SEXual Reproduction Review Pack KEY.

Extending/Further Opening Inquiry	Students could investigate the causes of nondisjunction of chromosomes in meiosis and oogenesis specifically, as well as the connections with maternal age. Additionally, students could research the links between aneuploidy and solid tumour cancers.

Math Connections

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Genetic disorder: Encourage students to gather data such as frequency within population and life expectancy, compared to population without disorders.

Topic 1.3 Assessment

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Check Your Understanding Answers

1. Gametes are reproductive or sex cells. Gametes combine together during the process of fertilization to produce a single cell called a zygote.

2. a) The body cells of a cat have 38 chromosomes. All gametes, including sperm cells, have been produced by the process of meiosis, which reduces the number of chromosomes in half. So there are 19 chromosomes in sperm cells of cats.

   b) In fertilization, a haploid egg, with 19 chromosomes, with fuses with a haploid sperm cells, also with 19 chromosomes, to produce a diploid zygote with 19 + 19 chromosomes, or 38 chromosomes. Thus the zygote has the diploid number of 38 chromosomes, the same number as all body cells in the new cat.

3. Meiosis is important because it produces haploid gametes, which when fused during fertilization result in a zygote with the correct diploid chromosome number.

4.

Question	Result of Meiosis
How many cells are produced for every cell that undergoes meiosis?	4 cells produced (sperm) [1 egg cell produced, plus 3 polar bodies, that disintegrate - extending the knowledge]
How do parent and daughter cells differ genetically?	Daughter cells (gametes) have half the DNA from each parent
How do daughter cells compare to each other ?	All gametes produced by meiosis are genetically different

5. A labradoodle can result from the mating of a Labrador retriever and poodle since the offspring in sexual reproduction combines the genetic information of both parents. Both poodles and Labs are breeds of the same species, so they can mate sexually, and the puppies produced would have some traits of both parents.

6. a) Twins resulting from two different eggs fertilized by two different sperm would only be as genetically similar as any siblings, and would be fraternal twins. Fraternal twins can then be the same sex, or different sexes, but otherwise, only share the same birth date and same parents. Only twins that result from one egg fertilized by one sperm, that unusually separates into two distinct individuals very early in embryonic development would yield identical twins. Since identical twins are genetically identical, they have all of the same DNA, which could only result from a single zygote dividing into two different offspring.

   b) Zygote is a term referring to the first, single diploid cell produced by the fertilization of an egg by a sperm. Fraternal twins are called dizygotic twins since this means two zygotes. Dizygotic describes the two separate eggs fertilized by two separate sperm, resulting in two zygotes. Identical twins are called monozygotic, or single zygote, since only one egg is fertilized by only one sperm, and results in only one zygote. Only after a few cell divisions by mitosis does the monozygote divide into two separate embryos, which develop into two separate individuals.

7. Sexual reproduction involves the combination of eggs and sperm by fertilization, to produce the offspring. The flower that self-pollinates still has eggs combining with sperm from the pollen to produce seeds. Whether the eggs and sperm come from the same individual plant or separate male and female plants, the seeds will still be a new combination of genetic information due to fertilization of an egg by a sperm—the hallmark of sexual reproduction.

Other Assessment Opportunities

- Rubrics for Curricular Competencies, as well as a wealth of additional rubrics, checklists, and general blackline masters are available to provide many avenues for assessment. Consult the Course Overview section.

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1.

Advantages	Disadvantages
• very fast; huge number of offspring produced quickly • no energy needed to find mates, since 1 parent only • short maturation time, can start reproducing when young • if parent is successful in the environment, and the environment is stable, then the offspring will likely be successful too	• genetically identical offspring are produced, no variety • if the environment changes, all offspring are equally vulnerable to the change, and may all be wiped out

2. Genetic variation refers to the difference in the DNA sequences of individuals in a species. Lack of genetic variation is caused by asexual reproduction. It can also occur in small population sizes of endangered species, due to overhunting or overharvesting, the loss of habitat, or competition by introduced pest species.

3. There are 2^{23} different combinations of chromosomes for any one parent's haploid eggs or sperm. When fertilization fuses the egg and sperm, there are $2^{23} \times 2^{23}$, or 2^{46} different offspring possible, from the same mother and father. Each generation produced by sexual reproduction builds upon this vast amount of variation, especially when new members join the family as parents.

