Exam 1 PBG430/530
2014

1. You read that the genome size of maize is 2,300 Mb and that in this species 2n = 20. This means that there are 2,300 Mb of DNA in a cell that is
    a. n (e.g. gamete)
    b. 2n (e.g. embryo)
    c. 3n (e.g. endosperm)

2. If you had to estimate how many genes there are in an average diploid plant, which number would you pick:
    a. 5,000
    b. 10,000
    c. 30,000
    d. 100,000

3. A simple operative definition of a gene is:
    a. Place on a chromosome where a gene is found and this place will (usually) be the same on two homologous chromosomes.
    b. DNA sequence associated with a particular phenotype.
    c. Dark matter, formerly thought of as junk

4. A simple operative definition of a locus is:
    a. Place on a chromosome where a gene is found and this place will (usually) be the same on two homologous chromosomes.
    b. DNA sequence associated with a particular phenotype.
    c. The form of the gene that is found at the locus in each of the two homologous chromosomes.

5. A homozygous Roundup resistant plant crosses with a homozygous Roundup susceptible plant of the same species. You harvest the F1 seed, plant it, and spray it with Roundup herbicide. What do you expect to happen?
    a. All plants will live
    b. All F1 plants will die
    c. The F1 plants will segregate 3:1 for survival
    d. The F1 plants will segregate 1:1 for survival

6. You produce a test-cross generation (e.g. F1 x homozygous recessive parent) of 100 plants from the cross described in question #5 (above). What ratio of living: dead do you expect?
    a. All resistant to Roundup
    b. All susceptible to Roundup
    c. 75 resistant: 25 susceptible
    d. 50 resistant: 50 susceptible

7. The inheritance pattern observed in the test-cross generation referred to in Question #6 is best described as
    a. Heterochromatic
    b. Insoluble
    c. Qualitative
    d. Quantitative

8. In a diploid species that is 2n = 32, the "F" gene is 3 kb long. Which of the following statements is most true?
    a. If you produce doubled haploids from the cross of the F1 derived from FF x ff the expected genotypic ratio for alleles at the F locus is 3:1.
    b. In a population of 1,000 plants of this species, only two alleles at the F locus are possible.
    c. Many alleles at the F locus are possible in a sample of 1,000 plants of this species, but only two alleles will occur in any single plant.
    d. If there are different alleles at the F locus, there is no way to study their inheritance.

9. Assume you have two homozygous tomato plants. The plants differ from each other in having different alleles at approximately half the loci in the tomato genome. F1 plants will be heterozygous at approximately how many loci?
    a. 7,500 loci
    b. 15,000 loci
    c. 30,000 loci

10. If you self an F1 plant, as described in question #9 (above), what % reduction in heterozygosity would you predict with each generation of selfing?
    a. 25%
    b. 50%
    c. 75%
    d. 100%

11. Based on the assigned reading on gene flow, which of the following statements are true?
    a. The event involved cultivated creeping bentgrass and its wild relatives in Oregon
    b. The authors conclude that transgene spread is more likely with cross-pollinated plants than with self-pollinated plants.
    c. The authors conclude that putting transgenes in the chloroplast genome, rather than the nuclear genome, will not be a 100% effective solution for controlling the spread of transgenes.
    d. All of the above

Consider the following data from a diploid plant. The dominant parent has purple seeds. The recessive parent has white seeds. Your produce 100 doubled haploids from the F1. Unfortunately, you forgot to check seed color at the F1 generation. Use this information to answer questions 12 – 15.

Seed color	Number of doubled haploid plants
Purple	45
White	55

12. Purple is dominant to white.
    a. T
    b. F
    c. No way to know, given these data

(a or c accepted – ambiguous question)

13. How many loci do you hypothesize determine seed color?
    a. 1
    b. 2
    c. 3
    d. 4

14. You calculate that the Chi-square for a predicted 1:1 ratio for purple: white is "1.0". How many degrees of freedom will you use to test the hypothesis that the observed and expected ratios are equal?
    a. 1
    b. 2
    c. 3
    d. 4

15. After referring to a chi square table (see last page of exam) will you accept or reject this ratio?
    a. Accept
    b. Reject
    c. Neither accept nor reject: chi square tests are not appropriate for these sorts of quantitative data.

