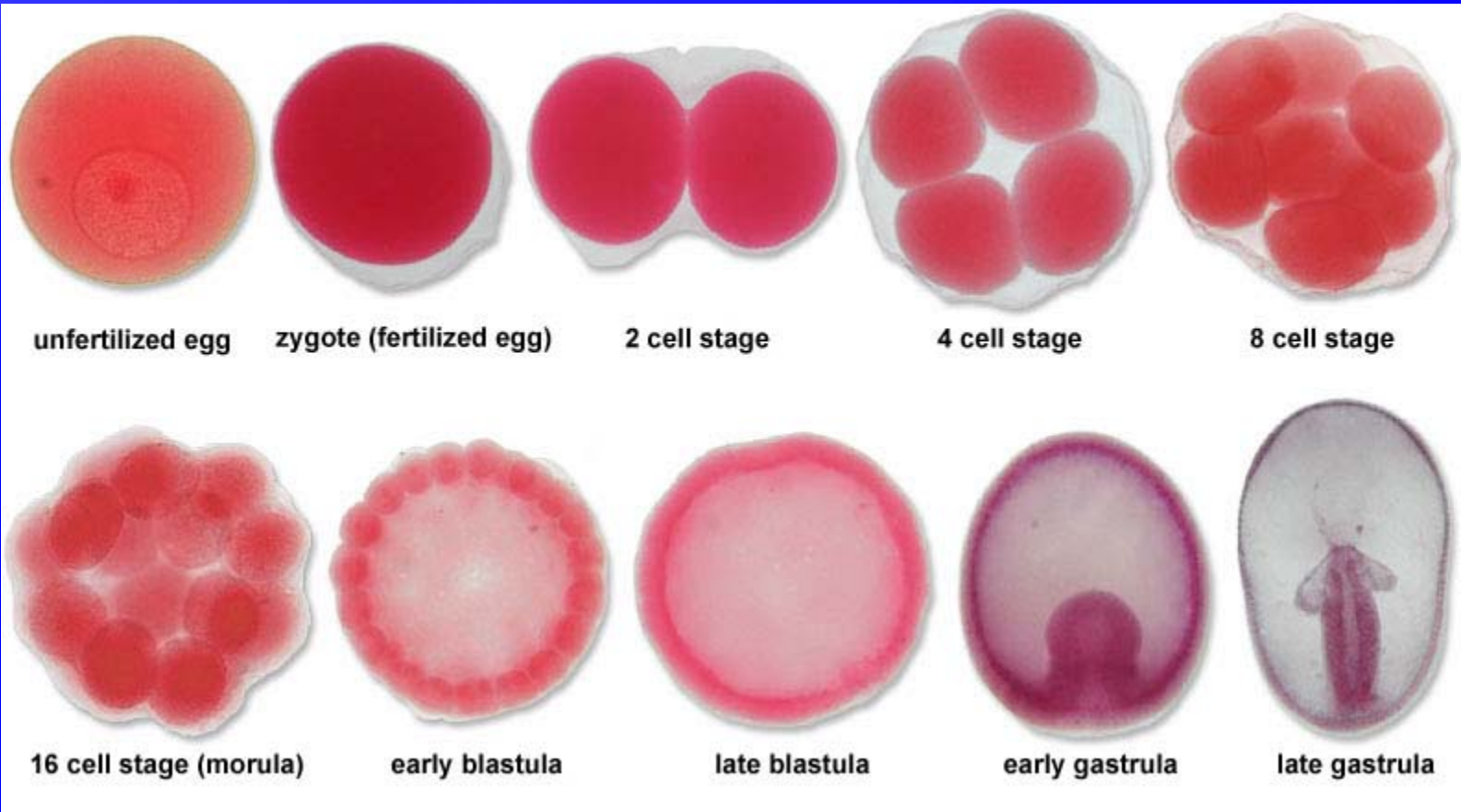


CELL DIFFERENTIATION AND GENE EXPRESSION

Student Expectation 5C - describe the roles of DNA, ribonucleic acid (RNA), and environmental factors *in cell Differentiation*.

Student Expectation 6D - recognize that gene expression is a regulated process.

How did you get here?

