HASPI Medical Biology Lab 22

Adaptations

NGSS HS-LS4-3

Teacher Information

Description

a. Survival of the Fittest: HIV Immunity

Students will be given a numbered vial and exchange fluids with 5 other students in the class. One vial will contain sodium hydroxide that is not visible and acts as simulated HIV. This will be followed by a simulated "HIV test" in which the students will use a drop of phenolphthalein, and any vials that have had sodium hydroxide transferred to them will turn pink indicating contamination with HIV. A few students will also have vials that contain vinegar and represent HIV immunity. Students follow up by tracing back to determine who transferred the virus to them and who is immune. The impact of HIV immunity and its application to natural selection will also be discussed.

b. Analysis of Human Traits

Students apply concepts of statistics and probability to analyze actual human conditions or disorders. Punnett squares, pedigrees, Hardy-Weinberg equilibrium, and the chi-square test are applied to human mutations. Following analysis, students will determine whether traits occurring from each condition could be advantageous in specific environments.

Next Generation Science/Common Core Standards

Students who demonstrate understanding can:

HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.

***Medical Application**: Concepts of statistics and probability are applied to the analysis of human conditions to determine whether these conditions could be advantageous.*

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.	**LS4.B: Natural Selection** • Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population, and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. • The traits that positively affect survival are more likely to be reproduced, and thus are more common in the populations. **LS4.C: Adaptation** • Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. • Adaptation also means that the distribution of traits in a population can change when conditions change.	**Patterns** • Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.

Connections to other DCIs in this grade-band: **HS.LS2.A, HS.LS2.D, HS.LS3.B**
Articulation to DCIs across grade-levels: **MS.LS2.A, MS.LS3.A, MS.LS4.B, MS.LS4.C**
Common Core State Standards Connections: *ELA/Literacy –* **RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes. **WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research. *Mathematics –* **MP.2** Reason abstractly and quantitatively.

Essential Question

By the end of this activity students will be able to:

- Apply concepts of statistics and probability to human genetic traits.
- Describe how HIV-1 immunity provides evidence of natural selection in action.
- Analyze whether human genetic traits or conditions could relay an advantage in specific environments.

Time

Estimated Time	***Actual Time*** *(please make notes below)*
Lab 22a: 40 - 45 minutes	
Lab 22b: 55 - 60 minutes	

*Note: Share the actual time on the forum (**www.haspi.org**) or at HASPI curriculum conference*

Materials

HASPI is a grant-funded project and on occasion we are able to provide supplies to participating sites. If we are unable to provide supplies, the company, item number, and approximate cost have been included.

Supply	Provided (P) or Needed (N)	Quantity	Company/ Item #	Approximate Cost
Labels (minimum 40)	P	1 sheet	Office supply	$10.00
Phenolphthalein	P	5 ml	Carolina/ 879995	$6.25
0.1 M sodium hydroxide	P	5 ml	Carolina/ 889551	$5.65
White vinegar	P	5 ml	Carolina/ 971852	$2.55
Plastic pipettes (rinse & reuse)	P	43	Carolina/ 736984	$5.10
Plastic vials w/caps	P	42	SKS/ 0710-01	$20.16
Paper towels	N	As needed	-	-

Company Contact Information:		
Carolina Biological Supply www.carolina.com 800.334.5551	Ward's Science www.wardsci.com 800.962.2260	Office Supply Can be purchased at any office supply store

Common Student Misconceptions

The following is a list of possible misconceptions that students experience. Please feel free to add any additional misconceptions students experienced during this activity to be better prepared for the future use of this lab/activity.

- Students may confuse the concept that HIV immunity or conditions do not appear in response to the environment. Reinforce the concept that these mutations, and therefore traits, are already present in the genome.

Additional Misconception Notes:

Guiding Questions

These questions are meant to support discussion of the concept/standard.

- Discuss how statistics and probability can be used in basic models, such as a coin flip.
- Have students discuss in groups whether the conditions/traits in 22b could be advantageous, and in which conditions.

The Task/Response System

Through multiple discussions and suggestions HASPI has decided to use the task/response system for lab procedures and directions. The response column can be utilized to:

- Provide space for answers to questions provided in the task column
- Provide space for data/observation records
- Provide images to help relay a step
- Support reinforcement of the standards/concepts immediately during the lab investigations
- Any other way you see fit to use it!

Additional Information

Information	Page #	Location
Lab 22a. Natural Selection in Action: HIV Immunity		
Using the stickers provided, number the vials 1-40.	Set up	Set up
Choose 1 vial at random, and add 2 ml of 0.1 M sodium hydroxide and 3 ml of distilled water. Record the vial number in a hidden location.	Set up	Set up
Add 5 ml of distilled water only to the remaining vials.	Set up	Set up
Some of the vials that have been exposed to the diluted HIV (passed along 4-5 times) may not test positive, or may be extremely light pink. If someone believes he/she was exposed but does not test positive, remind him/her that sometimes HIV remains dormant for years (may still be carrying the virus).	Page 564	Steps 7 & 8

BEFORE THE HIV TEST: You will want to be sneaky for this part. Choose 1-3 vial(s) and add several drops of white vinegar before the HIV tests. Record the vial number(s). These vials represent students that are immune to HIV.	Page 564	Steps 7 & 8
Lab 22b. Analysis of Human Traits		
Since this is a practice activity, the Connections & Applications can be found in Lab 22a.	Pages 566-567	Connections & Applications

Resources and References

- PBS. 1999. HIV Immunity. www.pbs.org.
- Marmor, M., Hertzmark, K., Thomas, S.M., Halkitis, P.N., and Vogler, M. 2006. A representation of HIV-1 entry into target cells. Journal of Urban Health, 83(1): 5-17.

Images (in order of appearance)

- http://www.blatantworld.com/feature_pics/adult_hiv_prevalence3.gif
- http://4.bp.blogspot.com/_RIWBU-b-irM/SbghpQe0LPI/AAAAAAAAAAk/R-n4-WCQDM0/s320/572px-Symptoms_of_acute_HIV_infection.svg.png
- http://www.bloodindex.com/images/hiv_life_cycle.jpg
- http://www.dreddyclinic.com/images/primary%20HIV.jpg
- http://www.lineaysalud.com/images/stories/sindromedeolorapescado(1).jpg
- http://cdn2.top10hut.com/wp-content/uploads/2013/02/1326947669_03657000.jpg
- http://www.medicalook.com/diseases_images/coronary_heart_disease.jpg
- http://1.bp.blogspot.com/_Dg1MLpkMYL0/TSuWc2fmLZI/AAAAAAAAAGA/RyZ7tih38vM/s1600/blog68.jpg
- http://www.thewellingtoncardiacservices.com/images/Heart/Coronorary-Artery-Disease2.jpg
- http://diseasespictures.com/wp-content/uploads/2012/10/hemophilia-2.jpg
- http://trialx.com/g/Congenital_Methemoglobinemia-4.jpg
- http://blogs.plos.org/neuroanthropology/files/2010/09/turkey-walking-on-all-fours-1.jpg
- http://withfriendship.com/images/i/44490/with-ectrodactyly-usually.jpg
- https://www.sciencenews.org/sites/default/files/14307
- http://compulenta.computerra.ru/upload/iblock/88b/o_plasmodium%20falciparum.jpg
- http://i.imgur.com/3fXmSxt.jpg
- http://medicalstuttering.com/wp-content/uploads/2013/05/Cystic-fibrosis.jpg
- http://geneticmutationruebe3.wikispaces.com/file/view/little-people-big-world31.jpg/309905494/little-people-big-world31.jpg