Classical Genetics

Johann Gregor Mendel

Gregor Mendel

- Born: July 22, 1822 in Heizendorf, Austria
- Died: 1884
- Called the father of genetics for his experimentation with pea plants. (The first important study of heredity.)

Mendel's Early Years:

- All his siblings were girls.
- When he was young, he frequently took to his sickbed for weeks (sometimes months) at a time.
- From 1851 to 1853, studied zoology, botany, chemistry, and physics at the University of Vienna. (He did not get a degree…some say because of his recurring illness, some low achievement, some financial reasons….)

Mendel the monk:

- He joined the Augustinian monks (reportedly he did not feel a strong spiritual calling, but did escape his financial worries) in 1843.
- Before turning his attention to peas, where he would make his most important discoveries, Mendel bred mice.
- The local bishop found mouse breeding offensive, however, forcing Mendel to find a more genteel area of study.

Pea Plant Studies:

- Worked well because they reproduced sexually and he was able to control variables which allowed him to study one trait at a time.
- He cross-pollinated select pea plants by hand with a brush (he removed male structures from the immature plants, dusted the female structures with a selected plant's pollen and covered it with a bag--insuring that he knew the parents of future plants.)

Where does a monk do experiments???

- He did his studies in the garden at the monastery.
- This is a photo taken in ~ 1920 of the monastery garden.

Generation names:

- Parents: P_1 generation
- Offspring of the parents: First Filial Generation; F_1 generation
  - filial: the offspring of the parents; son or daughter
- Offspring of F_1 generation: F_2 generation
- etc.

Results:

- He found that breeding pure tall plants with pure short plants, he always got all tall plants.

Results:

- He found that breeding the offspring of this cross, the hidden short "factor" showed up again in 25% of the resulting plants.

His results lead to….

- His identification of dominant and recessive "factors" which we now call traits and the Law of dominance.

Studied Traits of Mendel's Pea Plants...

- Dominant
  - Round seeds
  - Yellow seeds
  - Purple flowers
  - Flowers in axial position (on sides)
  - Green seed pods
  - Inflated seed pods
  - Tall height
- Recessive
  - Wrinkled seeds
  - Green seeds
  - White flowers
  - Flowers in terminal position (at tips)
  - Yellow seed pods
  - Constricted seed pods
  - Short height

His results also lead to….

- The law of segregation: Two alleles for a trait must segregate during the formation of sex cells (gametes; germ cells.)
- This allows a parent to randomly pass on one allele for a trait to offspring.

His results also lead to….

- The law of independent assortment: The gene that a gamete gets for one trait has no effect on which gene the gamete gets for another trait.
- We now know that this is only true if the genes are on different chromosomes or if they are far enough apart on the same chromosome that has undergone "crossing over" or a mutation.

Announcing….

- He reported on the results of his observations at the meetings of the Association for Natural Research in Brno on the evenings of February 8th and March 8th, 1865.
- The Association published the written accounts of these observations in 1866.

But….

- No one really showed interest: his approach and experimentation was too unconventional for the times and being shy, he likely did not make enough noise about his experiments.
- Another reason for the absence of any response from the scientific community was likely the limited number of people who read the Brno Association's records.

Written form….

- Mendel asked one of his fellow monks to send forty special reprints to botanists and other distinguished scientific figures known to be interested in the hybridization of plants.

Response….

- Only one response was returned and it was less than favorable. Carl Wilhelm von Nägeli responded that he felt Mendel's data to be "incomplete" and urged him to do more experimentation.
  - Nägeli also offered Mendel "fatal" advice: to continue his investigations using the hawkweed (*Hieracium*), this plant is asexual and returned inconclusive results.

In Charge….

- He was unanimously elected Abbot of the monastery in 1868.
- His election afforded only partial compensation for his disappointment of his "failures".
- His hopes of being able to resume his experiments were dashed by the sheer work load entailed in running the monastery.

His final thoughts...

In 1883, only a matter of months before his death in the following year, Mendel commented, with a hint of resignation mingled with the awareness of the importance of his discoveries:

"My scientific studies have afforded me great gratification; and I am convinced that it will not be long before the whole world acknowledges the results of my work."

Rediscovered….

- 1900: the rediscovery of Mendel's Laws by Carl Correns in Germany, Hugo de Vries in the Netherlands and Erich von Tschermak-Seysenegg in Austria.
- They realized that Mendel had not simply experimented with pea plants, but had actually studied the heredity of specific characteristics as they were passed on from parent plants to their offspring.
- In the early 1920s and early 1930s the full significance of his work was finally recognized with relation to evolutionary theory.