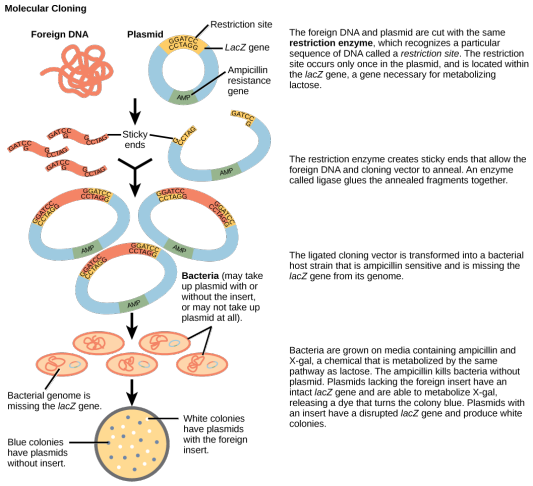
Biology 2e
Unit 3: Genetics
Chapter 17: Biotechnology and Genomics

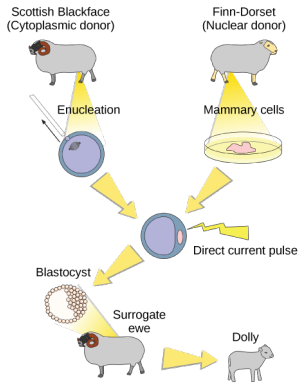
Visual Connection Questions

1. You are working in a molecular biology lab and, unbeknownst to you, your lab partner left the foreign genomic DNA that you are planning to clone on the lab bench overnight instead of storing it in the freezer. As a result, it was degraded by nucleases, but still used in the experiment. The plasmid, on the other hand, is fine. What results would you expect from your molecular cloning experiment?



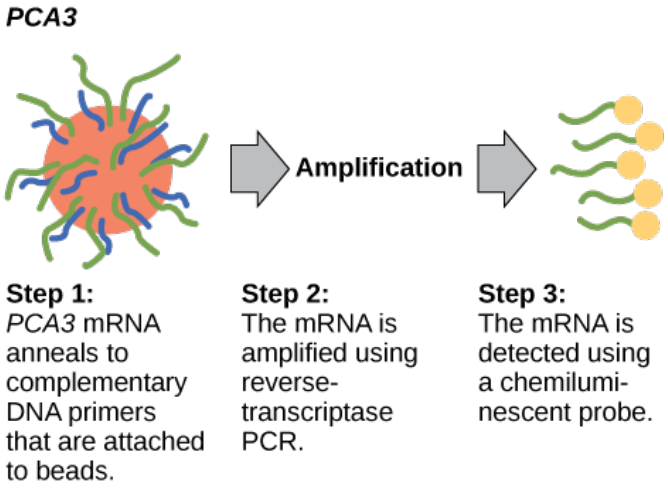
b. The experiment would result in blue colonies only.

2. Do you think Dolly was a Finn-Dorset or a Scottish Blackface sheep?



Dolly was a Finn-Dorset sheep because even though the original cell came from a Scottish Blackface sheep and the surrogate mother was a Scottish Blackface, the DNA came from a Finn-Dorset.

3. In 2011, the United States Preventative Services Task Force recommended against using the PSA test to screen healthy men for prostate cancer. Their recommendation is based on evidence that screening does not reduce the risk of death from prostate cancer. Prostate cancer often develops very slowly and does not cause problems, while the cancer treatment can have severe side effects. The *PCA3* test is considered to be more accurate, but screening may still result in men who would not have been harmed by the cancer itself suffering side effects from treatment. What do you think? Should all healthy men be screened for prostate cancer using the *PCA3* or PSA test? Should people in general be screened to find out if they have a genetic risk for cancer or other diseases?



There are no right or wrong answers to these questions. While it is true that prostate cancer treatment itself can be harmful, many men would rather be aware that they have cancer so they can monitor the disease and begin treatment if it progresses. And while genetic screening may be useful, it is expensive and may cause needless worry. People with certain risk factors may never develop the disease, and preventative treatments may do more harm than good.