4. Reproduction using both asexual and sexual reproduction allows plants to take advantage of all environments and situations. They can rapidly increase in number in favourable, stable environments, using asexual reproduction, while sexual reproduction ensures there is enough genetic variation in the population if the environment or conditions change. In this way, there should always be many members of the population that survive any condition, leading to long-term success for plants.

5. Overall reproduction of an organism is not necessary for the survival of an individual, but it necessary for the survival of a species. As long as at least the same number or more new individuals of a species are produced than die, the species will survive, and avoid extinction. Cellular reproduction (asexual reproduction) is necessary for the survival of an individual; otherwise they would not grow and develop, or be able to repair wounds.

6. A long gestation period is a disadvantage of sexual reproduction, as it leads to fewer offspring over time. The longer the gestation period, the longer the gap of time between pregnancies, and the fewer pregnancies per time.

7. Student answers should include ideas that support any argument. Stating that asexual and sexual reproduction are equally important, and that neither one is better could be supported by showing that they are both important in the production of most higher animals, including humans, since the zygote is formed by sexual reproduction, but the trillions of cells that form and sustain a human are produced by asexual reproduction and mitosis. Both asexual and sexual reproduction are necessary methods in the natural world, and allow for life on Earth. sexual reproduction could be the better form of reproduction if speed is the criteria, as far more offspring are produced in the same amount of time. Sexual reproduction could be seen as the better reproductive method if genetic diversity and variation are most important, as asexual methods produce only clones.

8. a) Students may have difficulty finding published or online traditional stories about the white bear. There are some sites that retell a narrative but they do not give any sources or attribution, so it is difficult to know how authentic they are. This might be a place to discuss the Curricular Competency to critically analyze secondary sources. One of these sources is found at the website http://bcspiritbear.com/spirit-bear-legends/. Discuss with students what evidence there is that that is a traditional story passed down by Tsimshian People. How could they find out if it is an authentic story?

   b) From a genetics standpoint, the Kermode bear is has a rare recessive homozygous trait for lack of pigment, caused by a single base difference, changing G to A, causing one amino acid to change from tyrosine to cystine in one gene. In terms of population studies, there are between 10% to 25% white bears on certain islands on the northwest coast of BC, where they have had a long history. The trait may have occurred by genetic drift in the smaller population of black bears on Gribbell Island or Princess Royal Island.

   c) The First Peoples accounts of the Spirit Bear and Western science explanations are similar in showing that the Spirit Bear is a special and unique creature. The two accounts differ in the source of the Spirit Bear's white colouring.

Math Connections

Page 69

Connecting Ideas, question 6: Students can visit San Jose State University: Gestational Periods and Animal Scale to research and plot data for gestation period vs. mass of various animals. Students can also research and compare predator data to prey data.

Other Assessment Opportunities

Rubrics for Curricular Competencies, as well as a wealth of additional rubrics, checklists, and general blackline masters are available to provide many avenues for assessment. Consult the Course Overview section.

TEXT pg 76 KEY

cell's genetic information. Other organelles may be included as well, such as ribosomes, endoplasmic reticulum, and Golgi apparatus.

5. Answers should indicate animal cells being more spherical, rounded or flexible in shape, not having a cell wall, large vacuole, or chloroplasts as found in plants. The similarities between animal and plant cells should include both having the nucleus as the location of the cell's genetic information. An animal cell nucleus would typically be the largest cell organelle, but it would be smaller than the vacuole region in a plant cell. Additionally, both animal and plant cells would have a cell membrane, as well as ribosomes, endoplasmic reticulum, and Golgi apparatus.

6. An organism's genetic material exists in the form of DNA. When a cell prepares to divide, the very large DNA molecule condenses into separate structures called chromosomes.

7. a) DNA is the molecule that stores genetic information.

   b) DNA must be duplicated during the interphase portion of the cell cycle so that a double, complete set of the cell's genetic information is available for mitosis to take place. Only then can the chromosomes be evenly divided during mitosis so each daughter cell receives a full copy of the genetic material from the parent cell.

8. Before bacteria reproduce using binary fission, the DNA sequence is replicated or copied, producing two DNA strands with the same exact sequence. Then the cell divides into two, each one with their own copy of the DNA. hus, one parent cell produces two individual, identical daughter cells, each containing the same DNA as the parent cell.

