SEXUAL AND ASEXUAL REPRODUCTION

INSTRUCTIONS

Overview:

In this lesson, students examine distinctions between sexual and asexual reproduction, processes of sexual and asexual reproduction, and advantages and disadvantages of each.

Objectives:

The student will:

- identify and define concepts and processes of sexual and asexual reproduction; and
- identify and describe similarities, distinctions, advantages, and disadvantages of sexual and asexual reproduction.

Targeted Alaska Grade Level Expectations:

Science

[6-7] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[6] SC1.1 The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by recognizing sexual and asexual reproduction

[7] SC1.1 The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by comparing and contrasting sexual and asexual reproduction.

Vocabulary:

asexual reproduction – the process, generally limited to unicellular organisms, by which a single parent reproduces by itself, and is therefore the sole contributor of genes to the offspring

chromosome –a single strand of supercoiled DNA that packages and carries on certain traits to offspring during reproduction

female –a participant in sexual reproduction that produces egg cells

fertilization – the process in sexual reproduction in which male and female reproductive cells join to form a new cell

gamete – a sexual reproductive cell; either a sperm cell or an egg cell

male –a participant in sexual reproduction that produce sperm cells

sexual reproduction –reproduction involving the union or fusion of a male and a female gamete; the primary means of reproduction in multicellular organisms

zygote –a fertilized egg

Materials:

- VISUAL AID: "E. coli"
- MULTIMEDIA: "E. coli growth" (http://upload.wikimedia.org/wikipedia/commons/2/27/E.-coli-growth.gif)
- STUDENT WORKSHEET: "Chromosome Templates"

Activity Preparation:

1. Print or project VISUAL AID: "E. coli."
2. Prepare Chromosome templates from supplementary page by copying and cutting apart, so that small groups of students have five per group (for sexual reproduction) and that the teacher has at least two (for asexual reproduction).

Activity Procedure:

1. Begin by describing to students chromosome as a container of information, a way of packaging and describing characteristics about themselves and other organisms so that those details might be passed on through reproduction.
2. Display for students the VISUAL AID: "E. coli" and solicit descriptions of apparent characteristics to list on chromosome template. (Note: bacteria chromosomes are circular.)

   NOTE: It may be helpful to point out that even though E. coli looks a bit different in each of the images, differences are only due to manipulation (i.e., dyes or digital tinting) for the purpose of highlighting characteristics of the organism. In reality, the differences don't exist. Some context about E. coli (that's it's commonly found in our intestines, and can potentially carry disease, for example) could be useful as well.

3. Once the class has come up with five characteristics (examples, in case class has difficulty: round, cylindrical, flagella, rough surface, tendency to cluster), print a different characteristic (by appropriate initials, in capital letters) in each of the five sections of one of the chromosome templates.
4. After the class sees the representation of one E. coli bacterium on a chromosome, place another blank chromosome on top of the completed one and trace the capital letters onto the blank one and then separate the two, simulating asexual reproduction. Highlight that the two resulting individuals have identical characteristics and no variation has occurred.

   NOTE: If appropriate and desired, students might be shown the E. coli colony animation located at http://upload.wikimedia.org/wikipedia/commons/2/27/E.-coli-growth.gif to see a brief depiction of the way bacteria reproduce and grow.

5. Next, solicit from class discussion general, common, and binary traits (although, not all human traits are binary) we/they share such as hair color; eye color; tall/short; toe length (if second toe is longer than big toe); tongue (if it curls or not). Display five of these singular traits, in capital letter initial form, along with their binary opposite, in matching lower case letter initial form, for the class to see. For example (simplified), list hair color binary as "B" for brown hair and "b" for red/blonde/black hair.
6. Divide students into groups of two or three, and distribute to each group five blank chromosome templates. Instruct them to fill in two of these templates with trait letters from those displayed, selecting either a capital letter trait or a lower case letter trait for each of the two templates' sections.
7. After they have completed the two individual chromosomes, have groups copy them exactly to two other chromosomes, similar to the E. coli's asexual reproduction. Explain here that copies created can represent gametes, or reproductive cells - sperm cells for males, egg cells for females. Since gametes cannot live and grow on their own the way a bacteria can, these reproductive cells must combine to form a zygote, or fertilized egg.
8. To represent this zygote, instruct to students to look at the combination of gametes they have created and to select between the traits they have represented according to the capital/lower case distinction - that is, the letters (traits) chosen to be printed in each section of the zygote should be the capital letters represented on the gametes. If both gametes contain a capital letter in the same section, there is no difference and this letter is carried to the zygote. If (and only if) both gametes contain a lower case letter in a section, however, students should use this lower-case letter.