16. A principal limitation to Chi Square tests if that they are old-fashioned and can only be applied to phenotypic data. That is, they are not useful for determining if alleles at a locus defined by a Single Nucleotide Polymorphism (SNP) are showing the expected segregation ratio.
    a. T
    b. F

17. In the alternation of generations in angiosperms there is
    a. Only meiosis
    b. Only mitosis
    c. Meiosis and mitosis
    d. A continuous state of epigenetic gene silencing

18. Assume you get a job propagating a plant that is an obligate apomict. Your task is to identify heritable phenotypic variation in this species. You tell your boss that this is going to be a very challenging task because there are only two possible sources of heritable phenotypic variation in this obligate apomict. Which two sources of variation will you say are most likley?
    a. Segregation and independent assortment
    b. Mutation and epigenetics
    c. Monoecy and dioecy
    d. Centromere and telomere shortening

19. A transcription factor gene encodes a protein that
    a. regulates the expression of another gene (or genes)
    b. causes the failure of spindle fibers
    c. causes shortening of telomeres
    d. causes expansion of “dark matter” with each mitosis

20. Sexual reproduction is generally considered to be more advantageous than asexual reproduction in the long run. However, only dioecious plants enjoy this advantage.
    a. T
    b. F

21. A pollen mother cell (PMC) has the genotype VvQQ. The tetrad of microspores resulting from meiosis of the PMC will have which genotypes?
    a. VQ,VQ,VQ,VQ
    b. VQ, VQ, vQ,vQ
    c. vq,vq,vq,vq

22. A megaspore mother cell (MMC) has the genotype (VvQQ). Considering the genotypes of the eight nuclei in a single embryo sac produced by this MMC:
    a. All of the 8 nuclei in a single embryo sac will be either vQ or VQ
    b. In the same embryo sac some nuclei will be VQ and some will nuclei will be vQ

23. The synergids in the embryo sac of a diploid plant
    a. Are each "3n"
    b. Give rise to 3n endosperm
    c. Have no known function
    d. Attract sperm

24. You have two homozygous diploid parents. They have contrasting alleles at the "Z locus". You make two crosses ZZ x zz and zz x ZZ (female genotype is shown first). In the F1 seed of the two crosses:
    a. Embryos will be Zz and endosperm ZZz
    b. Embryos will be Zz but the endosperm will be ZZz or zzZ depending on which genotype was used as the female

25. The ancestral condition of angiosperm flowers is thought to be
    a. Hermaphroditic
    b. Monoecious
    c. Dioecious
    d. Self-incompatible

26. Male sterility is best described as the situation where alleles at the SI locus in the pollen and the stigma determine if the pollen will germinate, grow, and fertilize.
    a. T
    b. F

27. Male sterility can be very useful in plant breeding. The problem is that this trait is always controlled by genes in the chloroplast.
    a. T
    b. F

28. Pleiotropy is the situation where one gene
    a. Determines only one phenotype
    b. Determines more than one phenotype
    c. Is regulated by a transcription factor and a neighboring gene is not regulated by that transcription factor.

29. In terms of the genetics of parents and progeny, asexual reproduction from somatic tissue and propagation from apomictic seeds are equivalent.
    a. T
    b. F

30. Telomere shortening occurs because of
    a. Spontaneous doubling of chromosome numbers
    b. The digestion of chromatids by telomerase at Zygonema
    c. DNA replication considerations in mitosis
    d. Epigenetic silencing of spindle fibers

31. In a dioecious plant where males are xx and females are xy, the expected ratio of male to female offspring is
    a. 1:1
    b. 3:1
    c. 1:1:1:1
    d. 9:3:3:1

32. Nucleosomes are responsible for
    a. "Packaging" of DNA in chromosomes so that it can fit into the nucleus
    b. Male sterility
    c. Gene regulation
    d. Mutation

33. Constitutive heterochromatin is generally more compact than euchromatin. Therefore, it is likely that there are many more highly expressed genes in the constitutive heterochromatic regions.
    a. T
    b. F

34. Centromeres play a very important function in plants. This is:
    a. Point of attachment of spindle fibers
    b. Capping ends of chromosomes
    c. Marking the point at which the two DNA molecules forming each chromosome (e.g. the two arms of each chromosome) are joined.