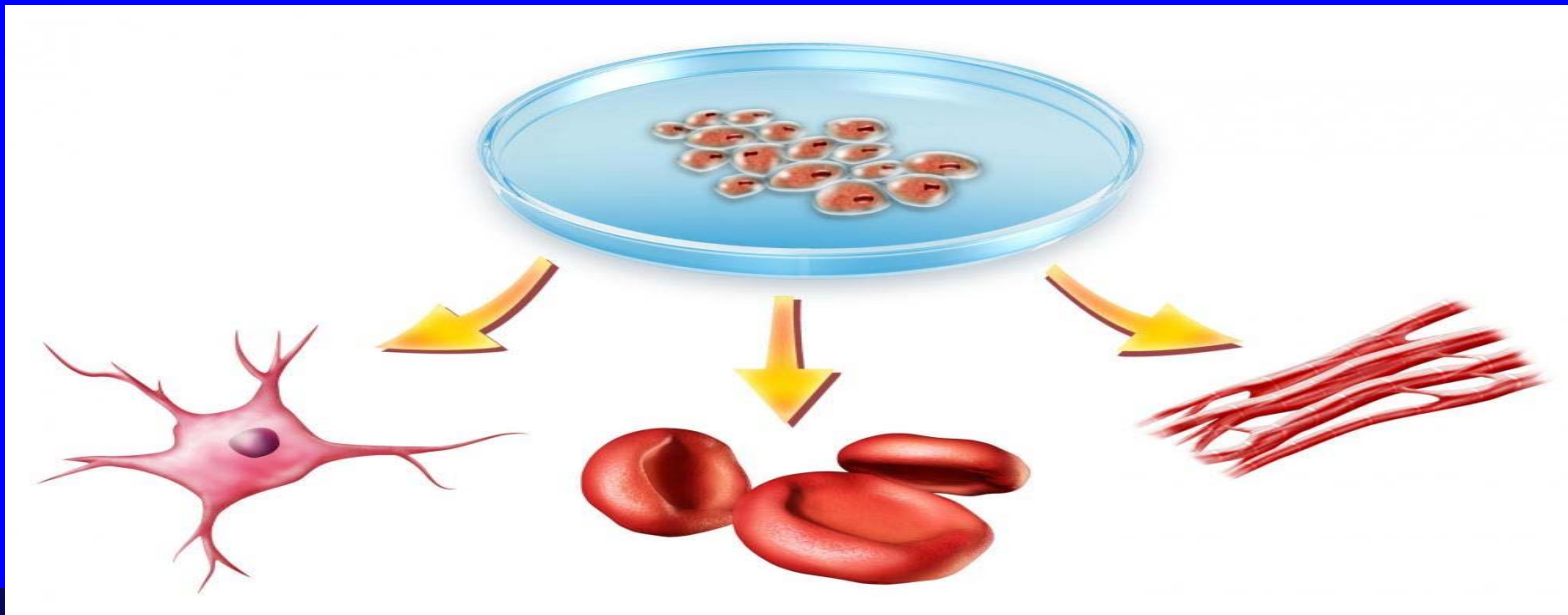


Cell Differentiation

- ◆ Cells in fertilized eggs are directed by DNA to become many types of specialized cells
- ◆ DNA regulates this by turning genes off and on to produce different proteins

Stem Cells

- ◆ Undifferentiated cells that can develop into a specialized cell when genes are activated



1 EMBRYO

An egg is fertilized or cloned to form an embryo. The embryo begins to divide

2

1 TO 5 DAYS
The embryo divides again and again and takes shape as a sphere called a blastocyst

3 5 TO 7 DAYS

By this time embryonic stem cells are visible and are capable of developing into any tissue in the body

