**Study Guide: Transgenics and editing**

***Reading assignments:*** Ye et al.\_ Golden Rice Full paper.

1. Explain why transgenic plants are created – considering both commercial and research applications.
2. Explain the basis of Roundup Ready herbicide resistance, including source of the gene and general architecture of the construct. If a Roundup Ready variety has a construct using the CaMV promoter, is the gene likely to be expressed in all tissues and throughput the plant life cycle or only expressed when the herbicide is applied? What is the role of gene flow in herbicide resistance being transferred to weedy and wild crop relatives?
3. Give an example of gene flow and its consequences.
4. What are the essential elements of a transgene construct?
5. Explain the advantages and disadvantages of different types of promoters in transgenic constructs.
6. Why are selectable markers used in transgenics? Give an example of a common selectable marker.
7. What are reporter genes and how do they differ from selectable markers?
8. What are two key differences between GUS and GFP?
9. What are the two main methods for introducing a transgene and what are the benefits and disadvantages of each?
10. What is the role of a disarmed Ti plasmid in the Agrobacterium mediated transformation protocol?
11. What is a hemizygote? Explain the predicted pattern of inheritance of a transgene in an otherwise homozygous inbred diploid plant – starting with a biolistically transformed cell in a petri dish.
12. What is cisgenics and how is it different from transgenics?
13. Explain the principle of RNAi.
14. How is RNAi used in the case of the Arctic Apple?
15. Define the CRISPR and Cas9 acronyms.
16. What is concept of genome editing and how does the CRISPR technology differ from “classical transgenic technology”, e.g. agrobacterium-mediated Roundup Ready herbicide resistance?
17. If you get your dream job – as a geneticist working on your favorite plant – what is the appeal of CRISPR-Cas9 editing vs. mutagenesis by radiation or chemicals?
18. Based on [The MIT video](https://www.youtube.com/watch?v=2pp17E4E-O8) and [The Nature video](https://www.youtube.com/watch?v=4YKFw2KZA5o), answer the following questions.

Briefly explain where the system is naturally occurring and what it does in that situation.

What is meant by “gene editing”?

What are the two principal components of the CRISPR-Cas9 system and what are their roles?

How does the CRISP-Cas9 complex identify a specific target in the genome?

What type of break does Cas9 make in the host double helix, and why is this break important?

What is meant by “knocking out” a gene?

Is gene “knock out” all that CRISPR-Cas 9 can do?

Is CRISP-Cas9 really cheap and easy? Why or why not?

1. Explain the role of plant hormones in seed formation in tomato and how CRISPR-Cas9 gene editing was used to create seedless tomatoes.
2. What is a gene drive?
3. Based on [*Gene drives – The TED talk*](https://www.youtube.com/watch?v=OI_OhvOumT0) , and the CRISPR-Cas9 resources presented in the lecture slides and online resources, describe the pros and cons of implementing a transient edit in your favorite plant vs. implementing a gene drive.
4. Based on the Ye et al paper, answer the following questions:
	1. Why was Golden Rice developed?
	2. What is a key difference between Golden Rice and Roundup Ready crops in terms of the complexity of the genetic basis of the phenotype?