**Teaching the concept of cell membrane and Transport**

**Back ground information of Cell membrane and Transport:**

The contents of cell are enclosed in a limiting membrane, called plasma membrane. The plasma membrane is the dynamic barrier which regulates exchange of materials between the cell interior and its environment through selective permeability receives signals, coordinates molecular interactions at the surface such as a cell recognition, adhesion and communication.

Fluid-Mosaic model – Recently Singer and Nicolson (1972) proposed most convincing model. According to this model, in most of the membranes lipids are in the form of fluid bi-layer .The membrane proteins, which are globular in nature, are partially or wholly embedded in the lipid bilayer. Lipids which are mostly glycolipid and phospholipid in nature, when suspended in water, give rise to aggregates of various shapes forming micellae. These aggregates preserve the hydrophilic and hydrophobic properties of phospholipids, but the hydrophobic regions are internally arranged in such a way that the water is expelled, where as the hydrophilic region remains in contact with the outer aquatic phase. The membrane proteins are two type peripheral and integral. Peripheral superficially located, where as integral protein penetrates into interior of membrane along with fatty acid chain.

Membrane Transport- Cell exchange both matter and energy between themselves and the environment through the plasma membrane. The membrane is a living entity and allows continuous molecular traffic across it and exchange of matter is random but need-based. Generally the molecules can diffuse across the membrane down the concentration gradient , however the rate of diffusion depend on size of the molecule, type of charge and degree of lipid solubility. Mainly two types of transport are there-Passive transport, because of concentration gradient and Active transport, against gradient in expense of energy. Another type of transport is Membrane assist transport-endocytosis and exocytosis.

**Advance preparation / Teaching Ideas.**

Students’ should have a prior knowledge of Eukaryotic cell organelles and its function. To teach the cell organelles and its function, a video showing the cell organelles and function will be use full, especially the structure and function of cell membrane. To show this video teacher need a computer, internet (YouTube fluid mosaic model and transport) access connected to projector to display video on overhead screen.

Once the video shown, the teacher would take the students to a lab, where the experiment had set up for osmosis with potatoes in salt and plain water. Beside the dishes should have clearly labeled instruction about the type of water (salty/plain) time, amount of salt added etc. Teacher can ask students to observe the potatoes and to note down the appearance. Ask them to do the same after 20 minutes, and then compare the change in potatoes. They use an “Inquiry based” approach to learn independently the concept. A virtual lab for active and passive transport as well as Fluid mosaic model also will fortify their learning.

After the virtual lab completed teacher would engage the students in Role play for demonstrating Fluid Mosaic model. For this role-play, the model displayed on over head screen will be helpful. Students will get an idea where they have to stand according to the model. Prior to demonstration teacher selects 8 pairs of students to act as Phospholipids bilayer. Another 2 students are assigned as integral protein and other two as peripheral proteins. Teacher would also post the structure and functions of phopholip bilayer, integral and peripheral proteins. Prior to demonstration it is advisable to check with students understanding about their role and function. If required, teacher explains again. (Good suggestions from students are also acceptable)

To begin the activity 4 pairs of students with a band tide on their head stands facing each other with extended their both arms to each other (towards centre).By leaving a small gap, another 4 pairs of students stand in a same manner. The band tied on their head represents the polar head and the extended arm towards the centre represents the non-polar tails. Now two students (assigned as integral protein) stand inside the gap facing each other without extending their arms. These students represent the integral protein (inserted protein) and the gap between them for the passage of molecules. Students who represent peripheral proteins stand outside back to back with different color flag, as they are surface markers to identify lipids and proteins. Now another set of students, who represents ions and molecules, can pass across through the channel until both side have equal number of students.(demonstrating passive transport and Dynamic equilibrium). Another 3 students holding their hands together(represent ATP) to attach to a student who is represents the ion pump and they splits as 2+1 (2-ADP & 1 is P) which in turn help transport against concentration gradient(demonstrating active transport).

After teaching the concept of cell membrane and transport, teacher gives a topic for debate. Topic would be “Insight into stem cell Technology”. (Pros and cons) and topic for presentation (Technological advances in cell Biology)

**Curriculum Expectation Addressed (Grade 12: Biochemistry)**

B1.2 Evaluate, on the basis of research, some advances in cellular biology and related Technological

Applications

B2.2 plan and conduct an investigation to demonstrate the movement of substances across a membrane (e.g., the effects of salt water and distilled water on a potato)

B3.6 describe the structure of cell membranes according to the fluid mosaic model, and explain the dynamics of passive transport, facilitated diffusion, and the movement of large particles across the cell membrane by the processes of endocytosis and exocytosis.