9. Genetic variation is very important to the survival of a species, as it produces some individual differences between individuals. If conditions vary, genetically identical organisms could all die, as they are all equally vulnerable to changes. But variation in the genetic information between members of a species would allow for differential survival. Even slight genetic differences could mean that some individuals within a population can survive in the changed conditions, and are able to reproduce and the population can continue.

10. Yes, it is an example of mitosis. Replacement of any cells in a multicellular organism is accomplished by the process of mitosis, as this copies the individual's DNA exactly to produce more identical cells. For example, skin cells are constantly dividing and producing new skin cells, as the outer, dead skin cells are constantly worn off.

11. a) Meiosis is necessary for reproduction of individuals in a population. It produces gametes, the eggs in females, and sperm in males. These are haploid cells, having only 23 chromosomes in humans, instead of the usual diploid number of 46 chromosomes in all other cells. Then, when the egg and sperm join during fertilization, the zygote will have the correct total number of chromosomes, or 46. If eggs and sperm were produced by mitosis, they would still be diploid and each have 46 chromosomes. Combining an egg and a sperm would then result in a zygote with double the human number, at 92 chromosomes, making the zygote inviable.

   b) All other facets of human development require the process of mitosis. This includes the single celled zygote dividing by mitosis a vast number of times in order to produce a human, with our trillions of cells. All of the pre-natal developmental stages, including embryonic and fetal development, occur by

mitosis, as well as the growth of a human after birth, all the way to his or her adult size. Ongoing repair and replacement of cells throughout the human's lifetime is also done by mitosis. Mitosis is the necessary process for all of these steps, since not only can it be a very rapid cell division process, but more importantly, it is the only process that ensures every daughter cell has identical DNA or genetic information to the parent cell, and thus, codes for all the necessities of that particular human life. If meiosis was used for any of these steps, the cells produced would be haploid, with only half the correct chromosome number, not capable of independent existence, and not able to be useful as the cells for any part of the individual.

12. Sexual reproduction is an advantage for an organism as it produces great genetic diversity of gametes, and also genetic diversity of the subsequent offspring, with two different parents. This increases the ability of a population to survive and thrive in varying conditions. Disadvantages of sexual reproduction include the great deal of energy and time expended finding a mate, fewer offspring are produced than by asexual reproduction, there is a longer amount of time before an organism is sexually mature and can reproduce, and there may be a great deal of time and energy spent by parents raising offspring.

13. a) Answers should include one of a variety of vegetative propagation methods discussed. For example, strawberry plants producing new plants at the end of horizontal stems called runners, 'piggyback' plants producing new plants on the leaves of the parent plants, or spider plants producing new plantlets along aerial stolons.

b) Each example used for plant asexual reproduction would involve only one parent, and the new plants would be produced by mitosis. This would mean that the offspring are all genetically identical to the parent plant, and to each other.

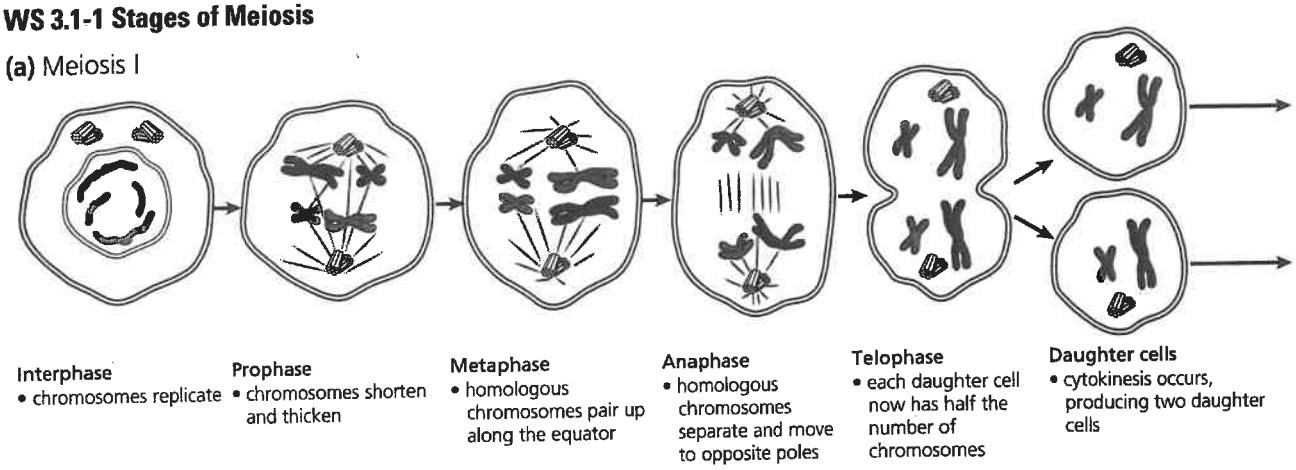
c) Examples include farmers and gardeners making use of relatively simple, quick and affordable plant asexual reproduction methods such as potato tubers cut and planted, daffodil and tulip bulbs separated, leaf cuttings of African violets, stem cuttings of geraniums and ivy, peony and lily roots divided, grafting new twigs on fruit trees, layering of climbing roses or willows, air layering of tropical plants, or tissue culture of trees.

