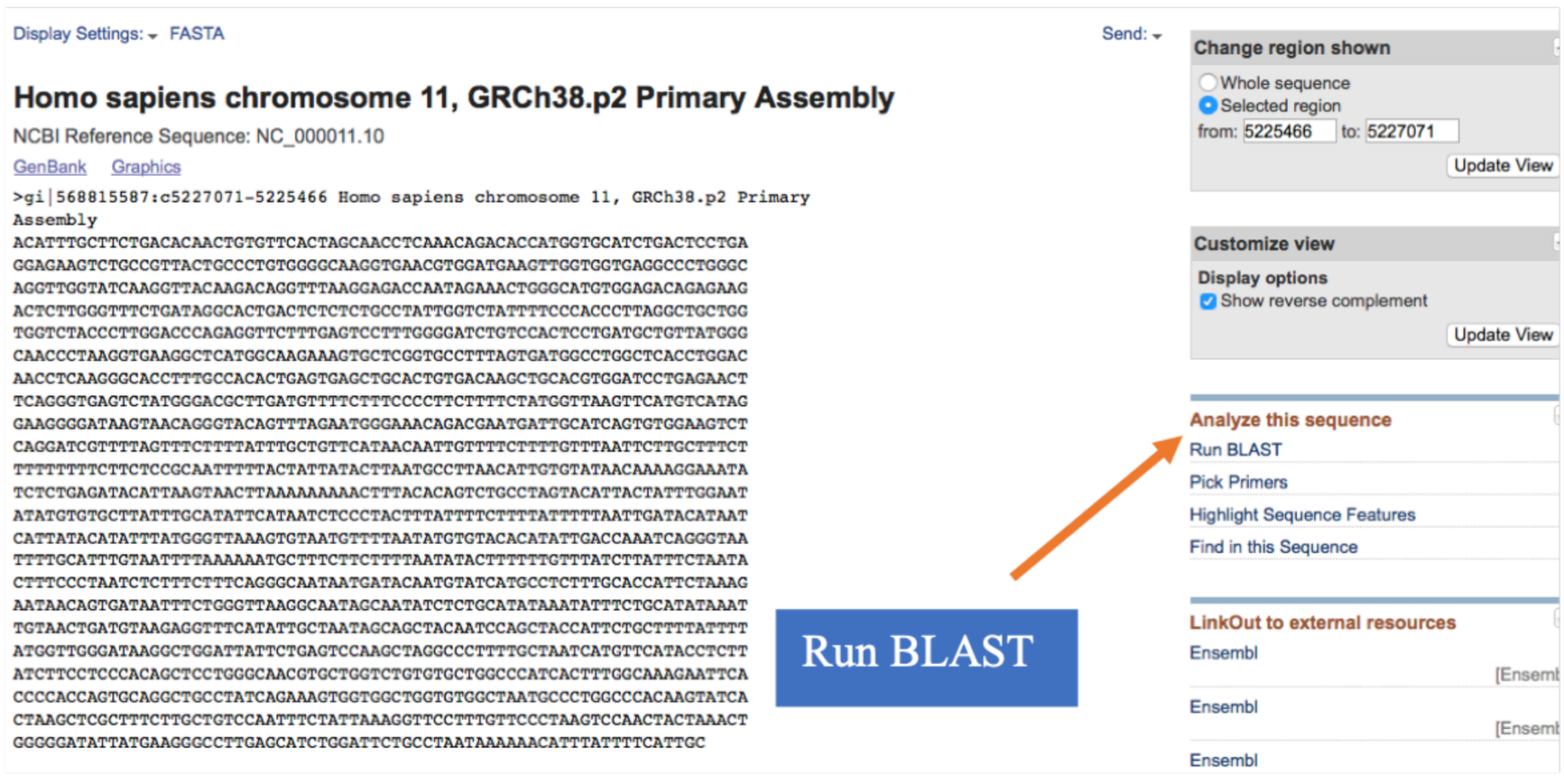


Name/Gene ID	Description	Location	Aliases	MIM
HB1 ID: 816103	non-symbiotic hemoglobin 1 [*Arabidopsis thaliana* (thale cress)]	Chromosome 2, NC_0 (6982531..6983631, c	T2G16060, AHB1, ARATH GLB1, ATGLB1, CLASS HEMOGLOBIN, F7H1.8, F7H1_8, GLB1, EMOGLOBIN, NSHB1, hemoglobin 1	
HB2 ID: 820216	non-symbiotic hemoglobin 2 [*Arabidopsis thaliana* (thale cress)]	Chromosome 3, NC_003074.8 (3276226..3277860, complement)	AT3G10520, AHB2, ARABIDOPSIS HEMOGLOBIN 2, ARATH GLB2, ATGLB2, GLB2, HEMOGLOBIN, HEMOGLOBIN 2, NON-SYMBIOTIC HAEMOGLOBIN 2, NSHB2, haemoglobin 2	
HBB ID: 3043	hemoglobin, beta [*Homo sapiens* (human)]	Chromosome 11, NC_000011.10 (5225466..5227071, complement)	CD113t-C, beta-globin	141900
HBG1 ID: 3047	hemoglobin, gamma A [*Homo sapiens* (human)]	Chromosome 11, NC_000011.10 (5248272..5249857, complement)	HBG-T2, HBGA, HBGR, HSGGL1, PRO2979	142200