**Lesson Sequence:** As it is the structure of the plasma membrane and the transport across it, requires number of classes to explain different modes of transport across the membrane. The following is the outline for the lesson how it would be organized to teach the concept.

Lesson 1: Cell membrane: an overview

Structure and functions of cell membrane

Lesson2: Fluid mosaic Model

Features of Fluid mosaic model

Lesson3: Passive transport

Transport by diffusion, osmosis and Facilitated diffusion

Lesson4: Active Transport

Primary active transport and secondary active transport

Lesson5: Membrane assist Transport

Endocytosis and exocytosis

Lesson 6: Advances in cellular biology

A presentation on topic

**Potential student difficulties and possible solutions:**

Since fluid mosaic model is an abstract concept, student may find it as difficult to understand this structure. The displaying of this model on overhead projector helps the student to understand the structure and the role-play will help them to learn this concept thoroughly. They get a clear idea about bi-lipid layer, integral protein and peripheral protein and their functions

Students may confuse with osmosis, diffusion and facilitated diffusion. The demonstration of lab will help them to differentiate between osmosis and diffusion. A T chart helps student to organize the difference between osmosis and diffusion. A mnemonics may help to differentiate between different types of passive transport

Different types of active transport is little bit tough concept to understand. Role play certain extend will help to understand the role of ATP, then an audiovisual presentation of active transport make the idea clear. Finally, a flow chart with pictures showing the steps of primary and secondary transport makes the concept clear. For endocytosis can use the example of amoebae capturing food and exocytosis with waste disposal. An anchor chart will help to differentiate between endocytosis and exocytosis

**Differentiated Assessment:**

Students will be involved involves in variety of different assessment throughout the unit including diagnostic, formative and summative assessment. Diagnostic assessment in the form of mini quiz which incorporate variety of learning styles and background knowledge included. Fluid mosaic model of membrane and transport across the membrane as culminate task assessment help the student to select their own assessment activity. This activities are targeted towards students multiple intelligence. A bio remix song about different types of transport (musical) a chart or model for active transport (visual) a poem about plasma membrane (Linguistic) a 3D model of fluid mosaic model with students (Kinesthetic) a debate on stem cell technology (interpersonal) a presentation on Technological advances in cell biology (intrapersonal) and comparison of osmosis and diffusion is( logical) to address variety of learning needs. A summative unit test addressing the skills from all areas of achievement chart would be used to evaluate students understanding on cell membrane and transport across the membrane. Formative assessment will be during the debate, class discussion, role-play, lab activity and presentation in an effort to support student learning and to guide instructional strategies.

**Applications and Societal issues/ Implications:**

A debate on stem cell technology students will discuss the pros and cons of stem cell technology. Especially their importance in medical field (see reference) and the issues related to it. They learn about advancement in cell technology through research papers and on line learning. A presentation on this topic helps them to gain a good knowledge about this technology and how it is helpful to human kind.

**Annotated References/ Annotated Internet Address:**

McGraw-Hill Ryerson – Grade 12 Biology

This text book serves as an organizational tool for the lesson sequence part for this assignment. This helps for the role play of Fluid mosaic model, Active and Passive transport. This book helps to se the questions and to evaluate advances in cellular biology. It helps to set the lab questions.

Cell functions by Jennifer viegas

This book give an idea to teach about the membrane and functions. This book provides illustrated pictures with description. Gives a give idea about the nature and functions of each cell organelles

Cell and Molecular Biology- S.C. Rastogi-India

This book gives a detailed structure for fluid mosaic model, active and passive transport. Fluid mosaic model is an abstract concept for students. This book clearly explains about bilipidlayer and integral proteins, helps in role-play.

<http://www.cellsalive.com/cells/cell_model.htm->

This is the website, where students can learn about different cell organelles and their functions. An interactive animation of cell organelles help student to understand the concept better.

<http://www.youtube.com/watch?v=LfjjuWVqhsQ>

The above mentioned site gives a clear idea about Fluid mosaic model and transport.

<http://www.youtube.com/watch?v=y3LU9OC2oNA>

Virtual lab for osmosis and diffusion.

<http://www.sciencemag.org/site/products/cell_120205.xhtml>

<http://www.nlm.nih.gov/medlineplus/stemcells.html>

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1129084/>

These on line articles give information for Stem cell technology and their application in medical fields. This will be helpful for students for their presentation and debate activity.