35. Chromosome doubling of haploid plants is essential in the production of doubled haploids because
    a. It doubles the 2n the chromosome number each generation, making diploids into polyploids and therefore more productive
    b. Haploid plants are sterile and doubled haploid plants are fertile
    c. Haploid plants are fertile but only half as productive as doubled haploids
    d. It fixes heterozygosity at each locus

36. In the production of doubled haploids, chromosome doubling can be spontaneous or induced by various chemicals. The principle of chromosome doubling in this application is
    a. More than one spindle fiber attaching to each centromere
    b. Failure of spindle fibers at mitosis
    c. Spindle fibers that move twice as fast
    d. Functioning spindle fibers at Anaphase and Telophase

37. If you wanted to study the expression of the maximum number of genes in a specific plant, what stage of the cell cycle would you prefer to use?
    a. G1
    b. S
    c. G2
    d. Mitosis

38. A plant is 2n = 2x = 28. How many bivalents do you expect at Metaphase I of meiosis?
    a. 7
    b. 14
    c. 28
    d. 56

39. Homologous chromosomes pair during
    a. Mitosis
    b. Meiosis
    c. Mitosis and Meiosis

40. In meiosis, crossing over occurs during
    a. Pachynema
    b. Anaphase I
    c. Prophase II

41. The source of new alleles at a locus and new combinations of alleles at different loci is
    a. Meiosis
    b. Mutation
    c. Mutation (for new alleles) and meiosis (for new combinations of alleles at two or more loci)

42. Segregation of alleles at a locus (ignoring crossovers) occurs at what stage of meiosis?
    a. Zygonema
    b. Pachynema
    c. Anaphase I

43. Independent assortment of alleles at two or more loci located on non-homologous chromosomes occurs at what stage of meiosis?
    a. Zygonema
    b. Pachynema
    c. Metaphase I

44. If you examine actively dividing root tips under a microscope you are most likely to observe
    a. Mitosis
    b. Meiosis
    c. Neither mitosis nor mitosis – the cells are dead.

45. The C-value paradox refers most correctly refers to
    a. The fact that polyploids always have bigger genomes than diploids
    b. At a given ploidy level (e.g. when comparing two different diploids) genome size is not related to chromosome number or the number of genes.
    c. The fact that no one seems to know what the "C" refers to

46. The key difference between epigenetics and mutation is that differences in phenotype due to epigenetics are not inherited.
    a. T
    b. F

47. According to the assigned reading, a key line of evidence that "dark matter DNA" is not "junk DNA" is that on average which percentage of a genome is most likely transcribed?
    a. 5
    b. 20
    c. 80

48. In question 3 on this exam, you selected a simple, operative definition of a gene. What percentage of a 3,000 Mb plant genome would you expect to consist of such genes?
    a. 5
    b. 20
    c. 80

49. According to the assigned reading, the conservation of DNA sequence in non-coding DNA in two distantly related organisms implies that
    a. Non-coding DNA has a functional role
    b. Non-coding DNA has no functional role
    c. The amount of non-coding DNA is directly related to evolutionary complexity

50. Phenotypic variation in the F2 progeny of a cross between two heterozygous diploid individuals could be due to
    a. Allelic variation at multiple protein encoding loci, where the alleles differ in DNA sequence
    b. Allelic variation at multiple protein encoding loci, where at some loci one allele consists of a functional gene and the other allele is the absence of that gene
    c. Alternative regulation of genes
    d. All of the above

Table 2-2 Critical Values of the χ^2 Distribution

	P								
df	0.995	0.975	0.9	0.5	0.1	0.05	0.025	0.01	0.005	df
1	.000	.000	0.016	0.455	2.706	3.841	5.024	6.635	7.879	1
2	0.010	0.051	0.211	1.386	4.605	5.991	7.378	9.210	10.597	2
3	0.072	0.216	0.584	2.366	6.251	7.815	9.348	11.345	12.838	3
4	0.207	0.484	1.064	3.357	7.779	9.488	11.143	13.277	14.860	4
5	0.412	0.831	1.610	4.351	9.236	11.070	12.832	15.086	16.750	5
6	0.676	1.237	2.204	5.348	10.645	12.592	14.449	16.812	18.548	6
7	0.989	1.690	2.833	6.346	12.017	14.067	16.013	18.475	20.278	7
8	1.344	2.180	3.490	7.344	13.362	15.507	17.535	20.090	21.955	8
9	1.735	2.700	4.168	8.343	14.684	16.919	19.023	21.666	23.589	9
10	2.156	3.247	4.865	9.342	15.987	18.307	20.483	23.209	25.188	10
11	2.603	3.816	5.578	10.341	17.275	19.675	21.920	24.725	26.757	11
12	3.074	4.404	6.304	11.340	18.549	21.026	23.337	26.217	28.300	12
13	3.565	5.009	7.042	12.340	19.812	22.362	24.736	27.688	29.819	13
14	4.075	5.629	7.790	13.339	21.064	23.685	26.119	29.141	31.319	14
15	4.601	6.262	8.547	14.339	22.307	24.996	27.488	30.578	32.801	15