GUT PUNCHED!!!

Immunology : The Role of Gut Microbiota in Inflammatory Disease

Retha Prescod
Atlantic High School
2455 W. Atlantic Avenue
Delray Beach, Florida 33445
retha.prescod@palmbeachschools.org

Funded by The American Association of Immunologists
Mentored by Zhibin Chen, M.D., Ph.D.
Department of Microbiology and Immunology
University of Miami Miller School of Medicine
Miami, Florida 33136

Teacher Section

I. Abstract

"Can gut microbiota be altered in order to diminish the incidence of inflammatory disease?"

Inflammatory diseases such as Crohn's disease and rheumatoid arthritis negatively affect quality of life for many Americans. During my summer laboratory internship through the AAI High School Teachers Program, I tested bacterial loads in the gut of antibiotic-treated and control mice and examined correlation between certain levels of bacteria and the incidence of inflammation. Based on this experience I designed a curriculum for my students in which they will explore the relationship between the incidence of inflammatory disease and the presence of certain gut microbiota. Students will become familiar with immunological terminology, inflammatory diseases, and how diet can contribute to inflammatory pathogenicity. They will participate in an Immunology "Boot Camp" where they will receive lectures on immunological principles that help them identify bacterial loads through the use of graphs, comnf qoial ltill nr(e)4(?(o)2

report, written report, or group project. The final portion of the boot camp will end with an assessment of the project as a whole. Students will judge the boot camp on effectiveness and delivery by using a Likert Survey. The survey will also include a written portion which will help me utilize this module and make any necessary improvements.

Days9-10 Formal Assessment

hurriedly washed the dishes, collected her pay and was off to her night job with the Kings' family. Today is Sunday, Mary won't see the Smith's again until Wednesday afternoon)

Mr. Smith: That was a really good stew that Mary made, wasn't it dear?
Ms. Smith: Yes it was! I've always loved Mary's cooking.
Mr. Smith: Me too! Well let's shower and get ready for bed. (Mr. Smith motions and then states "after you….)
Narrator: They both take their showers and get bed in order to get ready for work tomorrow morning.

Later that evening at the King's home…….

Narrator: Mary is about to begin preparing dinner, but before she starts dinner she needs to use the bathroom. After she finishes, she begins dinner immediately. She takes out ground beef and begins making the meatballs for the spaghetti. Each meatball is made perfectly round, baked and then added into Mary's special pasta sauce. Dinner would be ready momentarily.

Mr. King: Johnny, make sure you eat your meatballs, Mary made them nice and big for you!
Johnny: Yes, sir.

8. Active Immunity - occurs when exposure to an antigen of a disease-causing organism triggers the immune system to produce antibodies to that particular disease. (i.e. vaccination)

9. Innate Immunity - the part of the immune system that is always ready to function. This portion is very nonspecific in

After being introduced to the vocabulary above, the students will be able to fully grasp the concept of the “Typhoid Mary” story and the purpose of upcoming hand washing lab. Through the explanation of innate and adaptive immunity, students will understand that although they may encounter pathogenic organisms daily, innate immunity protects them from getting sick and/or displaying physical symptoms of fighting illness.

Typhoid Mary Follow-Up Lab Activity

consumption. Current research has shown a possible correlation between inflammatory disease incidence and a change in gut microbiota. (http://www.nature.com/nri/journal/v9/n5/abs/nri2515.html)

Furthermore, the promotion of probiotic use has been ever present in television commercials. A probiotic is any microorganism that maintains the natural balance of intestinal flora. Although more research is needed, perceived benefits range from maintaining cholesterol levels to controlling inflammation and infections. The benefits that are associated with probiotics has driven an increasing trend of including live bacteria in certain foods. For example, Activia the yogurt company has spent millions on advertisements, "the Activia Challenge" and a jingle in order to increase awareness of the probiotic properties. Activia contains the bacteria Bifidus regularis which boasts to increase bowel regularity after just two weeks of including it in your regular diet. Even if you haven't joined the "Activia Challenge" drugstores also have the shelves stocked with probiotic supplements that claim to help keep the digestive track in shape. I suspect that as probiotic research increases that the probiotic craze will continue and may contribute to healthier individuals as a whole.