HBG2 ID: 3048	hemoglobin, gamma G [*Homo sapiens* (human)]	Chromosome 11, NC_000011.10 (5253191..5254781, complement)	HBG-T1, TNCY	142250
HBA1 ID: 3039	hemoglobin, alpha 1 [*Homo sapiens* (human)]	Chromosome 16, NC_000016.10 (176651..177522)	HBA-T3, HBH	141800
HBA2 ID: 3040	hemoglobin, alpha 2 [*Homo sapiens* (human)]	Chromosome 16, NC_000016.10 (172847..173710)	HBA-T2, HBH	141850
HBD ID: 3045	hemoglobin, delta [*Homo sapiens* (human)]	Chromosome 11, NC_000011.10 (5232829..5234628, complement)		142000
HBE1 ID: 3046	hemoglobin, epsilon 1 [*Homo sapiens* (human)]	Chromosome 11, NC_000011.10 (5268345..5281945, complement)	HBE	142100
Hbb ID: 24440	hemoglobin, beta [*Rattus norvegicus* (Norway rat)]	Chromosome 1, NC_005100.4 (168971269..168972680, complement)		

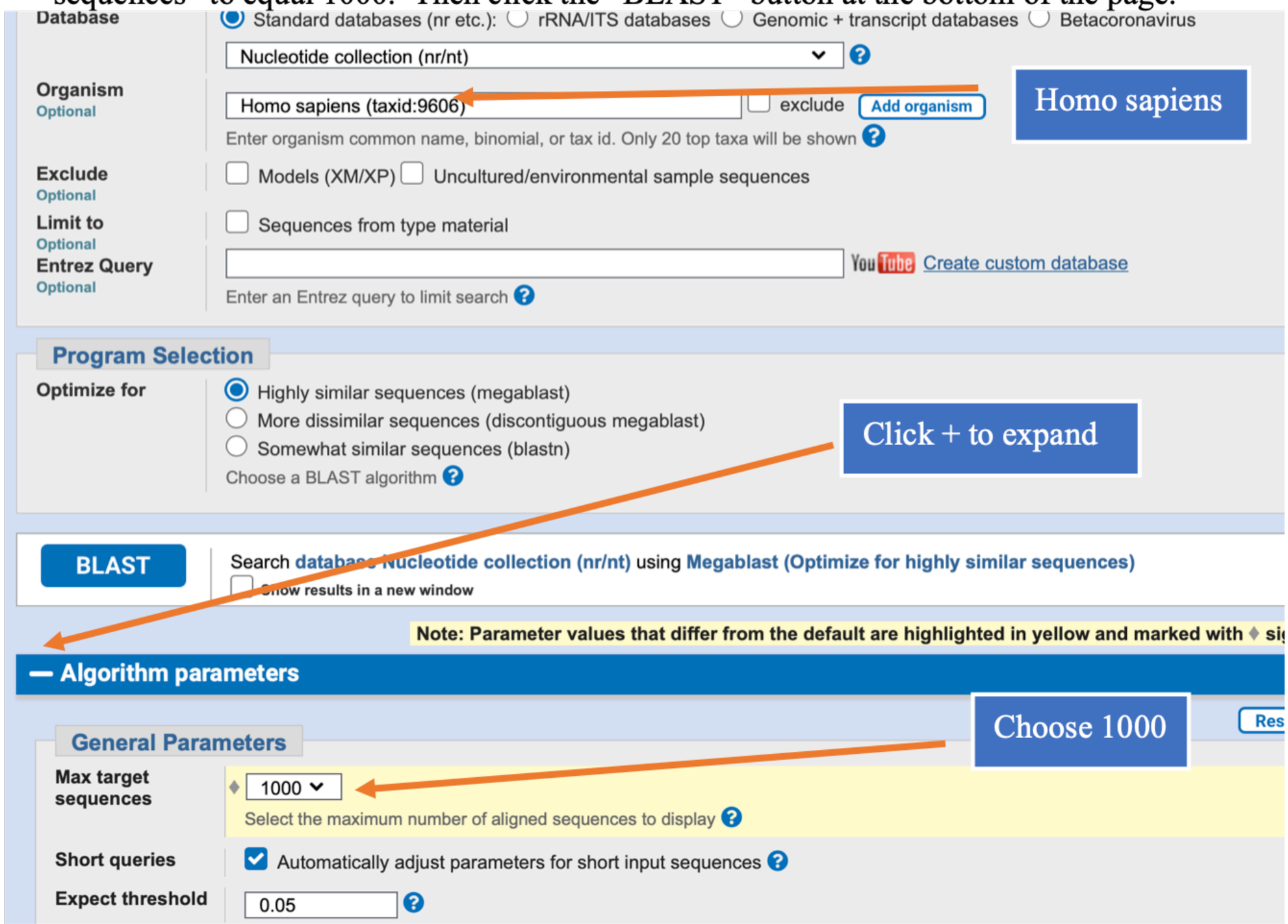
4. On the HBB hemoglobin beta [Homo sapiens (human)] page, you will see a link in the third section down “Genomic regions, transcripts, products”. Click on the FASTA link.



