Mendel and the gene part 1

I. Mendel, before and during

- Heredity – “the sum of the qualities and potentialities genetically derived from one’s ancestors”

A. Before Mendel - Prevailing beliefs about heredity in the 1800s

1) Blending Inheritance

2) Inheritance of Acquired Traits
   - ______________________ causes structures to enlarge or shrink
   - “all such changes are ____________”

B. Mendel - the “father” of genetics

- born 1822 in what is now the Czech Republic... entered the monastery
- started investigating variation among plants
- Chose a good “model” organism: Pisum sativum - the
  - Able to generate large datasets which provided ____________________ - became the basis for his “laws” of heredity
  - used mathematics/probabilities to explain his results

Why pea plants?
Advantages:
small, short generation times;

Possess variable, heritable traits
By using __________________, Mendel designed experiments to determine the quantitative relationships between ____________ and traits
• Studied 7 contrasting traits
  – Able to describe that traits are passed on from parent to offspring in a

C. Genetics Terminology, derived from Mendel’s results:
• Mendel’s concept of the gene was based on the analysis of variants –

• Genes come in different forms = __________
  – i.e. there may be a single gene for flower color but several alleles, each producing a
different color
  – Every individual has ___________ per gene
• Dominant = an allele that expresses its effect even when only ________ copy is
  present
• _______________ = An allele whose effect is only expressed when individuals have
  ____ _________ of that allele

Genotype and Phenotype
Genotype = The "internally coded, inheritable information", holds the critical instructions
that are used and interpreted by the cellular machinery of the cells to produce the
Phenotype = "outward, physical manifestation" of the organism.

  Homozygous = the alleles of a gene are
  Heterozygous = the alleles of a gene are

  True breeding = two organisms with a particular, inheritable
  phenotype produce only offspring with that
  ____________________

1). Mendel’s Monohybrid Cross - inheritance of a single trait
Controlled mating of two specific organisms dealing with one pair of contrasting
characteristics
• Used to determine how a single trait is inherited
  • Example =
Homozygous Dominant X Homozygous Recessive

P Sperm + p Eggs same as p Sperm + P Eggs

Pp X Pp Cross

Mendel’s results from the monohybrid crosses

<table>
<thead>
<tr>
<th>Parental</th>
<th>F₁</th>
<th>F₂</th>
<th>F₂ ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round x wrinkled</td>
<td>All round</td>
<td>6474 round</td>
<td>1850 wrinkled</td>
</tr>
<tr>
<td>Yellow x green seeds</td>
<td>All yellow</td>
<td>6022 yellow</td>
<td>2001 green</td>
</tr>
<tr>
<td>Purple x white</td>
<td>All purple</td>
<td>705 purple</td>
<td>224 white</td>
</tr>
<tr>
<td>Inflated x pinched</td>
<td>All inflated</td>
<td>882 inflated</td>
<td>229 pinched</td>
</tr>
<tr>
<td>Green x yellow pods</td>
<td>All green</td>
<td>428 green</td>
<td>152 yellow</td>
</tr>
<tr>
<td>Axial x terminal</td>
<td>All axial</td>
<td>651 axial</td>
<td>207 terminal</td>
</tr>
<tr>
<td>Long x short</td>
<td>All long</td>
<td>787 long</td>
<td>277 short</td>
</tr>
</tbody>
</table>

Mendel’s principles to explain his data

1) the existence of __________ in ________ – particulate theory of inheritance
   - Traits inherited as discrete units that remain unchanged as they pass from parent to offspring

2) genes are in pairs, thus 2 phenotypes must be determined by __________ of ______ gene

Dominant
Recessive
3) the principle of _______________, genetic units segregate from each other during gamete formation.

Mendel’s Principle of ______________________ =
The two members of a gene pair segregate from each other into the gametes; ___________ ________________ member of the pair and the other __________ of the gametes carry the other member of the pair.

Using Punnett Squares in Genetic Crosses
Considers only genes of interest
List sperm genotypes across top
List egg genotypes down side
Fill in boxes with zygote genotypes

Making a Punnett Square: Heterozygous X Heterozygous

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Frequencies</th>
<th>Phenotypes</th>
<th>Frequencies</th>
</tr>
</thead>
</table>

Question:
Brown mouse x Black mouse
F₁: All black offspring
what do you predict for the F2?

A homozygous tall pea plant was crossed with a homozygous short pea plant. The allele for Tall is dominant to short. What will be the expected phenotypic and genotypic results in the F₁ & F₂ generations?

If a white flower was crossed by a purple flower, and ½ the progeny were white, ½ were purple,
2). Mendel’s Dihybrid cross

- **Controlled mating of two specific organisms dealing with two pairs of contrasting characteristics, example:**
  - Follows the inheritance of ____________ traits within the ____________ individual.
    - i.e. Yellow color, Round texture x Green color, Wrinkled texture

Mendel’s principle:________________________

-________________________ = two different genes on different chromosomes will ______________ assort their ______________ during gamete formation
- shape & seed color genes are on different (non-homologous) chromosomes, which line up in metaphase I
What if the genes for seed shape & seed color had been on the _________ chromosome (were “linked”)?

- Linked genes ________________ independently of one another
- Produces _________________ phenotypic ratios

Question:
1. Consider the following two traits in rabbits (each controlled by two different genes):
   - Hair color
   - Hair texture

   - Predict the phenotypes that will occur from this cross:

   - Predict the genotypic ratios

Using a testcross to determine genotypes

- Testcross = The organism of the dominant phenotype is crossed to a known __________ ________________ individual