   Critical Thinking Activity. ***Genes and Their Effects.*** After student groups have completed this simulation of sexual reproduction, keep them in their groups and ask them to reflect on the resulting zygote or individual. How is this individual similar to its "parents?" How is it different? If parent chromosomes had included different traits, how would this have changed the resulting offspring?

9. Considering these models for reproduction, discuss with students the differences, highlighting that the first method not only took less time, but also required fewer participants; that is, each E. Coli bacteria can

reproduce, asexually, an equal number of offspring as the sexual partners, without the need for a mate. Asexual reproducers can also benefit from identical offspring—each resulting cell contains the same genetic information as the original.

10. Highlight the relative benefits of sexual reproduction, namely that since parents combine to mix genetic information and resulting traits, offspring produced are varied and diverse. Discuss with class why this might be beneficial. Are parent traits always ideal? Might variation and diversity from parent traits, in offspring, sometimes lead to relative strengths? What if environmental conditions change? Highlight potential for increased disease resistance (if parent is vulnerable to certain disease, genetic diversity increases likelihood offspring may be immune and may still sustain lineage).

Extension Ideas:

1. Continue the discussion of genetic diversity by soliciting or providing examples of environmental changes that may lead to new difficulties for previously successful species/populations. If these species produced genetically identical offspring, how would they adapt? Consider the example of the Cheetah bottleneck, leading directly to full exploration of selection and adaptation of GLE [6] SC1.2.
2. As a side effect of this activity, students become familiar with the use of a capital/lower case initial system for dominant and recessive traits. As a result, it may be helpful to further develop this system in anticipation of the more detailed genetic discussions of GLEs [7] SC1.2 and [8] SC1.1 and, perhaps, Punnett Squares.

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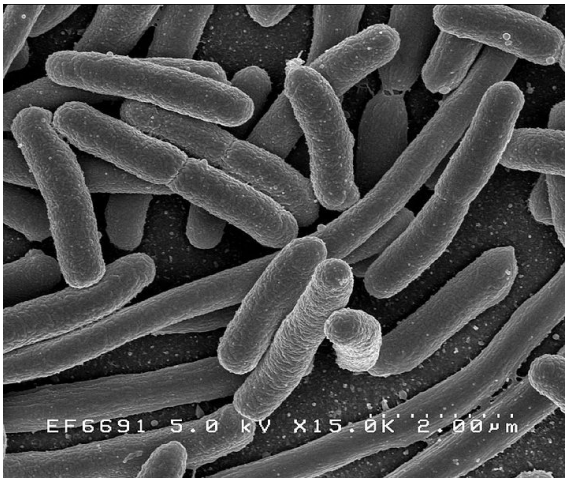

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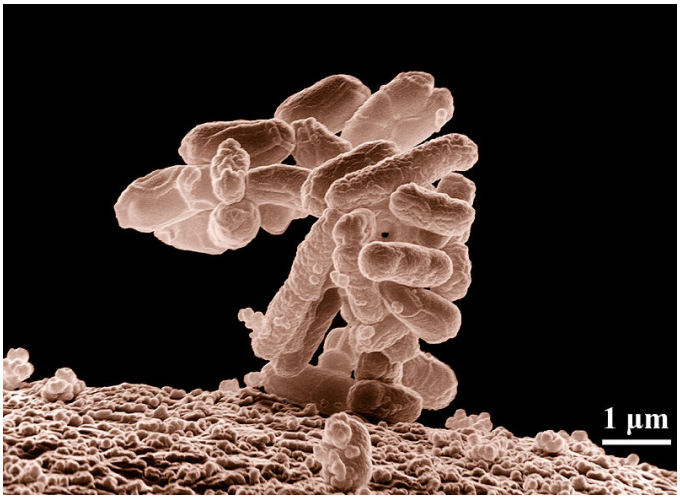

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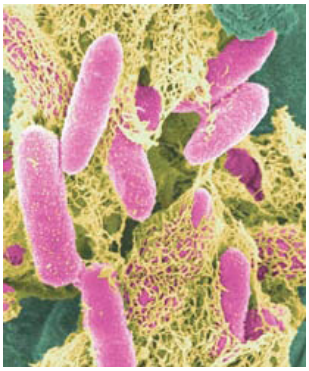

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STUDENT WORKSHEET

CHROMOSOME TEMPLATES