5. On this page, you will see the entire gene and all of its nitrogen bases (letters). Click on the link titled “Run BLAST”. On the next page, click the BLAST button at the bottom of the screen



6. Under Choose Search Set, on the organism text box, type “Homo sapiens”.
7. Scrolls down to the bottom and click + Algorithm parameters. Select “Max target sequences” to equal 1000. Then click the “BLAST” button at the bottom of the page.



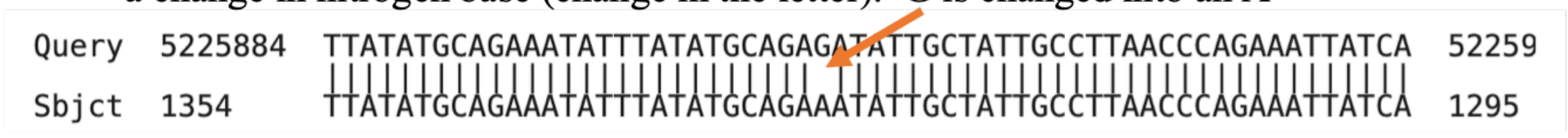
8. It may take a few seconds to run the DNA comparison search, but once you get to the results page, scroll down to the descriptions section. Listed here are hemoglobin genes that have been sequenced. Scroll down to near the bottom of the list until you get to

   Homo sapiens beta-globin (HBB) gene, with t to c mutation L114P resulting in dominant beta-thalassemia intermedia

9. What you will notice is that there are several different types of mutations that will cause beta-thalassemia. Beta thalassemia is a type of sickle cell disease. Click the link below.

   Homo sapiens beta-globin (HBB) gene, with t to c mutation L114P resulting in dominant beta-thalassemia intermedia

10. Look at line Query 5225884 for a mutation with subject 1352. A missing line represents a change in nitrogen base (change in the letter). G is changed into an A