5 TISSUE PRODUCTION

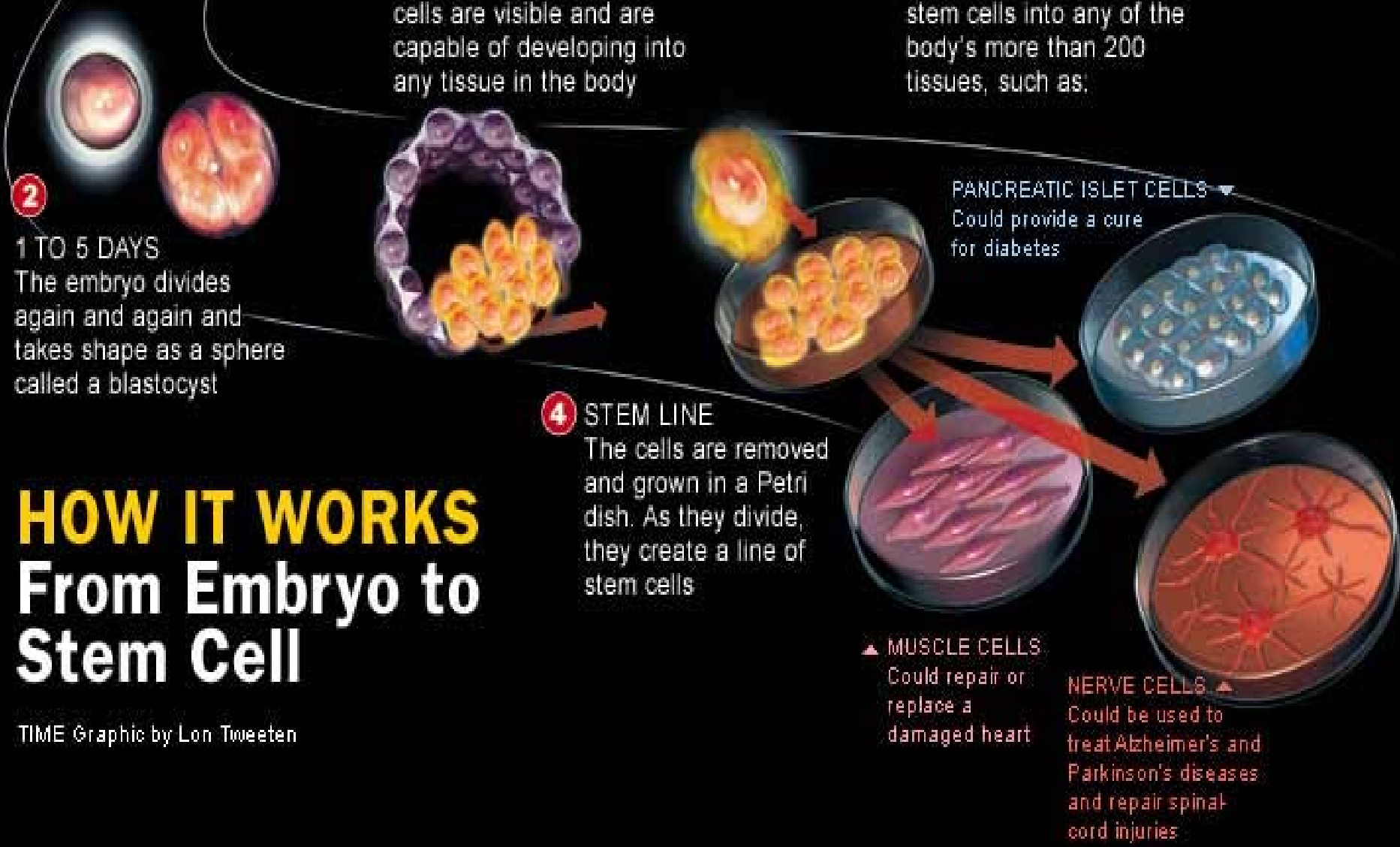
Using various recipes of nutrients and other factors, scientists hope to turn stem cells into any of the body's more than 200 tissues, such as:

4 STEM LINE

The cells are removed and grown in a Petri dish. As they divide, they create a line of stem cells

