A Jigsaw and Role-Play Based Open Educational Resource Covering COVID-19 Tests Increases Student Understanding of Antigens, Antibodies, and Testing.

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Introduction

- As evidenced by the COVID-19 pandemic, an increase and improvement in immunology literacy is necessary[1].
- Open Educational Resources are a money saver for students, but more importantly, they can increase grades across demographic groups, making them a potential equity strategy[2].
- Sensitivity and specificity of COVID-19 tests have led to confusion around positive and negative test results[3].
- Active learning strategies can improve learning immunology concepts[4].

Learning Outcomes and Hypothesis

1.Vision and Change: Transfer of Information
1. Explain how knowledge of DNA replication can be used to detect the presence of SARS CoV2 genomes.
2. Distinguish viral genes (that code for viral antigens (epitopes) expressed in infected cells) from human genes (that code for antibodies expressed by B lymphocytes, or B cells).
3. Describe how mutations in the viral genome sequence could lead to changes in the amino acid sequence of viral antigens.

2.Vision and Change: Structure and Function
1. Describe how viral antigens (epitopes) are recognized by the immune system, such as when antibodies bind to them.
2. Describe how mutations in the viral genome sequence could lead to changes in the amino acid sequence of viral antigens.

3.Vision and Change: Core Competencies
1. Communicate and Collaborate with other disciplines.
2. Understand the relationship between science and society.

We hypothesized that students would answer questions correctly about viral replication, antigen formation, and the impact of mutation better after completing the COVID-19 testing activity.

Implementation

Time	Description	Resources
	Before Class: 1. Take pre-quiz 2. Watch video 3. Do Part A	1. Resource Quiz 2. Video Link 3. Part A
	1. Choose a specialty 2. Read testing 3. Complete Part B	1. Epidemiologist PCR Test 2. Infectious Disease Doctor Antigen Test 3. Immunologist Antibody Test
	1. Summarize specialty findings 2. Compare specialty answers	1. Part C of Student Handout
	1. Mix up specialties and compare findings 2. Class discussion	1. Part D of Student Handout
	1. Have students complete Quiz	1. Resource Quiz

Acknowledgments

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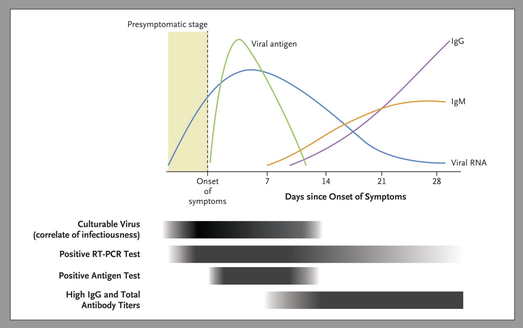
Scenario Information

Specialty	Test Type	Test Result in Scenario
Epidemiologist	RT-PCR Viral RNA Test	Positive
Infectious Disease Physician	Viral Antigen Test	Negative
Immunologist	Antibody Test	Negative

Where is the student in their SARS CoV2 Infection?



Timeline of Viremia, Antigenemia, and Immune Response during Acute SARS-CoV2 Infection[2]

Conclusions

1. Statistically significant improvement in total score post-activity completion.
2. Statistically significant improvement on questions 2 and 3 about antigen function and what cells produce antibodies.
3. Students found provided background sufficient and the activity engaging.
4. Continued data collection needs to occur especially in 1st and 2nd year courses.

Contact Me and Resource Download

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Download the Resource!

Literature Cited

1. Mixter PF et al. Immune Literacy: a Call to Action for a System-Level Change. JMBE. 2023.
2. Colvard NB et al. The Impact of Open Educational Resources on Various Student Success Metrics. *International Journal of Teaching and Learning in Higher Education* 2018, Volume 30, Number 2, 262-276
3. Recchia G, et al. How do the UK public interpret COVID-19 test results? Comparing the impact of official information about results and reliability used in the UK, USA and New Zealand: a randomised controlled trialBMJ Open 2021;11:e047731.
4. Stranford, SA, et al. (2020). Active learning and technology approaches for teaching immunology to undergraduate students. *Frontiers in public health*, *8*, 114.
5. Drain PK. N Engl J Med 2022; 386:264-272 DOI: 10.1056/NEJMcp2117115

Results

Figure 1. Pre-Post Quiz Score Comparison

Number	Question
Q #1	DNA polymerase performs which of the following processes?
Q #2	Pieces of viruses or bacteria that can be recognized by the immune system and bound by antibodies are called…
Q #3	Antibodies are proteins that are translated from RNAs made from…
Q #4	Which of the following statements correctly relates the terms “antigen” and “antibody”?
Q #5	Changes to the sequence of a virus (a mutation) can have which of the following effects on the ability of the immune system to recognize that virus…

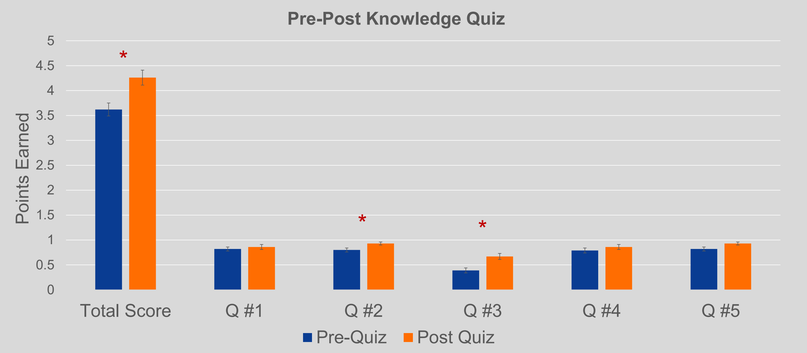

Figure 1. This graph compares scores earned from the five questions listed above. All values improved from pre-test to post-test, while the total, question 2, and question 3 were significant. The total score had a *P* value of 0.0014 (t = 3.2596), question 2 had a *P* value of 0.0277 (t= 2.241), and question 3 had a *P* value of 0.0009 (t=3.3824). The total number of students who took the pre-post quiz was n =84.

Figure 2. Student Attitudes about Background Clarity and Engagement.

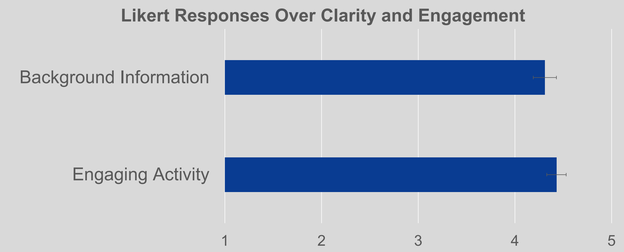

Figure 2. Student responses to the prompts “The background information provided during the activity was clear and sufficient.” and “The activity was engaging...” using a Likert scale of strongly agree (5) to strongly disagree (1). The mean responses to the two questions were 4.43±0.1 and 4.31±0.12 respectivel.

Figure 3. Post Activity Word Cloud of Student Comments