PowerLecture:
Chapter 13
DNA Structure and Function
Section 13.0: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 13.0: Roslin Institute—Cloning Summary

Section 13.0: Interview with Prof. Ian Wilmut

Section 13.0: Science Explained—The Cloning of Dolly

- Section 13.0: The Birth of Cloning: Contrary to the Popular Impression, Dolly Did Not Spring Full Grown from Ian Wilmut's Ingenuity. J.B. Gurdon. *The Sciences,* Sept.–Oct. 1997.

- Section 13.0: Dolly Was Lucky: Scientists Warn that Cloning Is Too Dangerous for People. John Travis. *Science News,* Oct. 20, 2001.

How Would You Vote?

The following is the question for this chapter. See national results below.

Do you think animal cloning research should continue?

Impacts, Issues: Goodbye Dolly

- Ian Wilmut was the first to produce a cloned sheep, which he named Dolly

- Dolly experienced health problems similar to other mammals cloned from adult DNA

Impacts, Issues: Goodbye Dolly

- The risk of defects in clones is huge

- Possible benefit – patients in desperate need of organ transplants

- Genetically modified cloned animals may produce organs that human donors are less likely to reject

- Cloning humans – ethical?

Section 13.1: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 13.1: DNA Interactive

Section 13.1: Conversation with James Watson

Section 13.1: Landmarks in the History of Genetics

- Section 13.1: A Twist of Fate (discovery of DNA). Michael Lemonick. *Time,* Feb. 17, 2003.

- Section 13.1: The Shape of Life. Stephen Gould. *Art Journal,* Spring 1996.

- Section 13.1: Linus Pauling: Scientist of the Century. George Kauffman et al. *Chemistry and Industry,* Feb. 19, 2001.

Miescher Discovered DNA

- 1868
- Johann Miescher investigated the chemical composition of the nucleus
- Isolated an organic acid that was high in phosphorus
- He called it nuclein
- We call it DNA (deoxyribonucleic acid)

Mystery of the
Hereditary Material

- Originally believed to be an unknown class of proteins
- Thinking was
  - Heritable traits are diverse
  - Molecules encoding traits must be diverse
  - Proteins are made of 20 amino acids and are structurally diverse

Structure of the
Hereditary Material

- Experiments in the 1950s showed that DNA is the hereditary material
- Scientists raced to determine the structure of DNA
- 1953 - Watson and Crick proposed that DNA is a double helix

Griffith Discovers Transformation

- 1928
- Attempting to develop a vaccine
- Isolated two strains of *Streptococcus pneumoniae*
  - Rough strain was harmless
  - Smooth strain was pathogenic

Transformation

- What happened in the fourth experiment?
- The harmless R cells had been *transformed* by material from the dead S cells
- Descendents of the transformed cells were also pathogenic

Oswald & Avery

- What is the transforming material?
- Cell extracts treated with protein-digesting enzymes could still transform bacteria
- Cell extracts treated with DNA-digesting enzymes lost their transforming ability
- Concluded that DNA, not protein, transforms bacteria

Bacteriophages

- Viruses that infect bacteria
- Consist of protein and DNA
- Inject their hereditary material into bacteria

Hershey & Chase's Experiments

- Created labeled bacteriophages
  - Radioactive sulfur
  - Radioactive phosphorus
- Allowed labeled viruses to infect bacteria
- Asked: Where are the radioactive labels after infection?

Section 13.2: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 13.2: DNA from the Beginning

Section 13.2: DNA Structure Animated Tutorial

- Section 13.2: Complex Window on Life's Most Basic Molecules (computer graphics of DNA). Terence Monmaney. *Smithsonian,* July 1985.

Structure of Nucleotides in DNA

- Each nucleotide consists of
  - Deoxyribose (5-carbon sugar)
  - Phosphate group
  - A nitrogen-containing base
- Four bases
  - Adenine, Guanine, Thymine, Cytosine

Nucleotide Bases

Composition of DNA

- Chargaff showed:
  - Amount of adenine relative to guanine differs among species
  - Amount of adenine always equals amount of thymine and amount of guanine always equals amount of cytosine

A=T and G=C

Watson-Crick Model

- DNA consists of two nucleotide strands
- Strands run in opposite directions
- Strands are held together by hydrogen bonds between bases
- A binds with T and C with G
- Molecule is a double helix

Watson-Crick Model

Section 13.3: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 13.3: PBS—DNA Workshop

Section 13.3: Nobel Foundation—DNA Replication

- Section 13.3: Sex, Errors, and the Genome. Mark Ridley. *Natural History,* June 2001.

- Section 13.3: How the Body Defends Itself from the Risky Business of Living. James Trefil. *Smithsonian,* Dec. 1995.

DNA Structure Helps
Explain How It Duplicates

- DNA is two nucleotide strands held together by hydrogen bonds
- Hydrogen bonds between two strands are easily broken
- Each single strand then serves as template for new strand

DNA Replication

Base Pairing during Replication

Each old strand serves as the template for complementary new strand

Enzymes in Replication

- Enzymes unwind the two strands
- DNA polymerase attaches complementary nucleotides
- DNA ligase fills in gaps
- Enzymes wind two strands together

A Closer Look at
Strand Assembly

Energy for strand assembly is provided by removal of two phosphate groups from free nucleotides

Continuous and Discontinuous Assembly

DNA Repair

- Mistakes can occur during replication
- DNA polymerase can read correct sequence from complementary strand and, together with DNA ligase, can repair mistakes in incorrect strand

Section 13.4: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 13.4: Cloning Fact Sheet

Section 13.4: On Topic—Cloning

Section 13.4: Genetic Savings & Clone, Inc.

Section 13.4: Advanced Cell Technology

- Section 13.4: Raising the Dead (recovering extinct species). Scott Weidensaul. *Audubon,* May–June 2002.

- Section 13.4: Cloning—Revolution or Evolution in Animal Production? Linda Bren. *FDA Consumer,* May–June 2003.

- Section 13.4: Cloning for Profit: Cloned Kittens Are Cute, but How Profitable Are Animal Cloning Companies? Ivan Oransky. *The Scientist,* Jan. 31, 2005.

Cloning

- Making a genetically identical copy of an individual
- Researchers have been creating clones for decades
- These clones were created by embryo splitting

Dolly:
Cloned from an Adult Cell

- Showed that differentiated cells could be used to create clones
- Sheep udder cell was combined with enucleated egg cell
- Dolly is genetically identical to the sheep that donated the udder cell

More Clones

- Mice
- Cows
- Pigs
- Goats
- Guar (endangered species)

Therapeutic Cloning

- SCNT – Somatic Cell Nuclear Transfer

- Transplant DNA of a somatic cell from the heart, liver, muscles, or nerves into a stem cell (undifferentiated cell)

Section 13.5: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 13.5: NOVA—Secret of Photo 51

Section 13.5: NPR—Dark Lady of DNA

- Section 13.5: Out of Her Hands: The Woman Who Didn't Win the Nobel Prize. *Odyssey,* Feb. 2002.

- Section 13.5: Was She, or Wasn't She? (Closing Bell). Nicholas Wade. *The Scientist,* Apr. 7, 2003.

Rosalind Franklin's Work

- Was an expert in X-ray crystallography

- Used this technique to examine DNA fibers

- Concluded that DNA was some sort of helix