HOW IT WORKS From Embryo to Stem Cell

TIME Graphic by Lon Tweeten



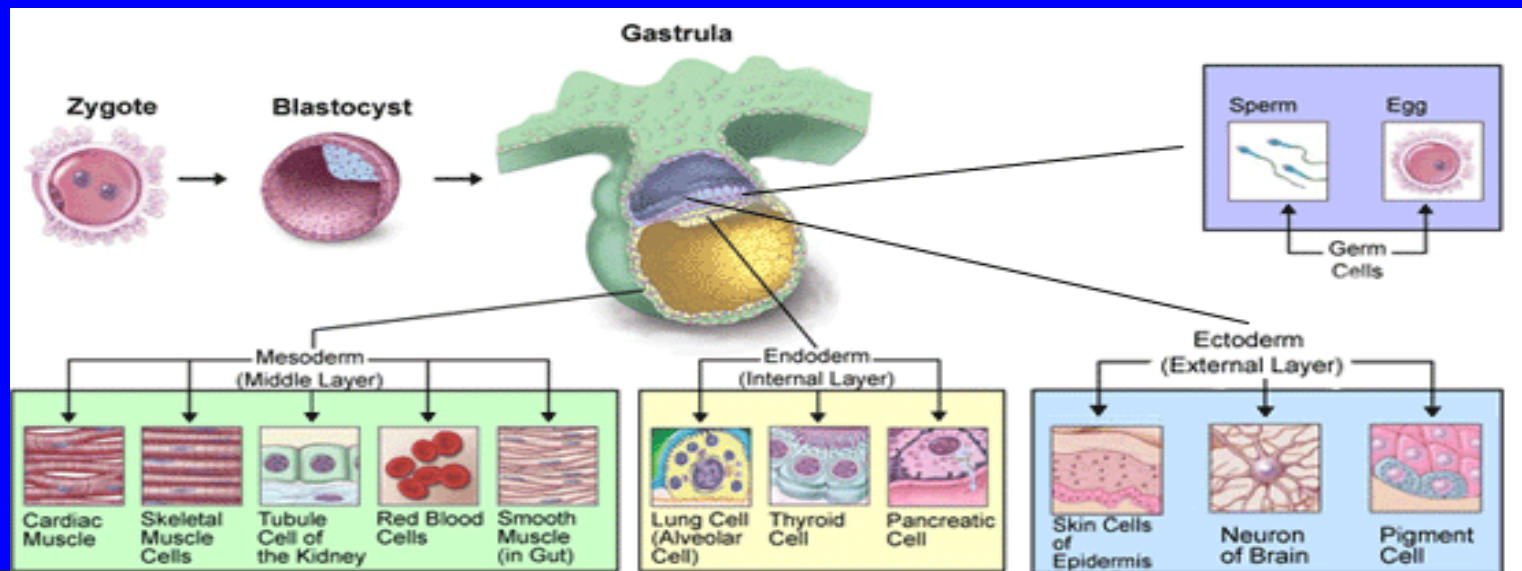
Stop and Think

- ◆ Stem cells are a hot topic in scientific research, but they are tied to some controversy.
- ◆ Why do you think scientists interested in studying stem cells?
- ◆ What advantages or disadvantages can you think of would come from using stem cells for scientific research?

Cell Differentiation

◆ Specialized Cells

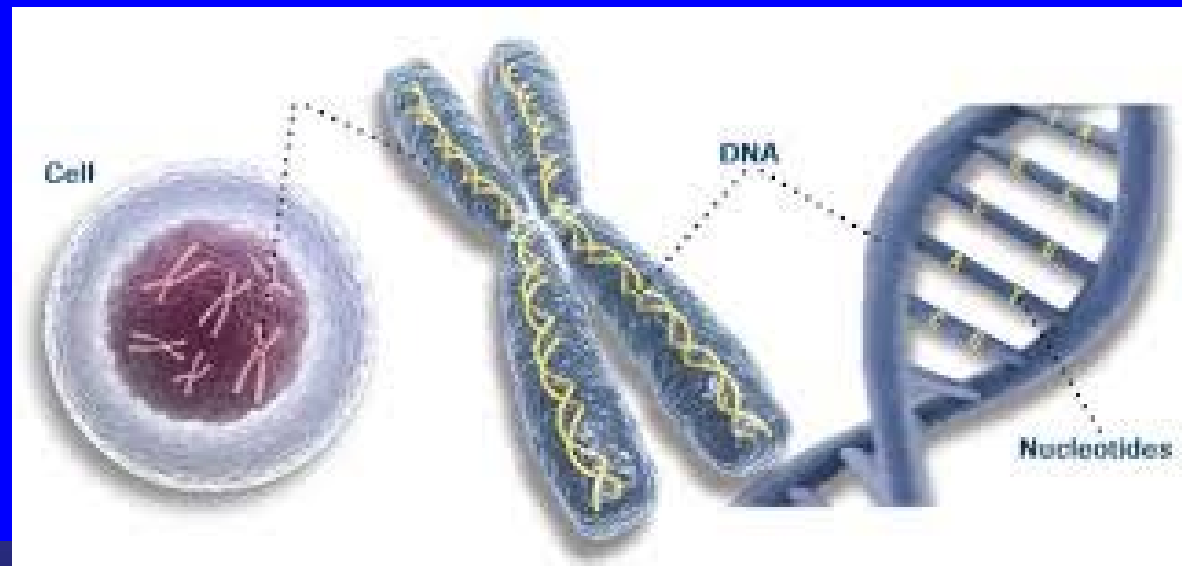
- ◆ Cells with specific functions that can work together to perform more complex functions
- ◆ Cells can be Somatic (body cells) or Gametes (Eggs and Sperm)
- ◆ Created from stem cells by turning genes on and off



- ◆ What are some examples of specialized somatic cells?
- ◆ Give two types of specialized cells that work together to perform a more complex job.

