

## **Pedigree Analysis**

This feature is designed to get you thinking about pedigree analysis. It highlights how pedigrees are used by disease researchers, as well as how they can inform patients and families.

Answer the questions throughout this feature. It should help you see that understanding and using pedigree information is not always clear-cut.

Name:

School Name:

Grade:

## It Runs in the Family

When more than one individual in a family is afflicted with a disease, it suggests that the disease might be inherited.

A basic method for determining the pattern of inheritance of any trait, including a disease, is to look at its occurrence in several individuals within a family, spanning as many generations as possible. Family history information is usually combined with information from medical tests, increasingly including genetic tests.

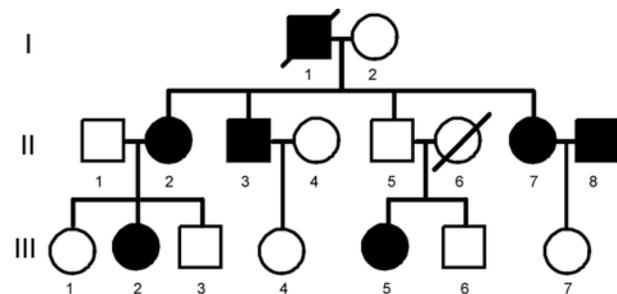
From family history and medical test results, a physician, genetic counselor, or researcher can draw a pedigree. A pedigree is simply a family tree that uses a particular set of standardized symbols.

### Introduction to Pedigree Symbols

- Males are represented by squares.
- Females are represented by circles.
- Filled symbols show individuals who exhibit the trait in question.
- A horizontal line between two symbols represents a mating.
- A vertical line descends from parents to a horizontal line shared by all their offspring.
- A diagonal line through a symbol indicates that person is deceased.
- Roman numerals (I, II, III, ...) represent generations.
- Arabic numerals (1, 2, 3, ...) represent the birth order of siblings.
- Specific combinations of numerals (like II-3) uniquely identify each individual in the pedigree. Many pedigrees do not include numerals.

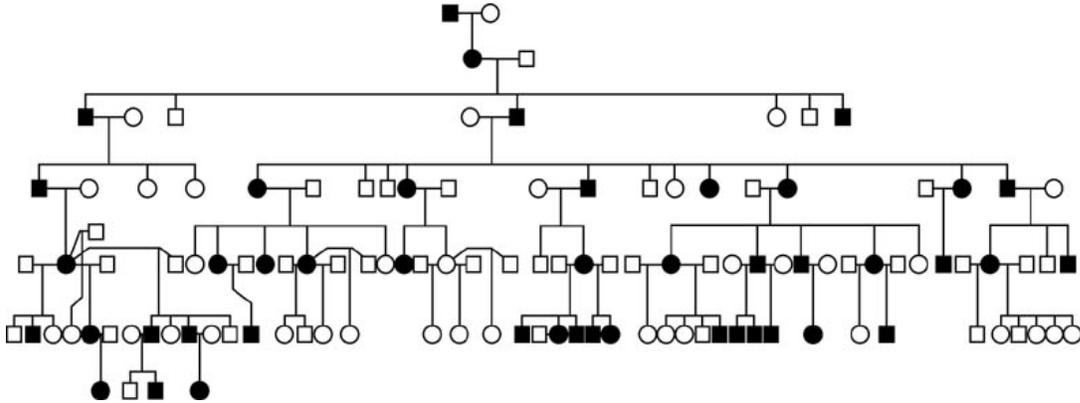
*Q1. Individual II-5 in the pedigree shown to the right is:*

- A) A male who does not exhibit the trait.*
- B) A father.*
- C) Has three affected siblings.*
- D) All of the above.*



Now let's look at a larger pedigree.

## Large Pedigree



This large pedigree was collected from an extended family all living in a small town.

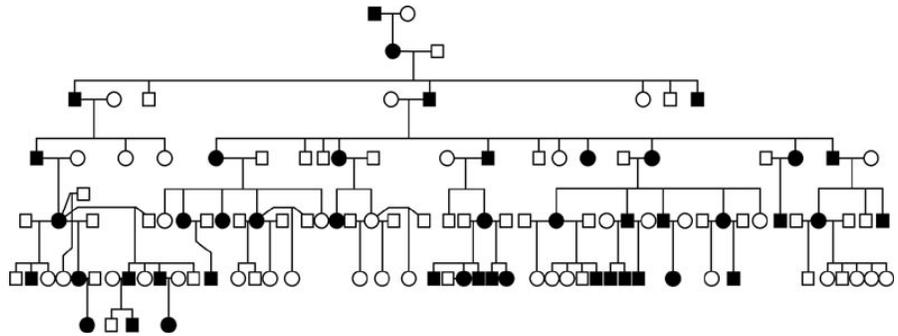
*Q2. This disease is very severe and strikes early in childhood.*

- A) True*
- B) False*

*Q3. This large pedigree shows a dominant trait because:*

- A) Mostly males are affected.*
- B) The family is very large.*
- C) The trait shows up every generation.*
- D) Filled symbols always show dominance.*

## Spinocerebellar Ataxia (SCA1)



The pedigree shows a large extended family affected by SCA1, a dominant disease that disrupts parts of the nervous system.