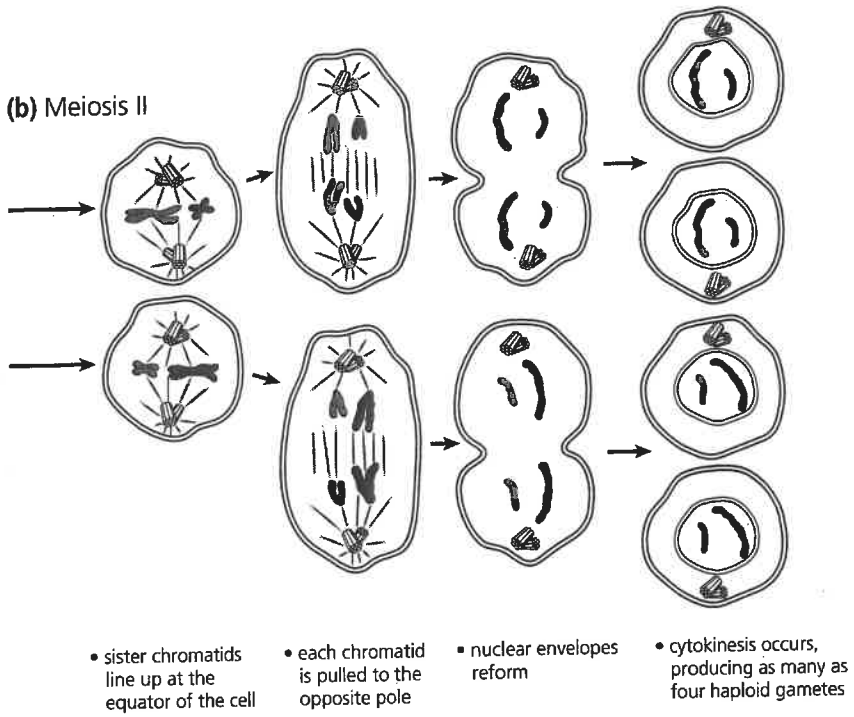
14. Comparison of Mitosis and Meiosis

Question	Mitosis	Meiosis
How many cells are produced for every cell that begins?	2	4 (sperm) 1 (egg) + 3 polar bodies
How do parent and daughter cells compare to each other?	Genetically identical	Parent cells are diploid Gametes produced are haploid (half the number of chromosomes)
How do daughter cells compare to each other?	Genetically identical	Genetically diverse, all different

KEY.

