Science Objectives

- Students will describe how the substitution of one nucleic acid sequence results in the production of a faulty protein.
- Students will describe how a translation mutation can result in a genetic disease.

Vocabulary

- genotype
- phenotype
- gene
- amino acid
- protein
- hemoglobin
- mutation
- sickle-cell anemia

About the Lesson

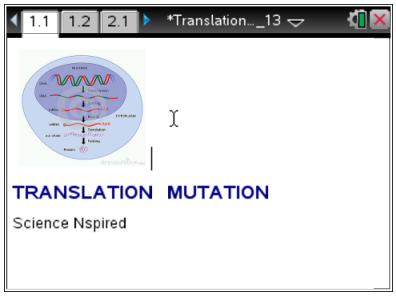
- This lesson is a student exploration of how gene mutations located on chromosomes result in harmful effects.
- Students will run a simulation that demonstrates each step: nucleic acid substitution, amino acid substitution, protein shape, genetic disease.

TI-Nspire™ Navigator™

- Send out the *Translation_Mutation_.tns* file.
- Monitor student progress using Class Capture.
- Use Live Presenter to spotlight student answers.

Activity Materials

- Compatible TI Technologies: TI- Nspire™ CX Handhelds, TI-Nspire™ Apps for iPad®, TI-Nspire™ Software



Tech Tips:

- This activity includes screen captures taken from the TI-Nspire CX handheld. It is also appropriate for use with the TI-Nspire family of products including TI-Nspire software and TI-Nspire App. Slight variations to these directions may be required if using other technologies besides the handheld.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

- Translation_Mutation_Student.doc
- Translation_Mutation_Student.pdf

TI-Nspire document

- Translation_Mutation.tns

Discussion Points and Possible Answers

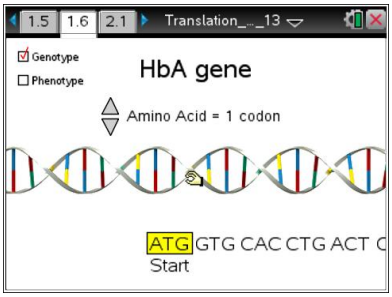
Have students read the background information stated on their activity sheet or in pages 1.2 - 1.5. Make sure students understand all relevant vocabulary, including the difference between phenotype and genotype.

Tech Tip: To access the Directions again, select > **Directions.**

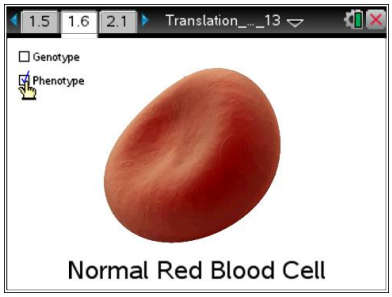
Tech Tip: To access the Directions again, select menu or **Document Tools ( ) > Genetic Mutation > Directions.**

Move to page 1.6

1. Students will select and drag the DNA helix to first view the normal hemoglobin gene, HbA.
2. Students will select the up and down arrows (▼ and ▲) to view the amino acid specified by each codon.

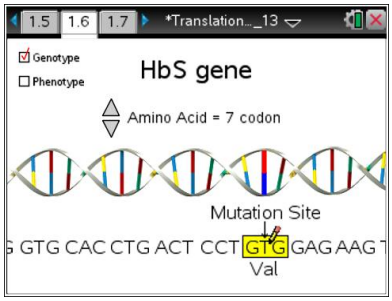


3. Students will select the "phenotype" to view the red blood cell.

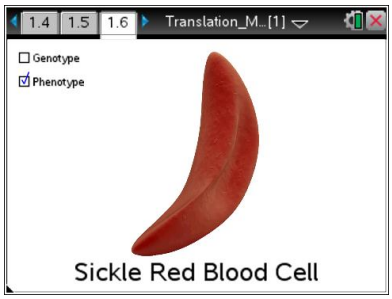


4.. Students will need to select the "genotype" to view the gene again and find the mutation site

5. Be sure they are highlighting the mutation site and they should see the switch from HbA to HbS at the top of the screen.



6. Finally, students should select the "phenotype" checkbox to view the sickled red blood cell.



Q1. Red blood cells are bags of hemoglobin so the shape of hemoglobin determines their shape. What is the normal shape of RBCs?

A. round
B. sickle

Answer: A. round

Q2. What letter substitution caused the translation mutation?

A. T → A
B. A → T
C. G → C
D. C → G

Answer: B. A → T

Q3. What amino acid substitution caused the translation mutation?

A. val (valine) for glu (glucine)
B. glu (glu) for val (valine)

Answer: A. val (valine) for glu (glucine)

Q4. Mutated hemoglobin is sticky and clumps together. What is the shape of the red blood cell containing mutated hemoglobin protein?

A. round
B. sickle

Answer: B. sickle

Q5. Hemoglobin transports oxygen in the blood. What symptom would a person with sickle-cell anemia experience?

A. hunger
B. thirst
C. fatigue

Answer: C. fatigue

TI-Nspire Navigator Opportunities

Make a student a Live Presenter to demonstrate how they are recording their data.

Wrap Up

- Use the graphic on the title page to reinforce each step of protein synthesis.

Assessment

- Students can design a “Foldable” that begins with the DNA helix and “unfolds” for each step of protein synthesis. One side will illustrate the normal sequence and the other side will illustrate the mutation.