Most individuals born with SCA1 begin life with normal motor control. As the disease progresses, balance and movement become increasingly affected.

There has been a mystery surrounding the age of onset and severity of symptoms for SCA1. Each generation, individuals are affected by the disease at a younger age, and symptoms are more severe.

*Q4. What might account for the increasing severity and earlier onset of SCA1 each generation?*

- A) There's toxic waste in the town that is getting worse each year.*
- B) Doctors have become more aware of SCA1 and are diagnosing the disease in children earlier than they did in the past.*
- C) People in the town are using their nervous systems in more challenging ways, making symptoms seem more severe.*
- D) The mutation in the SCA1 gene is dynamic and changes each generation to cause a more severe form of the disease.*

## Genetic Testing

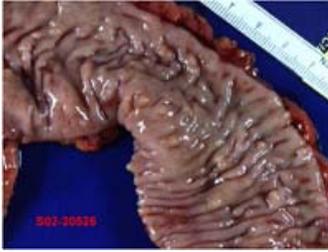
There is no cure for SCA1. Treatments include devices that aid patients' balance, and limited therapies for some of the symptoms.

*Opinion Poll 1. Since there is no cure for SCA1, why should family members be encouraged to have a genetic test?*

- A) Because having the genetic data from these families will help research into the disease.*
- B) Early detection of the disease can help families cope better with affected relatives.*
- C) The information could help individuals decide about marriage and children.*
- D) Relatives should not be encouraged to take a genetic test for mutated SCA1.*

Now let's consider another disease.

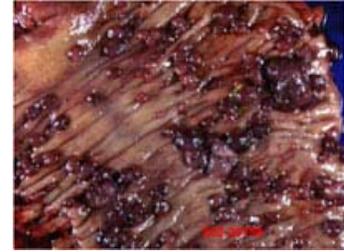
## Colon Cancer Can Run in the Family



*Inside of a normal colon*

Colorectal cancers kill more than 500,000 Americans each year.

Most colon cancers occur sporadically—meaning the disease is not seen to run in families.



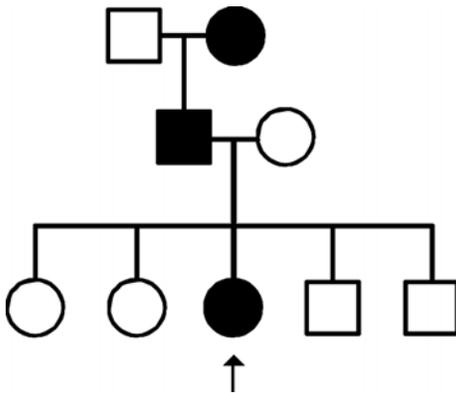
*Inside of a colon with tumors*

There is, however, a form of colon cancer that is inherited, called FAP—Familial Adenomatous Polyposis.

Colon tumors can be detected by endoscopy, a procedure that detects tumors after they have formed. A gene-based test can assess FAP risk before tumors form.

Detecting a mutant form of a gene named APC has been found to be a reliable test for FAP risk.

### FAP Pedigree



A 19-year old girl has been diagnosed with FAP (arrow).

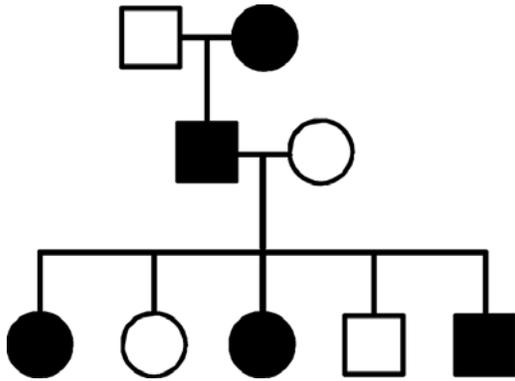
Her father and her grandmother died of colon cancer.

She has four siblings whose risk for FAP has not been determined.

*Opinion Poll 2. The girl should:*

- A) Tell her sibs to get an APC gene test.*
- B) Suggest to her sibs that they visit her genetic counselor.*
- C) Show them the scary pictures from her endoscopy.*
- D) Keep her FAP diagnosis private from her family.*

## FAP



In this case, each sibling decided to be tested for the mutant APC gene.

A sister and brother were found to be at high risk for FAP (filled symbols).

At the molecular level, FAP is known to be a recessive disease—both copies of APC have to be mutated for cancer to be initiated.

The FAP pedigree, however, has the appearance of a dominant trait: Each generation has affected individuals.

*Q5. Why does FAP appear to be dominant?*

- A) Although individuals inherit only one mutant copy of APC, the odds of a mutation occurring in the other copy are high.*
- B) The pedigree is small, and looks dominant because of random chance.*
- C) The father inherited a particularly bad form of the gene.*
- D) The siblings were probably raised in an environment with many cancer-causing agents.*