Role of DNA

- ◆ DNA is the same in each cell. (Big Instruction Book)
 - ◆ Contains all the genes that code for proteins
- ◆ Each cell will only use some of the DNA- depending on which genes are expressed (Read some chapters)
- ◆ DNA regulates gene expression and cellular differentiation



Topic B. Gene Expression

- ◆ Gene
 - ◆ Sections of DNA that code to make specific proteins which determine traits
- ◆ Gene Expression
 - ◆ Certain genes can be activated or deactivated by exposure to chemicals or hormones in the environment.

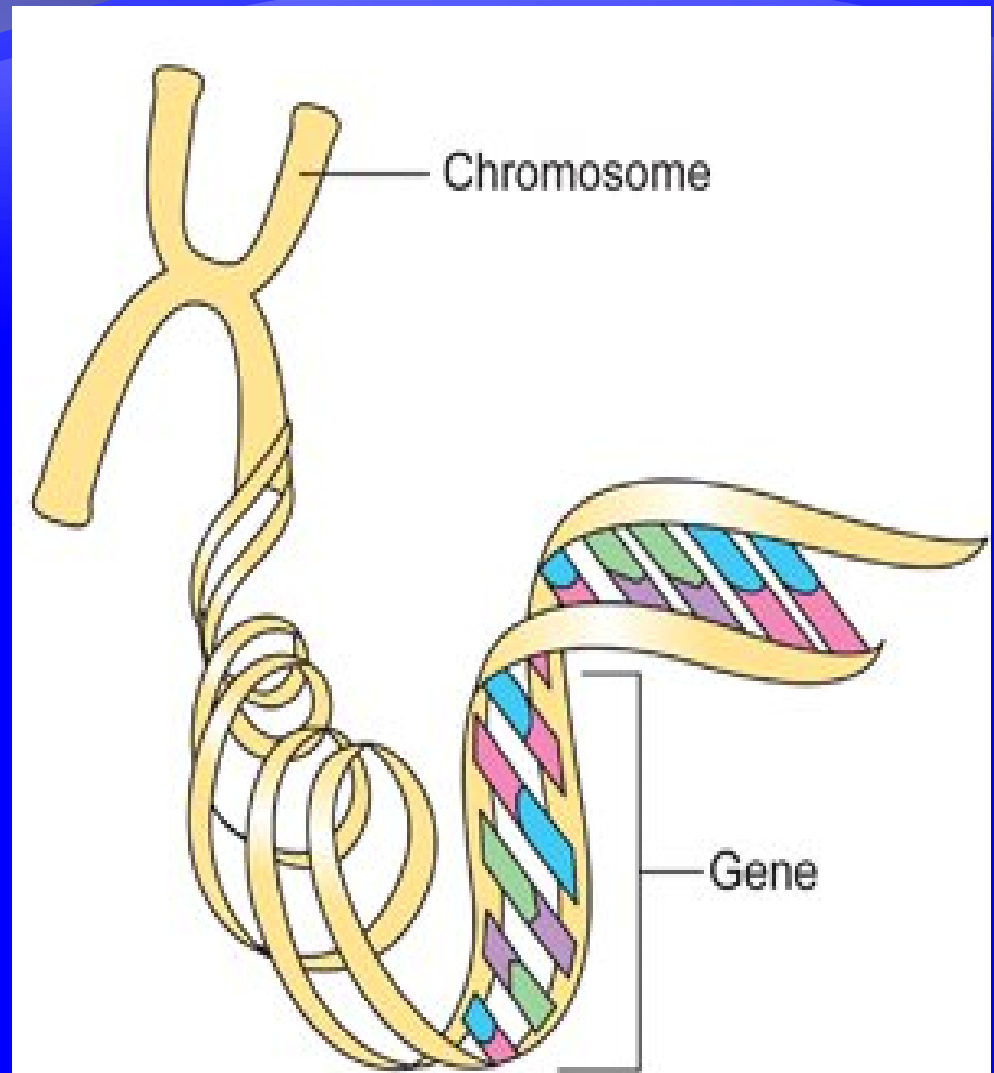
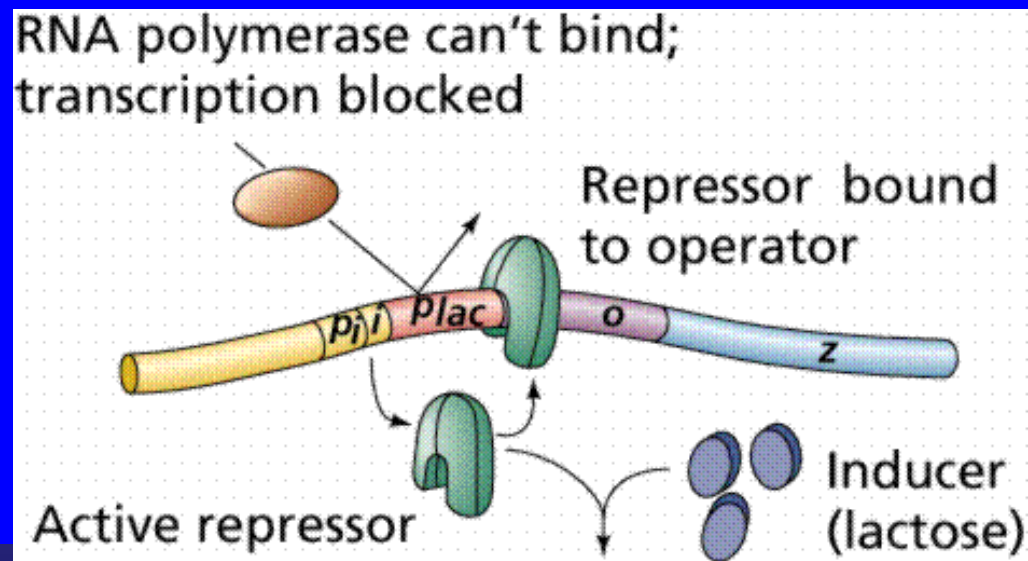


