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A Cases for Evolution Education Question Guide
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The Case of Seed Taste Evolution in Pea Plants

This Evo-Ed case consists of five modules that support the teaching and learning of biology in the framework of artificial selection of peas, *Pisum sativum*. Together, the modules present evidence that evolution occurs because of:

1) competition for resources and differential reproductive success in populations

2) heritable genetic variation and resulting differences in gene expression.

The following activities are designed to guide students' learning as they engage in the modules of this case. They can also be used as learning objectives. That is, "students will be able to" accomplish each of these as objectives.

The modules and activities are presented in the order in which they appear in the case and can be used as in-class activities, homework and/or formative assessments.

The background information on this case, and accompanying slides can be found at:
→ www.evo-ed.org/Pages/Peas

Natural History of Round and Wrinkled Peas

1) Research the environmental conditions under which modern day "wild" pea plants grow. Contrast that with how domestic pea plants are grown for human consumption.

2) Develop a hypothesis regarding circumstances that would allow a domestic population of pea plants to revert to the wild type.

3) Determine both the cultural (onset of agriculture) and biological aspects of domestication of Pisum sativum.

The Cell Biology of Round and Wrinkled Peas

1) Make a model that connects the inputs and the outputs of the Calvin cycle to the light dependent reactions.

2) Determine the source of the atoms in the final product of photosynthesis, G3P: O2 and C3H7O6P.

3) Develop a general explanation/model for the role of enzymes in biological reactions and the possible consequences of a change in a single amino acid of that enzyme. Explain how your model relates to smooth and wrinkled peas.

4) Using the information in the slides, explain how blocking starch synthesis leads to the accumulation of sugar in pea seeds.
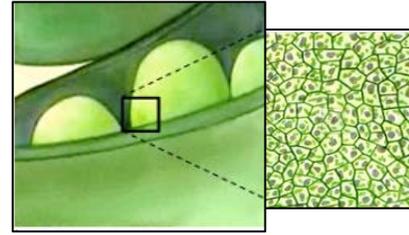
From Mendel to Molecules

1) Explain Mendel's rules of inheritance in terms of meiosis. Using the events of meiosis apply Mendel's rules to alleles of the gene for pea taste.

2) Defend or refute this statement: R and r alleles show a typical dominant/recessive relationship.

3) Determine patterns of inheritance of pea characteristics using data collected by Mendel. [students provided data sets for analysis].
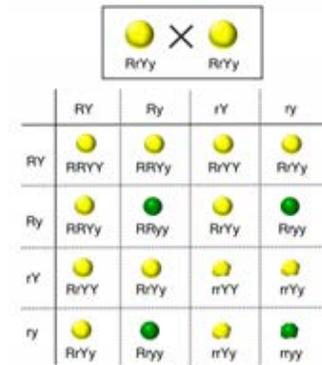
The Molecular Genetics of Round and Wrinkled Peas

1) Explain, in terms of protein function, why the R allele is dominant over the r allele.

2) Explain why the RR and Rr genotypes produce round peas in terms of alleles and gene expression.

3) Explain, in terms of protein function, how traits for "pea taste" are expressed when alleles are homozygous or heterozygous. [similar to above tasks]

4) Construct an explanation for how the sbe1 loss-of-function mutation is evolutionarily important (or not) for humans and non-humans.

5) Develop a simple whiteboard animation or video showing how a change in DNA can lead to a change in gene expression and cell function. Provide both the general changes and the specific one in this case (sbe1).
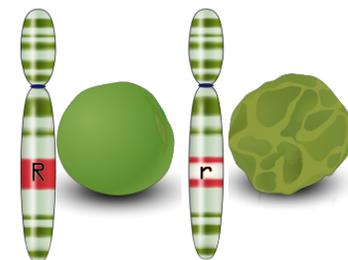
The Population Genetics of Round and Wrinkled Peas

1) Construct an explanation for a steady increase in r alleles in a defined population of peas being domesticated over time.

2) Based on data collected form the Online Farming Simulator, perform the following tasks:

   a. Determine whether, when selecting for round peas, you can eliminate the r allele in the population. Explain why/why not.

   b. Determine whether, when selecting for wrinkled peas, you can eliminate the R allele in the population. Explain why/why not.

3) Explain what data collected under the "no selection" option indicate about both artificial and natural selection.

4) Darwin used artificial selection as a model for natural selection. Construct arguments that both support and refute the use of artificial selection as a model for natural selection.