**Flowers, seeds, generations, and stems**

**Study guide and reading assignments**

**The numbers in front of each study question correspond to slide numbers, as presented during lecture.**

**Reading assignments:**

1. Hand Kultunow\_apomixis (Table 1)
2. Reid and Ross. Mendel. Whole paper
3. Komatsuda et al. vrs1Abstract, Introduction, and Conclusions.

1 Briefly describe two advantages and two disadvantages of sexual reproduction.

2 In the alternation of generations in angiosperms, what is meant by “n” and “2n”?

3 Compare and contrast the terms “diploid” and “polyploid”.

3 What is the difference between the “n” and the “x” in defining ploidy level

4 Which of the following is a more likely explanation for the prevalence of polyploidy in plants?

* Polyploids have more alleles and are therefore bigger, stronger, and more fit.
* Polyploids have more alleles and the alternative alleles may confer advantage at different growth stages, in different tissues, and/or under different environmental conditions.

4 What is the difference between homologous chromosomes and homoeologous chromosomes?

5 Be able to name, and identify on a diagram, three critical female reproductive structures in a perfect angiosperm flower.

6 Pollinator attraction systems are so cool, and often beautiful. Why then, do we not address them at this point in the class?

7 Be able to diagram and explain the steps between a megaspore mother cell and the 8 nuclei in an embryo sac.

8 Briefly describe the function and fate of the antipodals, the synergids, and the egg.

8 Be able to draw a general diagram of the 8-nucleate embryo sac and label the nuclei.

9 Considering the male reproductive structures in a perfect angiosperm flower, one stamen is connected to one anther, which can contain how many pollen grains?

10 What is different, in terms of the four products of meiosis, between the developing megaspores and microspores, and what implications does this have for genetic analysis?

11 If a plant is heterozygous at many loci, would it be possible for it to produce a tetrad of microspores, each with a different combination of alleles?

11 If a plant is heterozygous at many loci, would it be possible for the two sperm in a pollen grain to be genetically different?

12 What tissue is the site of pollen recognition?

12 Is there a genetic component to pollen recognition?

13 Explain how the egg can be 2n and the endosperm 3n.

13 What implications are there, in terms of the genetics of the embryo and endosperm, as to which parent is the female and which is the male?

14 Know the genetic consequences of which megaspore in the linear tetrad is the one to survive and give rise to the 8 nuclei in the embryo sac.

15 - 18 Explain how a seed can be a genetic mosaic, in terms of which alleles are represented (e.g. maternal, paternal, or maternal + paternal).

19 Explain why the % heterozygosity at a locus decreases by half with each generation of selfing and how this relates to inbreeding depression.

20 What is the special type of backcross called that involves the homozygous recessive parent as the recurrent parent?

21 How can doubled haploids be at the F infinity generation?

22 Explain why the statement in this slide is of critical importance for genetic analysis.

23 How does degree of homozygosity relate to pollination biology?

24 Explain why the points in this slide is of critical importance for genetic analysis.

25 Be able to complete a monohybrid Punnett square for the consequences of selfing a heterozygote.

26 If Mendelian analysis is based on using progeny to understand parents, why are parents usually included in genotyping/phenotyping analyses?

27 Explain why frequency distributions for quantitative and qualitative traits will be different.

28 In terms of expected inheritance, what is the difference between an autosomal and a sex-linked trait?

29 Why do chloroplast inheritance patterns usually not follow Mendelian expectations?

29 If a trait you are interested in is controlled by a gene in the mitochondrion, will it matter which parent you use as the female in a cross?

29 What about those other genomes: chloroplasts and mitochondria. From what did they evolve?

30 How many phenotypic differences can you observe in the parents of the Oregon Wolfe Barley?

31 – 35 Explain how the vrs locus example show that a recessive mutation (loss of function) can lead to a gain of function phenotype. Is there only one way to mutate a Vrs1 allele to get a vrs1 allele?

Key points from Komatsuda et al.

1. What does the wild type (dominant, Vrs1) allele encode?
2. Why are there (apparently) more possible recessive alleles than dominant alleles at this locus?

37 Revisiting this concept: why are many alleles possible in a population of diploid individuals but only two are possible in any given diploid individual?

37 Why is the number of alleles statement always qualified by specifying diploids? What is the situation with polyploids?

38 – 39 Why is chromosome doubling (spontaneous or induced) essential for producing completely homozygous doubled haploid plants.

38 – 39 In view of the information presented in these slides, re-visit your answer to question #21.

40 Why are the considerations shown in this slide so important for properly formulating hypotheses regarding the goodness of fit between observed and expected data?

41 – 43 What is meant by a good fit vs. a poor fit? What criteria is used to assess the goodness of fit?

44 Will the df be the same for a monohybrid example involving the phenotypic ratios in the F2, testcross, and doubled haploid generations?

45 Know how to use a chi square table, but don’t memorize it! If you need one for a quiz or exam, it will be provided.

45 In a chi square test, it is imperative that you use the correct degrees of freedom. Say you calculate a chi square value of 9. What conclusions will you make if you test goodness of fit at 2 df vs. 6 df?

46-49 Understand how to calculate a chi square and test the goodness of fit for mono-hybrid and dihybrid ratios in doubled haploid, F2, and testcross generations.

46 – 49 Why don’t we use chi square tests to test the expected vs. observed ratios for traits encoded in the chloroplast and mitochondrial genomes?

50 If chloroplasts in monocots usually show maternal inheritance, why are doubled haploids produced through anther culture green?

50 In what way to doubled haploids simplify dihybrid analysis, as compared to F2s?

50 If you study inheritance using only doubled haploids, why can’t you determine if an allele is dominant or recessive?

51- 53 Asexual reproduction passes an exact copy of a genome to offspring. Under what environmental conditions might this be appropriate?

51-53 Why might sexual, as opposed to asexual, reproduction be more suitable under rapidly changing environmental conditions ?

54 Why is it so convenient to be able to asexually and sexually propagate a plant?

56 – 59 Facultative apomixis could be considered the “Holy Grail” of plant breeding. Why might that be? Why might obligate apomixis not be the “Holy Grail”?

Define the following terms, in your own words, based on the definitions provided in Table 1 of the paper by Hand and Koltunow (available in the readings).

Apomixis

Embryo sac

Apomeiosis

Diplospory

Apospory

Parthenogenesis

60 What is epigenetics and how does it related to apomixis?

61 Why be concerned about gene flow from transgenic apomicts?

62-63 How does knowledge of reproductive strategies help to explain why the Himalayan blackberry is such a successful invasive plant?

Reid and Ross (available in the readings – may require some additional research on definitions)

What has molecular biology revealed about the mechanisms underlying the naked eye polymorphisms analyzed by Mendel?

In what way does the molecular information support Mendel’s contention that genes are fundamental units, passed from generation to generation?

What is intragenic recombination, and why would it have surprised Mendel?

What are transposable elements and why would they have surprised Mendel?