Lesson plan 1
Title : Understanding meiosis (Chromosomes and DNA)
: A coupled inquiry learning based on 5E

Subject : Biology
Time : 60 minutes
Grade Level : Undergraduate students (pre-service teachers)

Learning Outcomes :
At the end of the lesson, a student is able to :
1. Identify how the human chromosomes are arranged in a karyotype
2. Differentiate between chromosomes, DNA, genes and alleles
3. State the diploid number and haploid number for a human karyotype

Materials :
1. Preserved specimens of a fish, a bat, a rat and a plant
2. Laptop
3. Slide for lesson objective, questions and teacher direct instruction
4. Chromosome worksheet for the students
5. Scissors and glue
6. Nova video – Extract your DNA
7. 500ml bottled water
8. 3 x clear plastic cups or glasses
9. Clear washing up liquid
10. 1 tbsp table salt
11. 100 ml isopropyl alcohol
12. Blue food colouring
13. 100 ml beaker
14. 100 ml measuring cylinder
15. Dropper

1. Invitation to inquiry (5-10min.) / Engagement
   a. The teacher places preserved specimens of a fish, a bat, a rat and a plant on the table in front of the lab.
   b. Students are asked – what gives an organism its characteristics? What makes an organism the way it is? – *Genetic information / chromosomes / DNA determines the characteristics of an organism*
   c. Students are given 1 minute to think and write down their ideas on a piece of paper.
   d. The teacher then asks the students to share their ideas and type it into the word document on her laptop so that everyone may see.

2. Teacher – initiated guided inquiry (20-25min.) / Exploration and Explanation
   a. The teacher explains that the students are now going to work in pair.
   b. A chromosome worksheet with texts, instructions for the normal human karyotype matching activity and questions are given to each pair of students.
   c. Scissors and glue are provided to each pair of students.
   d. Students read the text and follow the instructions on the worksheet. After completing the activity, they answer the questions on the worksheet.
   e. The teacher went around the classroom checking on the students' progress.
   f. Each pair presents their answer after they have completed the last part of the worksheet.
   g. Teacher ask the students these questions after their answer discussion :

      i. Why did you say that there are ___ pairs of chromosomes but there are ____ sets of chromosomes in the normal human karyotype?
      - there are 23 pairs of chromosomes because 22 are autosomes or somatic cells (body cells) and 1 pair is sex chromosome. There are 46 sets of chromosomes because each 23 pair consists of 1 set chromosome from father and 1 set chromosome from mother.

ii. Do you think that the homologous chromosomes are similar to each other? Why?

- *The homologous chromosomes are similar in terms of size, centromere location and banding pattern. But their genetic content or alleles may be different.*

iii. What is the difference between a homologous chromosome and a sister chromatid?

- *A homologous chromosome is a pair of chromosome. Each of the homologous chromosome undergoes replication or duplication and becomes sister chromatid.*

h. If students cannot answer the questions and feels unsure of their answer, the teacher may ask them to Google for information so that they will be able to give a clear explanation. The teacher does not provide the answers but ask questions that trigger students to think and come to the answers.

3. Explore on your own (20-25min.) / Exploration and Explanation

a. Groups are given 3 minutes to list down claims or things that they think they now know about chromosomes.
b. The teacher ask this question:
   i. What is the function of the chromosome?
   - to carry genetic information (in the form of DNA – which stores codes for protein in the form of genes – which exists in different forms of alleles)

   ii. How are the genetic information coded into the chromosomes?
   - *They are coded in the DNA as genes (nucleotides with paired bases A-T, G-C)*

   iii. How does genetic information or DNA get passed down from a parent to their child?
   - *A copy of the parent's DNA is carried by their gametes – sperm and ovum each carrying 23 sets of chromosomes. In fertilisation, a zygote with 46 sets of chromosomes is produced.*

c. Students are given 30 seconds to think before eliciting their responses.
d. Their responses are typed onto a word sheet which is displayed on the screen.
e. If the students are not able to clarify their answers, the teacher may ask them to Google for information.
f. The teacher informed that the students are now going to extract their DNA by using the materials on the table.
g. They are instructed to find out the procedures of DNA extractions based on the materials provided to them.
h. Their procedures are compared with the procedure shown in a video of how to extract DNA.
i. Students carry out the DNA extraction activity in their groups.
j. Students are given 3 minutes to individually list what else are they interested to find out about chromosomes, which is searchable on the internet.
k. Groups compile their list and choose one question to be investigated.
l. These questions are typed onto the slide for record and the investigation will be carried out in the next lesson.