Unit 5 BILL

Unit Essentials

1. ☑ Unit map
2. ☑ Traffic light

   2 - Traffic Light

Term	Pre-Assessment	Post-Assessment
Pedigree	🟩	🟩
Sex-Linked Traits	🟩	🟩
P Generation	🟩	🟩
F2 Generation	🟩	🟩
F1 Generation	🟩	🟩
Homologous Chromosome	🟩	🟩
Law of Segregation	🟩	🟩
Nondisjunction	🟩	🟩
Crossing Over	🟩	🟩
Germ Cell	🟩	🟩
Homozygous	🟩	🟩
heterozygous	🟩	🟩
Phenotype	🟩	🟩
Dominant	🟩	🟩
Test Cross	🟩	🟩
Recessive	🟩	🟩
Somatic Cell	🟩	🟩
Sister Chromatid	🟩	🟩
Law of Independent Assortment	🟩	🟩
Genotype	🟩	🟩
Incomplete Dominance	🟩	🟩
Non-Nuclear Inheritance	🟩	🟩

3. ☑ Test topics

   3 - Test Topics

   1. Questions using pedigree – predict genotypes and inheritance patterns (autosomal, sex-linked, recessive, dominant)
   2. Mendel's crosses – what did F1 and F2 generations tell us about heredity? What was important about the inheritance of the traits he chose (aka why did it allow him to discover the patterns that he did)?

3. Independent assortment
    I. When does it happen?
        A. When genes are on different chromosomes
    II. Why is it important in genetics problems?
        A. It is easy to calculate and predict the possible geno and phenotypes of children
    III. When does it not happen?
        A. When genes are on the same chromosome
4. Vocabulary:
    I. Testcross
        A. Cross of two genotypes to simulate the result of children's genotypes
    II. Dihybrid
        A. Two gene cross to see the interaction between multiple genes and probabilities
    III. Monohybrid
        A. A single gene cross to see possible genotypes
    IV. Epistasis – definition, examples, how can you tell this is the inheritance pattern?
        A. When one gene blocks the expression of another gene
    V. True-breeding
        A. In breeding will always produce the same phenotype
    VI. Gamete
        A. A sex cell ready to mate
    VII. Phenotype
        A. The expression of a gene
    VIII. Genotype
        A. The alleles that make up a gene, which will be expressed in the phenotype
    IX. Heterozygous
        A. Has both alleles
    X. Homozygous
    XI. Has two of the same allele
    XII. Hemizygous
    XIII. Only has one allele (X linked for males)
    XIV. Polygenic inheritance – definition, examples, how can you tell this is the inheritance pattern?
    XV. Multiple genes working together to produce gene expression
    XVI. Height, mixture of many genes and factors to produce many different phenotypes
    XVII. Pleiotropy
    XVIII. A single gene having multiple effects and expressions in the body
    XIX. Allele
    XX. The specific code that codes for a particular phenotype, will combine with other alleles, get blocked, or block other alleles to produce expression
    XXI. Locus
    XXII. The location of a gene on a chromosome
    XXIII. Parental-type offspring
    XXIV. Offspring receiving multiple genes unrecombined from a single chromosome
    XXV. Recombinant-type offspring
    XXVI. Offspring receiving multiple genes mixed together from a parent
    XXVII. X-inactivation
    XXVIII. One of the X chromosomes are disabled in a female because there is twice the necessary DNA needed for expression
    XXIX. Aneuploidy (what is it, how does it happen, what diseases arise from it?)

