iGEM 2024
Team: PLKLFC

Biotechnology Lesson Curriculum

1. Basic information:

- Total lesson time: 3 hours
- Targeted students: S1-S3 students (Year 7-Year 9 students)

2. Background:

- Biotechnology is one of the most important fields in Science. Since 2004, our school has introduced a school-based biotechnology curriculum in junior forms (S1-S3). Some of the basic concepts about cancer and genes have also been included in the curriculum. However, we would like to allow our schoolmates have a chance to understand more about cancer, in order to let them raise awareness of cancer, especially prostate cancer. Moreover, we would like to cultivate their talents so that they can engage in the medical industry and help humans to fight against cancer in the future.

3. Lesson Plan for S1 students

3.1 Major Aim of lesson for S1 Students

- To understand the basic concept of gene, protein and cancer

3.2 Lesson contents

- Content of Lesson 1 (S1 Students)
  - Aim: To let students have a brief understanding of gene and transcription

Lesson name	Content	Suggested time (min)
1.1 Gene and organisms	- The basic knowledge of gene - The concept of DNA is the basic genetic materials of organisms and the function of DNA	15
1.2 Experiment	- Carry out the experiment of isolating DNA from bananas. - The waiting time (~10 minutes) will be used to talk about transcription	40
1.3 Homework	- Briefing of homework poster	5
	Total Lesson Time	60

- Content of Lesson 2 (S1 Students)
  - Aim: To let students to have an idea of gene expression and cancer

Lesson name	Content	Suggested time (min)
2.1 Gene Expression	- The process of gene expression	15

2.2 Cancer	- The basic knowledge of cancer
	  - Risk factors of cancer
	  - The concept of mutation
	  - The difference between cancer cell and normal cell
		20

2.3 Game 2	- Composing a gene
	  - Students will answer a few questions based on their knowledge
	  - They can compose a mRNA sequence based on the given gene sequence
		25

Total Lesson Time	60

- Content of Lesson 3 (S1 Students)
  - Aim: To let students to have a basic understanding of detecting and curing cancer

Lesson name	Content	Suggested time (min)
3.1 Game 1	- Intro to killer T cell and how cancer cell prevent themselves being killed by immune system - Allow students to know how our body defence against cancer cells in a cellular level through an online game - The game is on our wiki	30
3.2 Cancer treatments	- The traditional methods of killing cancer cell	15
3.3 Our project	- A basic concept of how our team develop a tool to kill cancer - To let students know that scientists are developing more safe and convenient ways to detect cancer	
3.4 Debating	- Time for students to debate the advantage and disadvantage of the traditional method and the new methods	10+5
	Total Lesson Time	60

4. Lesson Plan for S2 students

4.1 Major Aim of lesson for S2 Students

- To understand the concept of gene, protein and cancer
- To allow students understand how cancer-related research is carried out by plasmid and GFP

4.2 Lesson contents

- Content of Lesson 1 (S2 Students)
    - Aim: To let students have a brief understanding of gene, protein

Lesson name	Content	Suggested time (min)
1.1 Gene and organisms	- The basic knowledge of gene and protein - The concept of DNA is the basic genetic materials of organisms and the function of DNA	15
1.2 Gene Expression and protein	- The process of gene expression - The basic concept of protein - Function of protein	15

1.3 Game 2	- Composing a gene
	  - Students will answer a few questions based on their knowledge
	  - They can compose a amino acid sequence based on the given gene sequence
		25

1.4 Homework	- Briefing of homework poster	5
	Total Lesson Time	60

- Content of Lesson 2 (S2 Students)
    - Aim: To let students to have an idea of cancer

Lesson name	Content	Suggested time (min)

2.1 Cancer	- The basic knowledge of cancer
	  - The cell division of cancer cell
	  - The concept of mutation
		25

	- The difference between cancer cell and normal cell - The concept of oncogene and tumour suppressor gene	
2.2 Formation and killing cancer cells	- The process of formation of cancer cells - The current methods of treating cancer and their characteristics	
2.3 Debating	- Time for students to debate the advantage and disadvantage of the traditional method and the new methods	10
2.4 Game 1	- Allow students to know how our body defence against cancer cells in a cellular level through an online game - The game is on our wiki	25
	Total Lesson Time	60

- Content of Lesson 3 (S2 Students)
  - Aim:
    1. To let students understand what is plasmid and how it is used in killing cancer cells
    2. To let students understand how GFP is used in research

Lesson name	Content	Suggested time (min)
3.1 Experiment	- Carry out the experiment of bacterial transformation	60 (include a waiting time of around 30 minutes)
3.2 Plasmid and treatment	- The concept of plasmid and how it is used in the modern society for treating cancers - How it is used in our project	15
3.3 GFP	- A brief introduction of GFP and how it is used in modern society as a research tool	15
	Total Lesson Time	60

5. Lesson Plan for S3 students

5.1 Major Aim of lesson for S3 Students

- To understand how cancer-related scientific research is carried out in the modern world

5.2 Lesson contents

- Content of Lesson 1 (S3 Students)
  - Aim: To have a revision on the foundation knowledge of cancer

Lesson name	Content	Suggested time (min)
1.1 Cancer	- A basic revision on cancer, protein and gene	15
1.2 Game 1	- Allow students to know how our body defence against cancer cells in a cellular level through an online game - The game is on our wiki	15

1.3 Game 2	- Composing a gene
	  - Students will answer a few questions based on their knowledge
	  - They can compose a amino acid sequence based on the given gene sequence
		30

1.4 Homework	- Briefing of homework poster	5
	Total Lesson Time	60

- Content of Lesson 2 (S3 Students)
  - Aim: To have a lesson on how experiment is designed by scientists

Lesson name	Content	Suggested time (min)
2.1 Designing an experiment	- A brief introduction on how to design a valid and reliable experiment - A case study on the experiment that we are going to conduct in our research is included	45
2.2 Our Project	- Talk about how the iGEM team carry out fair test during the wet lab procedures	15
	Total Lesson Time	60

- Content of Lesson 3 (S3 Students)
    - Aim: To let students understand how can scientists build a gene in a real research project

Lesson name	Content	Suggested time (min)
3.1 Restriction enzyme and gel electroph-oresis	- The concept of restriction enzyme - The reason of having PCR - The principle of gel electrophoresis and the concept of banding - Gel electrophoresis may be demonstrated in a video	20
3.2 Game 3	- A game to allow students to understand gel electrophoresis in a graphical way	25
3.3 Poster presentation	- Time for students to present their poster	15
	Total Lesson Time	60

Remarks: Poster Requirements:

- Size: A5
- Format: Draw on paper/ draw on electronic devices (print out)
    - Drawing/ diagrams must be included
    - No paragraphs are allowed on the poster (only have titles and subheadings)
    - Need to be coloured (black and white is not allowed)
- Questions

  F1: Life of prostate cancer
    - From no cancer -> have cancer -> to be cured

  F2: Health problems of getting prostate cancer

  F3: Curing prostate cancer
    - Traditional methods VS New methods