Fruit breeder hits sweet spot with cotton candy grape
(excerpts from David Pierson, Los Angeles Times August 14, 2013 and Biology: The Dynamics of Life McGraw Hill)

Text Mark Up Directions:
1. Preview and **number** the paragraphs.
2. Read once and **circle the vocabulary** terms; then **define** or write a synonym next to the word.
3. Re-read and **highlight** the main points (per paragraph) and **annotate** (paraphrase) in the margin.

LOS ANGELES — It's not easy peddling fresh fruit to a nation of junk-food addicts. But in rural Kern County, California, David Cain is working to win the stomachs and wallets of U.S. grocery shoppers. Cain is a fruit breeder. His latest invention is called the Cotton Candy grape. Bite into one of these green globes and the taste triggers the unmistakable sensation of eating a puffy, pink ball of spun sugar.

By marrying select traits across thousands of nameless trial grapes, Cain and other breeders have developed patented varieties that pack enough sugar they may as well be Skittles on the vine. That's no accident. "We're competing against candy bars and cookies," said Cain, 62, a former scientist at the U.S. Department of Agriculture who now heads research at privately owned International Fruit Genetics in Bakersfield, Calif.

Although some of these grapes have been bred for higher sugar content, nutritionists don't seem all that bothered. "You would have to eat about 100 grapes to consume the same amount of calories in a candy bar," said David Heber, director of the UCLA Center for Human Nutrition.

Cain's company, in the heart of California's $1.1 billion table grape industry, specializes in bold flavors and exotic shapes. Purple-hued Witch Fingers are long and thin like chili peppers. A variety named Sweet Sapphire come as round and fat as D batteries. Ordinary grapes like the red Flame Seedless can cost as little as 88 cents a pound while the Cotton Candy could fetch around $6 a pound.

Not to be confused with GMO engineering, Cain is following **cross-breeding** techniques that are centuries old. Making a new grape variety involves mating or crossing two different organisms, in this case by transferring pollen from the male grape flower parts (stamen) onto the female flower part (pistil). In 1843, long before the structure of DNA was discovered, **Gregor Mendel**, pollinated pea plants in this way to discover the rules of trait inheritance. Mendel selected pea plants to research because they reproduced sexually with male sperm (pollen) and female eggs (ovules) and because he could control which plants fertilized which by moving the pollen and covering the flowers to prevent interference from wind/bees. After pollination when the pollen was transferred, the male pollen will grow a tubule to meet and fuse with the egg at the bottom of the flower to **fertilize** it. Mendel also carefully controlled his experiments in his Austrian monastery garden by studying only one trait at a time. The tall pea plants he used were from populations of plants that had been tall for many generations and had always produced tall offspring. These plants that consistently produce the same characteristic are said to be **true breeding**.

Mendel repeatedly crossed plant parents with different traits to produce **hybrids** with a blend of traits from both parents to see which physical trait (tall or short) would show up in the offspring. He took true breeding tall parent (P) plants and crossed them with true breeding short parent (P) plants and ALL the offspring in the first generation (F1) were tall. He wondered, "Did the short parent not pass down its trait?" So he covered the first generation hybrid flowers so they would self-pollinate to produce a second generation (F2). He found that the tall first generation plants produced 3/4ths tall second generation plants but $1/4^{th}$ was short! It was as if the short information was hidden and then reappeared!

Mendel concluded that each parent contained two distinct factors (we now call these factors **alleles** or forms of the same **gene** recipes). He also concluded that each parent only passed down one of their two factors (alleles) and furthermore that these factors came in two forms. One form if inherited would always show or even cover up the other form. He called the form that always showed when inherited the **dominant factor (allele**). The other form would only show if there were two copies inherited; one from each parent, and he called these **recessive factors (alleles).** The outward physical appearance or **phenotype** of each plant was determined by their inherited internal gene combination called a **genotype**.

He repeatedly mated two different true breeding plants with each other and produced hybrids to determine which allele factor was dominant. We now know those true breeding plants have two copies of the same allele and are called **homozygous** while those that were hybrids with one allele of each type are called **heterozygous**. This was the case with the tall homozygous parent (TT) crossing with the short homozygous parent (tt) to produce all tall heterozygous (Tt) offspring. Even though the hybrid heterozygous offspring had one of each allele the tall was dominant and won out. When the tall were mated with each other (Tt x Tt) some of their offspring would receive both of the recessive (t) versions and the short phenotype would be visible again. Mendel determined all these basic rules of genetics without even knowing what DNA was! That wouldn't be discovered until over a hundred years later!

1. Read this sentence from paragraph #2 in the article. *"By marrying select traits across thousands of nameless trial grapes, Cain and other breeders have developed patented varieties that pack enough sugar they may as well be Skittles on the vine."* Circle the correct sentence from the article BEST represents what the author means by his use of the term "marrying"?

A. Although some of these grapes have been bred for higher sugar content, nutritionists don't seem all that bothered.
B. Making a new grape variety involves mating or crossing two different organisms, in this case by transferring pollen from the male grape flower parts (stamen) onto the female flower part (pistil).
C. Cain's company, in the heart of California's $1.1 billion table grape industry, specializes in bold flavors and exotic shapes.
D. Mendel also carefully controlled his experiments in his Austrian monastery garden by studying only one trait at a time.

2. Why did Gregor Mendel choose pea plants to perform his breeding experiments?

3. What is a true breeding plant? What is another name for it?

4. What is a hybrid plant? What is another name for it?

5. What is the difference between a dominant allele and a recessive allele? Which was dominant and which was recessive (short or tall)?