Differentiation

• All cells that make up a multicellular organism contain the *exact same genetic information* (DNA) in their nuclei.

• As multicellular organisms *develop*, genetically identical cells *differentiate* and become *specialized*, allowing them to preform unique functions.

Transcriptions Factors are *proteins* involved in the process of converting (transcribing) DNA to RNA. These proteins *initiate* and regulate the transcription of genes.

Developing fruit fly with color labeled mRNA showing gene expression.

Expression of gene for nerve cell in the eyes.

Expression of gene for muscle cells in wings.

It takes just four days for cell division (growth) and differentiation (develop) to transform a fertilized frog egg (zygote) into a tadpole.

Unipotent differentiated into one type of cell.

• **Differentiation** is a result of *differential gene expression* (DNA transcribed and translated into a protein).

• **Cellular division** and differentiation produce and maintain multicellular organisms, which are composed of tissues, organs and organ systems.

Tadpole Growth and Development

Four types of tissue

1. Connective tissue
2. Epithelial tissue
3. Muscle tissue
4. Nervous tissue

organisms organ systems organs

Totipotent
identical cells

Blastula
(hollow ball)

Cross section of blastula

Blastocoele

Gastrulation

Archiendoer
Endoderm
Ectoderm

Pluripotent
Inner Mass Cells
(ES cells)

Eight-cell stage

Cleavage

Cleavage

Zygote

Four types of cell

Unipotent
differentiated into
one type of cell

Single Cell

mitosis

Two daughter cells containing identical copies of DNA

chromosome

DNA

chromosome

DNA

SLIDE 1

SLIDE 2
Most differentiated cells retain their nucleus and a complete set of chromosome.
Therefore, differentiated cells retain their genetic potential and can be used to produce genetically identical organisms - clones.

In 1997, Ian Wilmut cloned the first mammal, a sheep named Dolly, providing further evidence for the developmental potential of cell nuclei.

Cloning of nonhuman mammals has application in genetic research, agriculture and medicine.

Stem Cells are non differentiated cells that can give rise to one or more types of specialized cells
- Embryonic stem cells (ES cells) easily grow in culture, are immortal, and give rise to all different specialized cells in the body
- Adult stem cells are present in adult tissues, they generate replacements for non-dividing differentiated cells.