CMASTE
Centre for Mathematics, Science, and Technology Education

GlycoNet

UNIVERSITY OF ALBERTA
FACULTY OF EDUCATION

CAREER CONNECTION:

SACHIKO SATO, Ph.D., RESEARCH SCIENTIST IN GLYCOBIOLOGY

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Educational objectives
This lesson plan falls within the “Personal and Career Planning” and the “Environmental Awareness and Consumer Rights and Responsibilities” theme of the Broad Areas of Learning (QEP, Ministry of Quebec). The objective of this activity is to present science and technology students (Secondary 3, 4, and EST) or chemistry students (Secondary 5) with the opportunity to learn about the field of glycomic from Université Laval researcher Dr. Sachiko Sato. Dr. Sato presents her career path and research interests through an interview. Watch the interview here: https://youtu.be/cdLn3ab0kPs

Target class			
	Cycle and year: 2nd cycle 1st and 2nd year Chemistry		Timing: Near the month of November	

Time devoted to the task
1 period of 40 minutes

Activity type
■ Career connection

Introduction
In the Quebec education system, Cegep admission applications are made before March 1 to begin in the fall term. Therefore, this activity is best carried out at the beginning of the year for students taking the chemistry course in Secondary 5. The objective is to present career opportunities in science and technology to high school students. By viewing the interview and responding to the questions, students will realize that there are many steps to becoming a science researcher. Students will also be introduced to the study of glycomics, a relatively new and promising field of research that draws from concepts in both chemistry and biology. To provide context for Dr. Sato’s work, and to introduce the field of glycomics, the teacher will begin the lesson by showing the following video produced by the Canadian Glycomics Network: https://www.youtube.com/watch?v=CQGEGIoqTpQ

Targeted competencies		
□ CD2	Makes the most of his/her knowledge of science and technology ❑ Puts scientific or technological issues in context (2nd cycle) ❑ Understands the scientific principles underlying the issue (2nd cycle) ❑ Forms an opinion about the issue (2nd cycle S&T)	❑ Appropriate use of scientific and technological concepts, laws, models and theories ❑ Suitable justification of explanations, solutions, decisions or opinions (2nd cycle S&T)
□ CD3	Communicates in the languages used in science and technology ❑ Participates in exchanging scientific and technological information ❑ Interprets scientific and technological messages* ❑ Produces and shares scientific and technological messages*	❑ Accurate interpretation of scientific and technological messages* ❑ Appropriate production or sharing of scientific and technological messages*

Cross-curricular competencies		
Competency 3	Competency 7	Competency 9
Exercises critical judgement	Achieves his/her potential	Becomes familiar with various modes of communication
		Uses various modes of communication

Students must answer several questions about Dr. Sato's interview. In doing so, students will realize that career paths are seldom linear and often require many steps. They should realize that in science, as in many fields, there are many unanswered questions and that taking risks is required to be competitive.

BAL and focuses of development		
□ Personal and career planning ❑ familiarity with the world of work, social roles, and occupations and trades	□ Health and well-being ❑ Self-awareness and awareness of basic needs ❑ Awareness of the impact of his/her choices on health and well-being	□ Environmental awareness and consumer rights and responsibilities ❑ Construction of a viable environment based on sustainable development ❑ Responsible use of goods and services ❑ Awareness of social, economic, and ethical aspects of consumption

One of the educational aims of this lesson is to help students comprehend the competitive nature of the job market, as well as its possibilities. This activity emphasizes careers in glycomics, a relatively new field of research that is helping to advance the discovery of new drugs and therapies against infectious diseases. New discoveries in this area have the potential to provide new, environmentally friendlier synthetic routes to important molecules.

Compulsory concepts	
■ The living world	■ The technological world

Cultural references

- The pharmaceutical industry
- Career possibilities
- The Québec health care system

Prerequisite knowledge

No prerequisite knowledge is required. However, the science teacher must be familiar with glycomics and be able to make connections to the science curriculum

Compulsory concepts	Optional concepts
Compulsory concepts developed in this activity, listed by concept	Optional concepts developed in this activity, listed by concept
English as a second language **Career choice exploration** **Living world (science and technology)** - Lymphatic system - Vaccination - The cell - Macromolecules (proteins, carbohydrates, and lipids)	

Intradisciplinary or interdisciplinary links
Personal and professional development Mathematics (percentage)

Textbook resources
Observation Manual (2nd year of the 1st cycle, the environment) Observation Manual (2nd year of the 2nd cycle, the environment)

Internet resources:
THE GLYCONET STORY https://www.youtube.com/watch?v=CQGEGIoqTpQ