Diagram of a gene on a chromosome
Copyright © CancerHelp UK

Gene Expression and Regulation

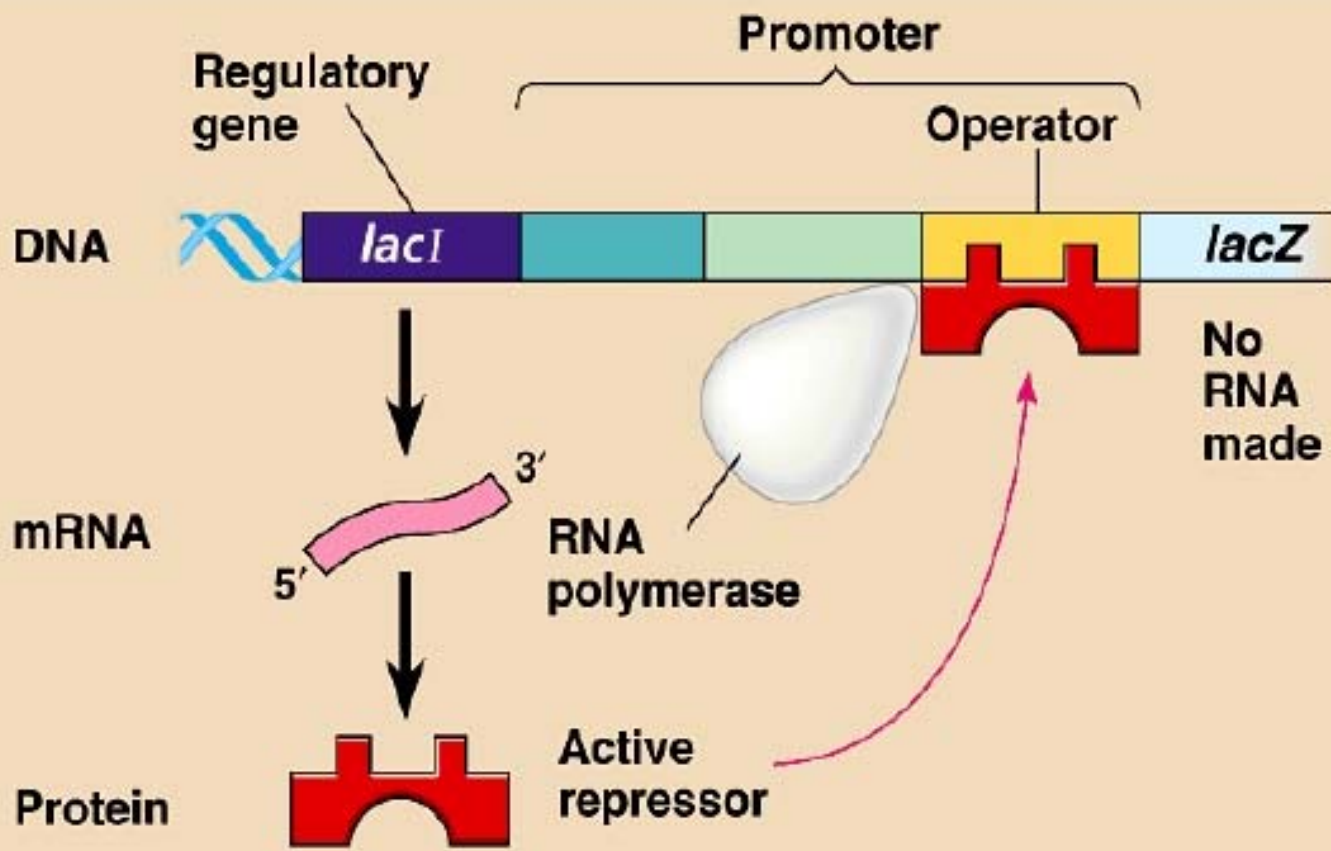
- ◆ Gene expression is regulated by the production of transcription factors from DNA and RNA
- ◆ Repressor- Stops Gene Expression
- ◆ Promoter- Encourages gene expression