XXX. Extra or not enough chromatids
XXXI. Happens because of nondisjuction
XXXII. Down syndrome

5. Punnett square questions
    I. Sex-linked
    II. Multiple alleles (blood type)
    III. Complete dominance
    IV. Dihybrid crosses (might be quicker to use laws of probability and monohybrid crosses)
6. Frequency of recombination based on linkage map
    I. Further apart → More likely to recombine
7. Given recombination frequencies, determine linkage map
    I. Small frequencies → Next to each other on the map
8. Probability questions
    I. When do you use rule of multiplication?
        A. When you want both things
    II. When do you use rule of addition?
        A. When you want either thing
9. Types of chromosomal mutations - definitions
10. Understand the heredity principles involved in:
11. Huntington's disease
    I. Autosomal dominant
12. Down syndrome
    I. Too many chromosomes
13. Calico cats
    I. In females, multiple colors because X chromosome
14. Understand the relationship of heredity to meiosis.
15. Produces randomness through alignment, crossing over, and random selection
16. Understand how the following deviate from Mendel's Laws and ratios:
17. Incomplete dominance
    I. Mixture of two alleles (in splotchiness)
18. Sex-linked traits
    I. Males only have one X chromosome
19. Co-dominance
    I. Mixture of two alleles
20. Linked genes
    I. Doesn't recombine completely randomly because of the distance on chromosomes
21. Chi square analysis with genetics problems
22. $\chi^2 = \Sigma(e-o)^2/e$

4. ☑ Unit summary

4 - Unit Summary

AP Biology Standards:

- Construct a representation that connects the process of meiosis to the passage of traits from parent to offspring.
    - Traits from parent's parents are combined almost completely randomly to produce a single copy of all DNA passed into the haploid cell
    - Haploid cells from mom and dad are combined into the offspring
- Pose questions about the ethical, social, or medical issues surrounding human genetic disorders.

    - Should we prevent these people form reproducing so that these disorders could be irradiated? or do they still have the right to harm future people with their choice.
- Apply mathematical routines to determine Mendelian patterns of inheritance provided by data sets.
    - Basically each combo is 25%, and if one is seen multiple times, add the 25%s together
- Explain deviations from Mendel's model of the inheritance of traits.
    - Linked traits, they do not recombine completely randomly independently
- Explain how the inheritance patterns of many traits cannot be accounted for by Mendelian genetics
    - Often things that do not follow will inherit similarly but with different chances
    - For other things it tends to be multiple genes, which most commonly is just a range of expression
- Construct explanations of the influence of environmental factors on the phenotype of an organism.
    - Different genes are only expressed in certain conditions like temperature, pH, and others.
- Use evidence to justify a claim that a variety of phenotypic responses to a single environmental factor can result from different genotypes within the population.
    - One of the genes may be active normally, but then when a factor influences the cell it triggers the activation of the other gene possibly

Objectives:

- How are traits passed from one generation to the next?
    - Through genes
- How do eukaryotic cells store, retrieve, and transmit genetic information?
    - In DNA, condensed into chromosomes and transmitted through the production of gamettes
- How does genotype affect phenotype?
    - The dominant part of genotype will be the phenotype (most commonly)

5. ☑ Official AP Biology unit summary
6. ☑ Topic review guides
    - ☑ ~~5.1, 5.2 and 5.6 Meiosis, Genetic Diversity and Chromosomal Inheritance~~
      ~~5.1-5.2, 5.6~~

        1. ~~Because the resulting cells have half the chromosomes as the originals~~
        2. ~~Because when the sperm fertilizes the eggs, the number of chromosomes doubles~~
        3. ~~gene is a part of the DNA, chromosomes are collections of DNA, and sister chromatids are copies of the same DNA for redundancy~~
        4. ~~4~~
            I. ~~Starts with 2n, ends with 1n~~
            II. ~~By the end of meiosis 2, 4 cells are produced~~
            III. ~~The purpose is to mix the genes up and to produce haploids~~
            IV. ~~This happens only in sexual cells~~
        5. ~~5~~
            I. ~~Mixes genes on the same chromosome~~
            II. ~~Mixes chromosomes up~~
            III. ~~Mixes which random assortments from each parent~~
        6. ~~two of the same chromosome with possibly different matching genes from parents~~
        7. ~~Segregation states that you get one gene from each parent, and independent assortment means you get a random gene from each parent~~
        8. ~~Turner syndrome and down syndrome~~

