LETTER TO THE EDITOR

WILLIAM D. STANSFIELD

In the October 9, 2015, issue of *Science* (vol. 350, no. 6257, pp. 159–160), Gregory Radick published a paper on the history of science titled "Beyond the 'Mendel-Fisher Controversy.'" About 150 years ago, Gregor Mendel published his "Experiments on Plant Hybrids" in 1866. His hereditary studies on the garden pea eventually led to Mendel becoming known as "the father of genetics." Mendel died in 1884 without his paper becoming widely known. In 1900, Oxford biologist W. F. R. Weldon read Mendel's paper and concluded, in a 1902 article, that the observed ratios of yellow vs. green and smooth vs. wrinkled characters were too close to Mendel's expected ratios (3:l, 9:3:3:l, etc.) to be due to chance alone. In October 1900, Weldon informed the mathematician Karl Pearson of Mendel's paper. In his paper of 1902, Weldon made use of Pearson's new chi-square test to support his conclusion. Weldon died in 1906 before he could complete the manuscript of his planned book. In 1936, Cambridge statistician and theoretical geneticist Ronald Fisher reported that he had reanalyzed Mendel's data statistically and found they were improbably good. Fisher proposed that "Mendel was deceived by some assistant who knew too well what was expected." According to Radick, "Mendel's data are indeed improbably good, but that in itself is not evidence of fraud, nor is there any other evidence to suggest fraud. . . . Undoubtedly Mendel suffered from unconscious bias, counting as yellow what ought to have counted as green when it supported his theory." Radick's paper displays color photographs from Weldon's 1902 article, showing a color scale from green to yellow in 24 seeds of two hybrid pea varieties (with the seed coats removed) and differences between the color of a seed's coat and its cotyledons. "Weldon's point was that inherited characters are diverse in ways that a Mendelian perspective, indifferent to developmental context, neither acknowledges nor accounts for."

In an *ABT* Quick Fix article titled "Fuzzy Data Sets" (vol. 69, no. 2, 2007), I suggested that teachers distribute color copies of the cover of the *ABT* issue of January 2007 showing 22 pea seeds with varying degrees of yellow to green and smooth to wrinkled characters. Students would be asked to assign each seed to one of five groups (yellow round; yellow wrinkled; green round; green wrinkled; indeterminate). A class summary sheet is prepared from the student evaluations and used for class discussion. Students who participate in this Quick Fix activity may be surprised to learn that not everyone agrees upon the phenotypes of the 22 seeds. The "indeterminate group" gives students the opportunity to record data that was missing from Mendel's report based on 7324 seeds, 5474 of which had the dominant character of roundness (74.74% observed; 75% expected in a 3:1 ratio). Walden was more concerned with Mendel's deterministic view of dominance as something an inherited character possesses independently of its developmental or environmental context. "The manifest character can be dominant, or recessive, or neither." I believe that students should be introduced to "fuzzy (subjective) data sets" such as this before they encounter them in their biology or other scientific papers. Now that Radick's article is available, I suggest that it should be assigned reading to all students for "broader critiques of Mendel's legacy."

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Editor's Note Great Minds Think Alike

In the February issue (vol. 78, #2) of this journal, we included an article by Steven Autieri outlining a clever strategy relating genotype and phenotype called "Design-o-Saurs: Using Inquiry to Reinforce Aspects of the Relationship between Genoytpe and Phenotype." As the February issue was being prepared for publication, Steven contacted me with an amazing coincidence. Long after his article was written, submitted, reviewed, accepted and edited, he found another similar strategy called "Design-O-Saur" by Barbara Rafferty and Joy Gaughan on the web at http://www.beyondbenign.org/K12education/biotech_hs.html. This other strategy shared both a title and a basic instructional strategy thus reinforcing the notion — common even in science — that a good idea is impossible to suppress. We are pleased to acknowledge and recommend the work of Rafferty and Gaughan, even though it in no way influenced Steven Autieri's contribution to *American Biology Teacher*. One wonders what Charles Darwin and Alfred Russel Wallace might think about such a coincidence!