Lac Operon

- ◆ As you watch the video, takes notes and answer:
- ◆ What does a repressor do?
- ◆ How does this affect lactase production?
- ◆ What causes the repressor to leave?
- ◆ What occurs when the repressor is removed?

A Diagram of the Lac Operon



(a) Lactose absent, repressor active, operon off

Share it out

- ◆ Turn to your shoulder partner- The taller person is Partner A, the shorter person is Partner B
- ◆ Each person will have 30 seconds to explain
- ◆ Partner A- Explain to your partner how specialized cells are formed starting from a stem cell
- ◆ Partner B- Explain to your partner one way that a cell can turn genes on and off

Effects of the Environment

- ◆ Are identical twins truly identical?

CC (Carbon Copy)



Rainbow



Big Question 2: Why do CC and Rainbow not look exactly alike, even though they are clones?

Brainstorm!

- ◆ With your table, come up with a list of environmental factors that you think could affect how an organisms genes are expressed.
- ◆ What type of effect do you think they could cause?

4. How can the environment influence gene expression(action)?

A. A. Poor nutrition

can affect the height that a person grows regardless of genetic disposition



B. Hormones

Female vs male embryo

- ◆ Before four weeks of age, all fetuses are exactly the same.
- ◆ Around 4 weeks a special protein called Sex determining Region Y (SRY) which starts producing hormones and proteins that will make a male become male.



C. Drugs and Chemicals

Ex: Thalidomide was a drug distributed in the 1950s to help women with morning sickness. One side effect was that it interfered with the limb development, causing some babies to be born without arms