9. ~~Its dominant, which is not recessive~~

- [x] ~~5.3 Mendelian Genetics~~

  ~~**5.3**~~

  1. ~~Redundant, continuous, universal~~
  2. ~~Because it shares similar DNA and function across many different organisms~~
  3. ~~You will always have one gene from the top and one from the side, never two from one~~
  4. ~~It shows the different probabilities of combinations of genes in gamete production~~
  5. ~~You can easily visualize the inheritance pattern across generations and have multiple examples of different combos~~

- [x] ~~5.4-5.5 Non-Mendelian Genetics and Environmental Effects~~

  ~~**5.4-5.5**~~

  1. ~~Linked genes are on the same chromosome, so their recombination rate is not completely random and often tends to be lower depending on the distance on the chromosome~~
  2. ~~The chances of recombining depending on the distance from each other~~
  3. ~~Parental means that you get all the same genes of a certain chromosome from one of your grandparents (because your parent's DNA was never recombined), but when it is recombined, you get a mix of both grandparents from that parent~~
  4. ~~It doesnt depend on only one gene and alleles, it uses a combination of multiple factors to determine the phenotype, which is not completely random and certain results will be more common than others depending on the type of multi gene inheritance~~
  5. ~~Most of the time non-nuclear inheritance means we just get it from our mother because the sperm does not contain much other than the genetic material. No organelles with DNA are there. This is also why polar bodies are created during the production of eggs.~~
  6. ~~Different environmental factors define the phenotype of the hydrangeas, and not simply just genetically inherited.~~

Activity Log

1. - [x] Practice Packet: Mendelian Genetics

   1 - Mendelian Genetics

   1. 1

      I. Y
      - A. YY
      - B. Yy
      - C. yy

      II. Q
      - A. QQ
      - B. Qq
      - C. qq

      III. E
      - A. EE
      - B. Ee
      - C. ee

      IV. M
      - A. MM
      - B. Mm
      - C. mm

      V. F

        A. FF
        B. Ff
        C. ff
    VI. G
        A. GG
        B. Gg
        C. gg
2. 2

    I. P
    II. P
    III. p
    IV. B
    V. B
    VI. b
3. 3

    I. 50%
    II. 0%
    III. 100%
4. F_1: 100% Aa (A - tall plant)
	A	**A**
a	Aa	Aa
a	Aa	Aa

5. F_2: 25% AA (A), 50% Aa (A), 25% aa (a)
	A	**a**
A	AA	Aa
a	Aa	aa

6. All of them are Pp (Purple) because the white flowers are homozygous recessive (pp) and the purples are homozygous dominant (PP)
7. 50% Aa, it is a cross between heterozygous and homozygous recessive.
8. The man is likely homozygous dominant as all his offspring have freckles. The children are likely all heterozygous because the mother must be homozygous recessive
9. The father is likely heterozygous, mother must be homozygous recessive, the children with freckles are heterozygous and the ones without are homozygous recessive
10. 75%, because both parents are heterozygous (same for the second child)
11. Since the offspring tend to lean more towards a 3:1 ratio, this likely means that the parents are both heterozygous for freckles.
12. 12

    I. 100% AB
    II. 50% AB, 50% aB
    III. 50% Ab, 50% ab
    IV. 25% AB, 25% Ab, 25% aB, 25% ab

13. 13
    I. 100% ABC
    II. 50% ABc, 50% aBc
    III. 12.5% ABC, 12.5% ABc, 12.5% AbC, 12.5% Abc, 12.5% aBC, 12.5% aBc, 12.5% abC, 12.5% abc
14. Two RY and two ry