WS 3.1-1 Stages of Meiosis



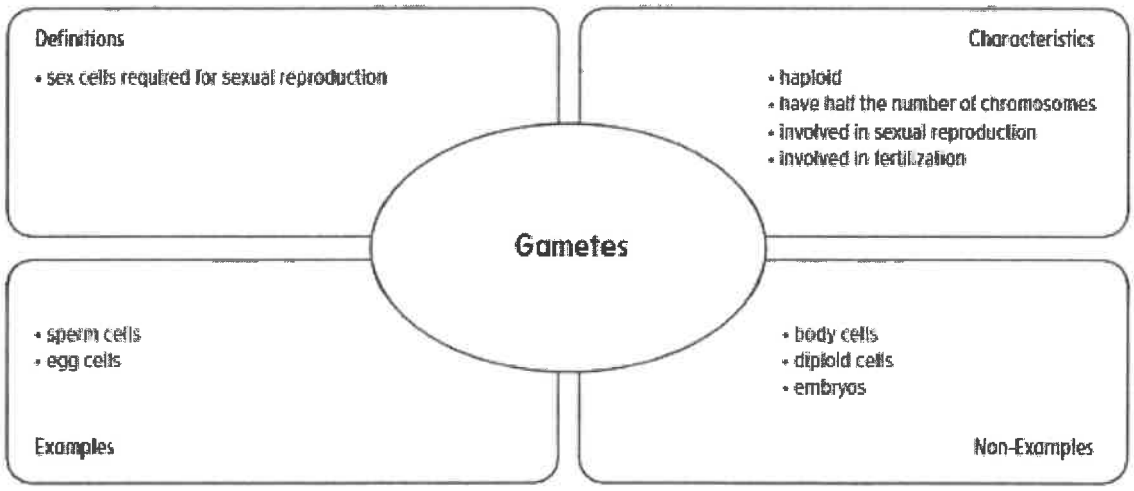


WS 3.2-1 A Comparison of Sexual and Asexual Reproduction

Use BLM 3.2-1 as an answer key.

1.3 Assessment, pages 31–33

1. C
2. A
3. E
4. D
5. B
6. A
7. C
8. B
9. A
10. B
11. C
12. C
13. D
14. A
15. D
16. A
17. D
18. D
19. C
20. B
21.



Disadvantages of Asexual and Sexual Reproduction, page 39

1. asexual reproduction
2. sexual reproduction
3. sexual reproduction
4. asexual reproduction
5. sexual reproduction
6. asexual reproduction
7. sexual reproduction
8. sexual reproduction
9. asexual reproduction
10. sexual reproduction
11. asexual reproduction
12. sexual reproduction
13. sexual reproduction
14. asexual reproduction

1.4 Assessment, pages 40–41

1. C
2. B
3. A
4. C
5. B
6. B
7. D
8. A
9. D
10. B

11. **Sexual Reproduction**

Advantages	Disadvantages
1. It promotes genetic diversity in a population producing unique individuals.	1. It requires two parents
2. Since offspring are not identical to the parents, if an environmental change occurs, the entire population would not be vulnerable to that change.	2. It takes time to find a mate
3. More variation in the genetic information make the population less susceptible to disease.	3. There is competition in finding a mate. Males may have to fight for the female, resulting in death or injury.
	4. It requires a lot of energy to find a mate and reproduce.
	5. It requires a lot of resources to raise the offspring until they are mature enough to be independent.
	6. It produces fewer offspring.

Embryonic Development Practice KEY.

1. What is the name of the cells which form during cleavage?
a. Blastula
b. Gastrula
c. Blastocoel
d. Blastomere

2. What is the name of the phase, when the embryo has 16 blastomeres (i.e., cells)?
a. Bastomere
b. Blastula
c. Morula
d. Gastrula

3. What is the name of the phase, when the embryo resembles a hollow multicellular ball?
a. Blastula
b. Blastopore
c. Bastomere
d. Blastocoel

4. In morula the embryo resembles a _____
a. Banana
b. Apple
c. Raspberry
d. Cucumber

5. What is the name of the simple backbone that can be seen during the development of a baby?
a. Neural plate
b. Notochord
c. Neural crest
d. Neural tube

6. Differentiation starts in _____
a. Morula
b. Blastula
c. Gastrula
d. Blastocoel

7. The name of the fluid filled cavity in the blastula is the _____
a. Blastopore
b. Blastomere
c. Blastocoel
d. Morula

8. The number of cells normally associated with the term morula
a. 2
b. 4
c. 8
d. 16

9. The number of germ layers that occur in the gastrula is
a. 1
b. 2
c. 3
d. 4

10. A developing child is considered a fetus when
a. 16 cells form
b. After 1 month
c. When organs start to develop
d. When gastrulation starts to occur

11. The cells of the embryo are _____
a. Differentiated
b. Stem cells
c. Undergoing meiosis
d. Genetically unique

12. External fertilization is common in _____
a. Terrestrial animals
b. Birds
c. Humans
d. Aquatic species