Review Questions

4. GMOs are created by _____.

b. introducing recombinant DNA into an organism by any means

5. Gene therapy can be used to introduce foreign DNA into cells _____.

c. of tissues to cure inheritable disease

6. Insulin produced by molecular cloning:

b. is a recombinant protein

7. Bt toxin is considered to be _____.

b. an organic insecticide produced by bacteria

8. The Flavr Savr Tomato:
d. all of the above (is a variety of vine-ripened tomato in the supermarket, was created to have better flavor and shelf-life, does not undergo soft rot)

9. ESTs are _____.
d. all of the above (generated after a cDNA library is made, unique sequences in the genome, useful for mapping using sequence information)

10. Linkage analysis _____.
b. is based on the natural recombination process

11. Genetic recombination occurs by which process?
b. crossing over

12. Individual genetic maps in a given species are:
a. genetically similar

13. Information obtained by microscopic analysis of stained chromosomes is used in:
d. cytogenetic mapping

14. The chain termination method of sequencing:
a. uses labeled ddNTPs

15. Whole-genome sequencing can be used for advances in:
d. all of the above (the medical field, agriculture, biofuels)

16. Sequencing an individual person's genome
d. all of the above (is currently possible, could lead to legal issues regarding discrimination and privacy, could help make informed choices about medical treatment)

17. What is the most challenging issue facing genome sequencing?
b. the ethics of using information from genomes at the individual level

18. Genomics can be used in agriculture to:
d. all of the above (generate new hybrid strains, improve disease resistance, improve yield)

19. Genomics can be used on a personal level to:
a. decrease transplant rejection

20. What is a biomarker?
b. a protein that is uniquely produced in a diseased state

21. A protein signature is:
d. a unique set of proteins present in a diseased state

Critical Thinking Questions

22. Describe the process of Southern blotting.

Southern blotting is the transfer of DNA that has been enzymatically cut into fragments and run on an agarose gel onto a nylon membrane. The DNA fragments that are on the nylon membrane can be denatured to make them single-stranded, and then probed with small DNA fragments that are radioactively or fluorescently labeled, to detect the presence of specific sequences. An example of the use of Southern blotting would be in analyzing the presence, absence, or variation of a disease gene in genomic DNA from a group of patients.

23. A researcher wants to study cancer cells from a patient with breast cancer. Is cloning the cancer cells an option?

Cellular cloning of the breast cancer cells will establish a cell line, which can be used for further analysis.

24. How would a scientist introduce a gene for herbicide resistance into a plant?

By identifying an herbicide resistance gene and cloning it into a plant expression vector system, like the Ti plasmid system from *Agrobacterium tumefaciens*. The scientist would then introduce it into the plant cells by transformation, and select cells that have taken up and integrated the herbicide-resistance gene into the genome.

25. If you had a chance to get your genome sequenced, what are some questions you might be able to have answered about yourself?

What diseases am I prone to and what precautions should I take? Am I a carrier for any disease-causing genes that may be passed on to children?

26. Why is so much effort being poured into genome mapping applications?

Genome mapping has many different applications and provides comprehensive information that can be used for predictive purposes.

27. How could a genetic map of the human genome help find a cure for cancer?

A human genetic map can help identify genetic markers and sequences associated with high cancer risk, which can help to screen and provide early detection of different types of cancer.

28. Explain why metagenomics is probably the most revolutionary application of genomics.

Metagenomics is revolutionary because it replaced the practice of using pure cultures. Pure cultures were used to study individual species in the laboratory, but did not accurately represent what happens in the environment. Metagenomics studies the genomes of bacterial populations in their environmental niche.

29. How can genomics be used to predict disease risk and treatment options?

Genomics can provide the unique DNA sequence of an individual, which can be used for personalized medicine and treatment options.

30. How has proteomics been used in cancer detection and treatment?

Proteomics has provided a way to detect biomarkers and protein signatures, which have been used to screen for the early detection of cancer.

31. What is personalized medicine?

Personalized medicine is the use of an individual's genomic sequence to predict the risk for specific diseases. When a disease does occur, it can be used to develop a personalized treatment plan.