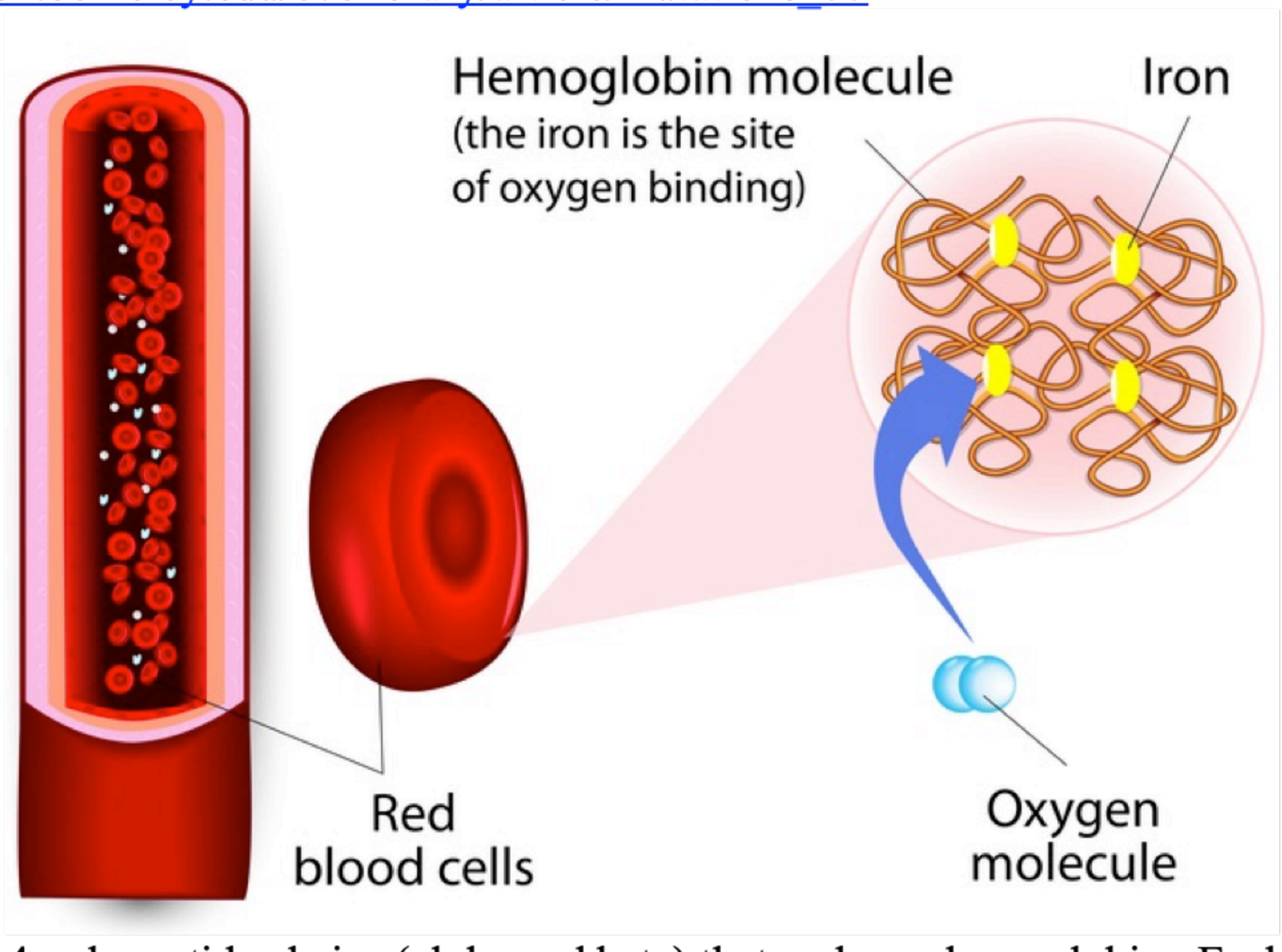


11. Try to find other mutations in the gene comparison and record the mutation in the data table below. Find three more mutations and enter in the location and which letter was changed.

Query: 5225884 Letter: G Sbjct: 1354 Letter: A	Query: _____ Letter: ___ Sbjct: _____ Letter: ___
Query: _____ Letter: ___ Sbjct: _____ Letter: ___	Query: _____ Letter: ___ Sbjct: _____ Letter: ___

Part 2: Research Hemoglobin Proteins and Red Blood Cell

The red blood cell has proteins inside of it called hemoglobin. You need to research to answer the following questions. You can use an Internet search or the following website. You MAY NOT copy straight from the Internet, you need to write in your own words to answer the questions.
http://evolution.berkeley.edu/evolibrary/article/mutations_06



1. There are 4 polypeptide chains (alpha and beta) that make up hemoglobin. Each of the polypeptide chains are held together by iron. What is another function of iron for hemoglobin?

2. How is the normal hemoglobin and the hemoglobin in sickled red blood cells different? Explain

3. What is a negative phenotype of sickled red blood cell? Explain

4. What is a positive phenotype of sickled red blood cell? Explain

5. What body system is the red blood cell part of? What is the main job of that body system?

6. Draw or provide a picture of a normal red blood cell and a sickle red blood cell.

Part 3: Research Sickle Cell Disease

You need to research more information on sickle cell disease, specifically beta-thalassemia. In your research make sure to answer the following questions. You can use an Internet search or the following website. You MAY NOT copy straight from the Internet, you need to write in your own words to answer the questions.
http://ghr.nlm.nih.gov/condition/sickle-cell-disease

7. What are the signs and symptoms of sickle cell disease?

8. What are other body organs / systems affected by sickle cell? Provide a list of organs / systems.

9. Select one system / organ from above that is NOT part of the circulatory system (ex. heart). Explain in detail how another body system / its main organ is affected.

Part 4: Summarize your evidence

Your goal is to now summarize all of the research you have done in this project to answer the following question: **How does DNA affect your body to help keep you alive?** The key thing to write is the evidence from your research that supports each of the ideas.

10. DNA codes for Proteins

11. Proteins provide an essential biological function

12. Cells make up tissues, organs, and body systems

Name: _____ Row: _____

Date:_____ Period:_____

Part 5: DNA to Proteins CER

Question: How do scientists really know that DNA codes for proteins and those proteins are represented in our traits? Write a Claim Evidence Reason paragraph to answer this question. Y*our evidence needs to based on real life information you found in this project. Your reasoning needs to include scientific concepts learned in class.*