Days V and VI: Part 2

After the discussion students should have a general understanding of the significance of gut microbiota as well as the helpful properties of probiotics. Students will create a collage which identifies the foods that may encourage the healthy growth of gut microbiota; thereby possibly lowering the incidence of disease; particularly inflammatory diseases

Post Lab –Discussion Session

After the students create their collage we will review the importance of maintaining a healthy diet to increase overall health. Students will explain their individual collages to the class. Closing questions will include:

1. Why do you think it's important to regulate intestinal flora?

Quantitative Polymerase Chain Reaction (qPCR) is the process that measures DNA amplification results as each cycle is taking place. Scientists use both of these processes as a way of “counting” gene expression.

Gel electrophoresis is a method for separation and analysis of macromolecules (DNA, RNA, and proteins) and their fragments, based on their size and charge. It is used in clinical chemistry to separate proteins by charge and/or size (IEF agarose, essentially size independent) and in biochemistry and molecular biology to separate a mixed population of DNA and RNA fragments by length, to estimate the size of DNA and RNA fragments or to separate proteins by charge.[1] www.wikepedia.com

Nucleic acid molecules are separated by applying an electric field to move the negatively charged molecules through an agarose matrix. Shorter molecules move faster and migrate farther than longer ones because shorter molecules migrate more easily through the pores of the gel. After a brief overview of the techniques above, an explanation of how the techniques were utilized in my summer research experience is briefly highlighted.

During my summer experience in the lab we amplified 2 genes. First we amplified the beta-casein gene which was used as a reference of comparison for amplification. Secondly, we quantified gene numbers for 16s rRNA that are specific for different types of bacteria to determine the bacterial load in the body. After amplification of these genes ran a gel electrophoresis to verify the amplification of the correct genes.

qPCR for eukaryotic genomic DNA control, of the beta-casein gene.

We utilized PCR for the detection of inflammatory pathogens in control vs. experimental mice.

qPCR for total bacterial 16s rRNA gene for a control animal (left lines) and an experimental animal.

qPCR for Helicobacterial16s rRNA gene for a control animal (left lines) and an experimental animal

1. Plasmid Vector DNA added Add DNA Sample onto Agarose Gel DNA Bands will Separated by size Dye Binds to DNA base pairs DNA bands are exposed under UV light.

Days IX and X

For this portion of the curriculum I will use a differentiated instruction model which will meet their academic needs and allow them to showcase their knowledge in a way that makes them comfortable. As a result of this

II. Post Boot Camp - Likert Scale Survey

Answer the following questions on a scale by circling the appropriate description below.

1. The lesson helped me learn more about basic immunological principles.
   1 – Strongly Agree 2 - Agree 3 - Disagree 4 - Strongly Disagree

2. The lesson was delivered in a manner that differentiated instruction for struggling learners.
   1 – Strongly Agree 2 - Agree 3 - Disagree 4 - Strongly Disagree

3. The lesson included activities that helped create a better understanding of laboratory principles.
   1 – Strongly Agree 2 - Agree 3 - Disagree 4 - Strongly Disagree

4. The lesson adequately prepared me to understand the application of biomedical technology in other professions.
   1 – Strongly Agree 2 - Agree 3 - Disagree 4 - Strongly Disagree

5. The lesson got me interested in the field of immunology and disease prevention.
   1 – Strongly Agree 2 - Agree 3 - Disagree 4 - Strongly Disagree

Classroom Discussion – Reflection Questions

1. What was the purpose of this lesson?
2. What did you learn from this lesson that you didn't know before?
3. How could this lesson have been improved?
4. How can this lesson influence you to make healthier choices when choosing foods to eat knowing that diet contributes to a change in intestinal flora?
5. Based on what you learned, do you think that you can "influence" your immune system to protect you from disease?

References

Note : Numbers 8-12 contain the images relating to the pictures in the showcase.

1. Youtube.com (Video: The Sneeze: How Germs are Spread)
2. http://www.dnalc.org/view/15475-The-cycles-of-the-polymerase-chain-reaction-PCR-3D-animation-with-no-audio.html (PCR Animation)
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6. http://missinglink.ucsf.edu/lm/immunology_module/prologue/objectives/obj02.html
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