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Lesson Plan

Career Connection: Dr. Sachiko Sato

(CD2 and CD3), (CT3, 7 and 9): Exercise critical judgement

Lesson Preparation
Activity 1 (10 minutes) First, the teacher presents a very short video about glycomics in order to introduce students to this field of research.
Lesson Activities
Activity 2 (15 minutes) Next, the students will watch an interview with glycobiology researcher Sachiko Sato. It is recommended that students use a personal computer, an electronic tablet, or their cell phone for viewing the video. In this way, students can go back as many times as they want to re-watch segments of the interview. This is especially valuable for English language learners, as the interview is in English. Students will then be asked to answer various questions that relate to this interview.
Conclusion & Reflection
Activity 3 (15 minutes) In a group, the teacher gives students formative feedback on their answers to the questions, elaborating as appropriate. One area of elaboration should be the post-secondary education system. The teacher can explain to students that after high school, a student interested in a science research career must undertake a Cégep natural science program in order to pursue a university science degree (e.g. chemistry, biology, microbiology, etc.). Following an undergraduate degree, students may then choose to pursue a master's or a doctoral degree. In most cases, students who complete their doctoral studies will pursue post-doctoral research, and may one day become professor-researchers at a university or work in a research institute. Like all fields, researchers interested in the field of infectious diseases must pursue unanswered questions, in order to publish original research and draw in funding. The teacher continues to discuss students' questions regarding Dr. Sato's interview and careers in science. Glycomics can be mentioned as one example of a new and dynamic field of research, which could lead to a satisfying career for students interested in health research.

Student Document

Dr. Sachiko Sato Interview Questions

Introduction

Most research conducted today is in English – it is the language spoken in many labs around the world, and it is the language most commonly used for scientific publications. In this activity you will learn more about glycomics, a relatively new field of research that investigates the roles that carbohydrate molecules play in the body and their role in diseases. You will also meet Dr. Sachiko Sato, a glycomics researcher, and learn about the years of preparation and work that she has devoted to understanding and treating infectious diseases.

Section 1: What is your personal, academic, and professional background?

1- Where does Dr. Sachiko Sato work?

At l'Université Laval, Quebec City.

2- Describe her position.

She is a professor at the faculty of medicine at the University Laval. She is also the principal investigator in glycobiology and bioimaging.

3- What degrees did she obtain?

Dr. Sato first obtained a bachelor's degree in pharmaceutical science from Chiba University, Japan.

After receiving her degree, she worked as a research assistant for a pharmaceutical company.

Later, she came back to academia in order to complete a Ph.D. in glycoscience near London, England.

4- What did Dr. Sato do after obtaining her Ph.D?

She completed a postdoctoral fellowship at Stanford University in the United States.

Finally, she accepted a professor position in the Faculty of Medicine at Université Laval, in Quebec city.

Section 2: What are your current research projects?

5- Which biopolymer, in which Dr. Sato is interested, plays a role in the regulation of the immune system in the infectious diseases?

Glycans (sugars).

6- What are the two infectious diseases on which Dr. Sato works currently?

HIV infections and fungal infections.

7- Describe briefly the two current projects that Dr. Sato is working on.

The first project aims to understand the role of galectins, proteins that bind to specific biopolymers (sugars), and play an important role in our immune system against an infection.

The second project's goal is to develop a single cell analysis system using a microscope.

Section 3 - Among your achievement, which one makes you particularly proud?

8- Explain one of the two achievements described by Dr. Sato.

Achievement no. 1

> *Her first achievement was to find out how oligosaccharides (expressed outside the cell) and proteins, called galectins (expressed inside the cell), communicate. Some of their preliminary findings suggest that this interaction is very important for the innate immune system in order to warn the body about an infection.*

Achievement no. 2

> *Her second achievement was to find out if it was possible to correct a genetic disease using a drug. The genetic disease she was working on was cystic fibrosis. Twenty years after this finding there are now some drugs called chemical chaperones or chemical correctors that allow changes to the environment of the cells in order to correct the problem caused by the mutation in the genes.*

Section 4 – Why are you interested in the use of glycans in infectious disease?

9- Are glycans found in the human body much different than those found in microorganisms?

The glycans found in microorganism are quite different from our glycans (found in the cells of the human body). We have many proteins that can recognize microbial glycans.

10- What is the role of glycans in regards to infectious diseases?

Microbial glycans can be detected by proteins in our bodies, such as galectins, and signal to our immune system that an infectious disease is present. Most of the time those proteins and our immune systems protect us from an infectious disease, but sometimes pathogens find a way to establish an infection in our bodies.

Section 5- What would you recommend to a student interested to work in your field of research?

11- Are the roles of glycans and their interactions with proteins well studied?

The interactions between the cell membrane proteins and the glycans attached to them have not been well studied. It turns out that the sugars attached to these proteins are not just a sweet decoration but can also independently regulate the protein function.

12- Which recent developments are very promising in the field of glycobiology?

There have been recent and very promising developments in analysis methods in the field of glycobiology. These developments will help researchers to discover new interactions, factors, or treatments to fight off infectious diseases.