At the end of this course students should be able to

1. **Apply** the fundamental concepts of molecular biology in order to clone a DNA fragment (guide RNA).

- Lesson 1: Describe the fundamental concepts of molecular biology, including Gene structure, replication, transcription, and translation.
    - ☐ Practical 1: Introduce databases, organisms, download sequences. Select guide RNAs; Golden Gate Cloning *in silico*, Primer Design

- Lesson 2: Demonstrate knowledge of the CRISPR-Cas9 system and its components (in bacteria) and explain how CRISPR-Cas9 is used as a gene-editing tool in biotechnology.

- Lesson 3: Apply principles of Golden Gate Cloning, Type 2 restriction enzymes and Polymerase Chain reaction to clone a guide RNA.
    - ☐ Practical 2: Setup PCR for gRNAs amplification
    - ☐ Practical 5: Gel run and cloning setup
    - ☐ Practical 7: Plasmid extraction and sequencing

2. **Define** the CRISPR-Cas9 system and its components focusing on its mechanisms including the roles of guide RNAs, Cas9 proteins, and target DNA recognition.

- Lesson 2: Demonstrate knowledge of the CRISPR-Cas9 system and its components (in bacteria) and explain how CRISPR-Cas9 is used as a gene-editing tool in biotechnology.
    - ☐ Practical 3: Arabidopsis WT and mutant seed sterilization, transfer to plates
    - ☐ Practical 4: Transfer Arabidopsis WT and mutant seed to square plates
    - ☐ Practical 8: Phenotypic distinction between WT and mutants, DNA isolation, sequencing
    - ☐ Practical 9: PCR Amplification target and off target genes
    - ☐ Practical 10: Identify mutations in genes by comparing sequences

- Lesson 4: Identify the different roles of each component required for CRISPR-Cas9, including the roles of guide RNAs, Cas9 proteins, and target DNA recognition.

3. **Appraise** the complexity of CRISPR-Cas9 with other gene editing techniques such as TALENs and ZFNs.

- Lesson 5: Examine the complications of gene editing technologies such as off targets, mosaics.

- Lesson 6: Compare and contrast CRISPR-Cas9 with other gene editing techniques, such as TALENs and ZFNs.

4. Evaluate CRISPR-cas9 delivery in plants and animals to differentiate between germline and somatic editing.

- Lesson 7: Assess CRISPR-cas9 Delivery in Plants and Animals to cause germline vs somatic editing
    - ☐ Practical 6: Competent cell preparation and bacterial transformation
    - ☐ Practical 11: Agrobacterium mediated transformation
    - ☐ Practical 12: Floral dip method of transformation

5. **Communicate** scientific findings related to CRISPR-Cas9 research.

- Lesson 12: Analyze and critique scientific literature related to CRISPR-Cas9 research, including experimental design, results, and conclusions.

- Lesson 10: **Develop and articulate** the ethical implications of gene editing and the regulatory frameworks governing its use

6. **Assess** various applications of CRISPR-Cas9 technology in fundamental plant research, and plant and animal biotechnology.

- Lesson 8: Effectively communicate scientific findings related to CRISPR-Cas9 research through written reports and oral presentations.

- Lesson 9: Assess various applications of CRISPR-Cas9 technology in fundamental plant Research, and plant and animal biotechnology.
    - ☐ Practical 13: Meet a scientist

7. **Judge** the pro's and con's of the ethical guidelines set by governing bodies on CRISPR use in order to communicate the use of CRISPR in marketable businesses and public communication.

- Lesson 10: **Develop and articulate** the ethical implications of gene editing and the regulatory frameworks governing its use

- Lesson 11: Discuss the use of CRISPR in marketable business

8. Practical: **Demonstrate** practical application of mediating a gene edit.
    All practical demonstrations