D. Temperature

Low temps can cause Himalayan rabbits to produce black pigment in their skin



Reared at 20°C or less

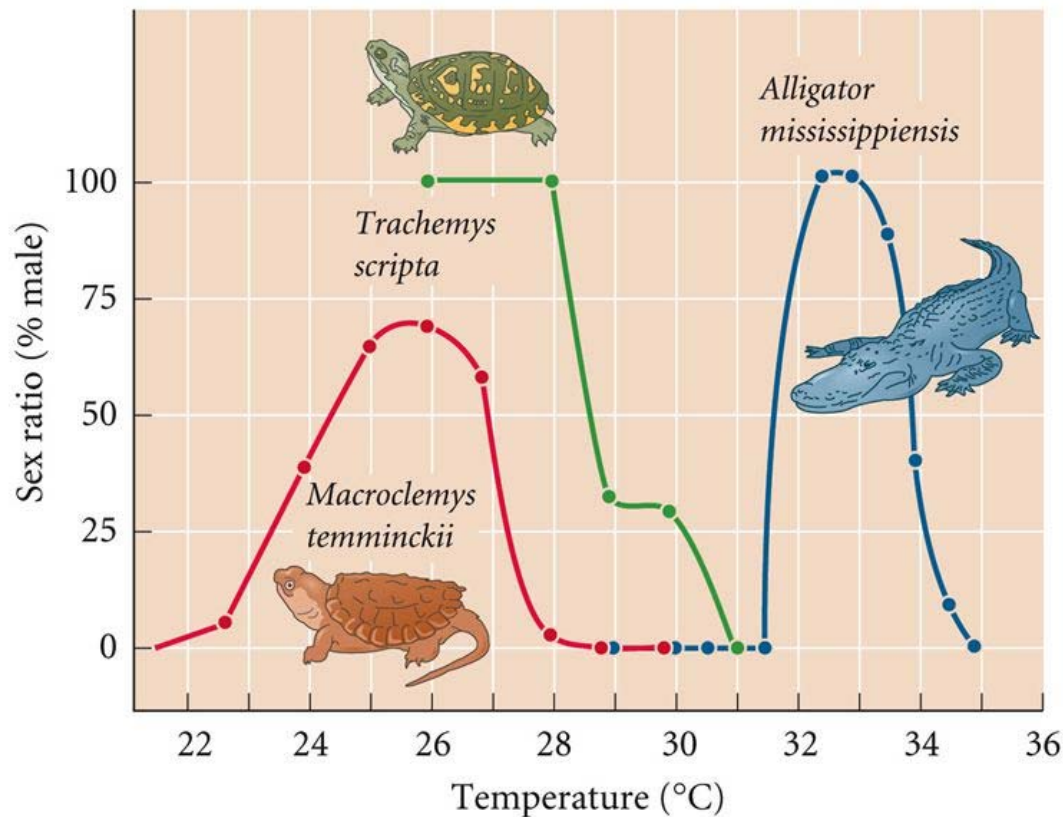


Reared at temperatures above 30°C

Temperature

- ◆ Temperature in the nest determines the sex of many reptile species

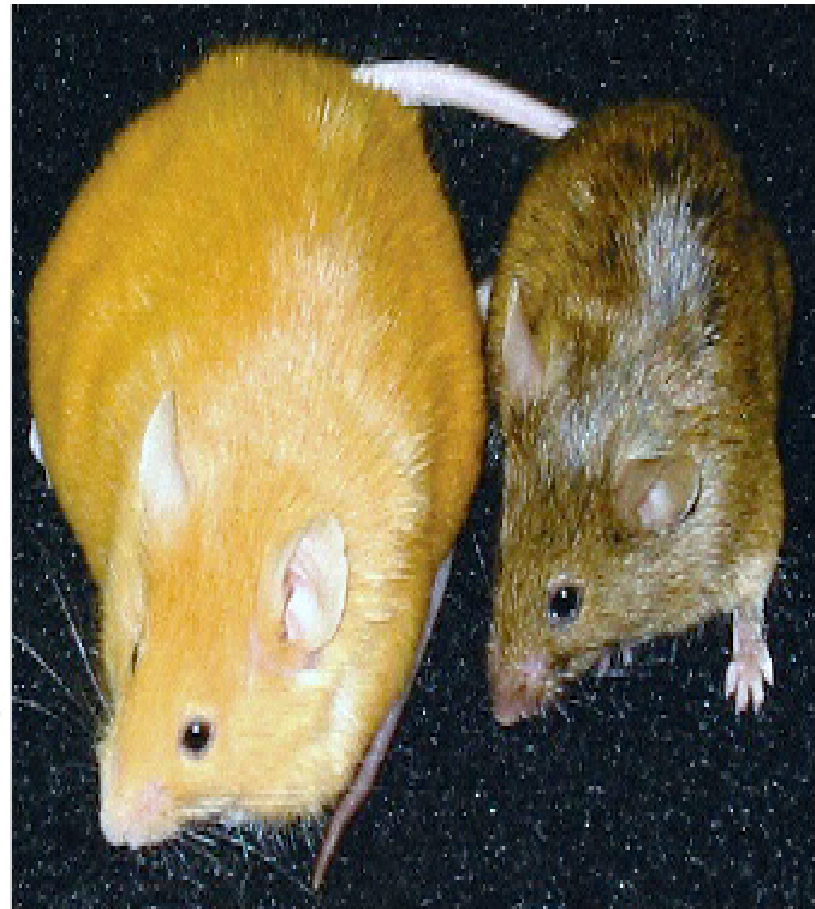
Figure 14.22 Temperature-dependent sex determination in three species of reptiles



What influences gene expression more? DNA or the environment?

- ◆ It depends on the case.
- ◆ Both Genetic (DNA) and environmental factors influence development but not always equally

These Two Mice are Genetically Identical and the Same Age



While pregnant, both of their mothers were fed Bisphenol A (BPA) but **DIFFERENT DIETS**:

The mother of this mouse received a **normal mouse diet**

The mother of this mouse received a diet **supplemented** with choline, folic acid, betaine and vitamin B12