	AB	**Ab**	**aB**	**ab**
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

15. 15
    I. AABB, AaBB, AABb, AaBb
    II. aaBB, aaBb
    III. AAbb, Aabb
    IV. aabb
16. 16
    I. 9/16, 56.25%
    II. 3/16, 18.75%
    III. 3/16, 18.75%
    IV. 1/16, 6.25%
17. 50%
18. 12.5%
19. 0%
20. 12.5%
21. 12.5%
22. 1.5625%
23. A-C-B, A&C
24. C-W-B-S, W&B
25. W-A-L-D, L&D
26. A-C-D-F-B, C&D
27. B-F-D-C-A, C&D
28. It is likely a recessive disorder, however there is not enough information to decide if it is autosomal or sex-linked, his grandfather has aa while his parents both have Aa, and he himself has aa
29. 29
    I. 25% chance of child getting it
    II. likely 0%
30. uneffected are hh, which the effected is Hh

2. ☑ Practice Packet: Extra Heredity Practices

2 - Extra Heredity Practices

1. D
2. B
3. C
4. 4

    I. Yes, Dd x Dd
    II. No
    III. Yes, D x Dd
    IV. No
    V. No
5. A
6. D
7. D
8. B
9. D
10. 10
    I. Heme, the last one
    II. Narduzzi, only parents with an A allele
    III. Dorsett, theyre the only ones that could have both A and B
    IV. Youngblood, both parents are O
11. 11
    I. 50%
    II. 50%
    III. 50%
12. 12
    I. 25%
    II. 50%
    III. 0%
13. 13
    I. 50%
    II. 100%
    III. 0%
14. 14
    I. 25%
    II. 0%
    III. 25%
15. 15
    I. 25%
    II. Black
16. C
17. C
18. D
19. B
20. C
21. A

Extra

1. 3: White, Red, Blue
2. Red and Blue are codominant, which produces purple, and both of them are dominant to white

3. ☑ Investigation: Chi Square M&M's Lab

Chi-Squared Analysis

MnM Lab

Data

Solo

Color	Obs	Exp	$o-e$	$(o-e)^2$	$(o-e)^2/e$
Red	7	5	+2	4	0.8
Orange	3	5	-2	4	0.8
Yellow	2	5	-3	9	1.8
Green	6	5	+1	1	0.2
Blue	7	5	+2	4	0.8
Brown	5	5	+0	0	0.0
Total	30	30	0		4.4

Group

Color	Obs	Exp	$o-e$	$(o-e)^2$	$(o-e)^2/e$
Red	31	29.833	+1.166	1.359556	
Orange	38	29.833	+8.166	66.683556	
Yellow	33	29.833	+3.166	10.023556	
Green	27	29.833	-2.833	8.025889	
Blue	26	29.833	-3.833	14.691889	
Brown	24	29.833	-5.833	34.023889	
Total	179		0	134.808335	4.51876562867

Analysis

Null Hypothesis

The assortment of colors in a crispy MnM packet are each of equal chance of occurring.

Conclusion

With a 95% confidence level, and 5 degrees of freedom, the χ^2 result of either 4.4 or 4.518 are insignificant to the threshold of 9.49, and fails to reject the Null Hypothesis that the MnMs' colors are equally assorted.

Additional Practice Problems

Phenotypic ratio heterozygous genes

	G	**g**
G	GG	Gg
g	Gg	gg

G:g ratio of 3:1

Chi-squared test for phenotypes in Green/Albino peas

Data

Phenotype	Obv	Exp	$o-e$	$(o-e)^2$	$(o-e)^2/e$

Phenotype	Obv	Exp	$o-e$	$(o-e)^2$	$(o-e)^2/e$
Green	72	63	9	81	1.28571428571
Albino	12	21	-9	81	3.85714285714
Total	84	84			5.14285714285

Analysis

Null Hypothesis

Pea seeds obey the law of independent assortment and the combination of genes are completely random, meaning that the dominant phenotype in a cross should account for 75% of the offspring.

Conclusion

With a 95% confidence level, and 1 degree of freedom, the χ^2 value of 5.14285714285 is significant at the threshold of 3.84, which rejects the null hypothesis that these peas obey the law of independent assortment.