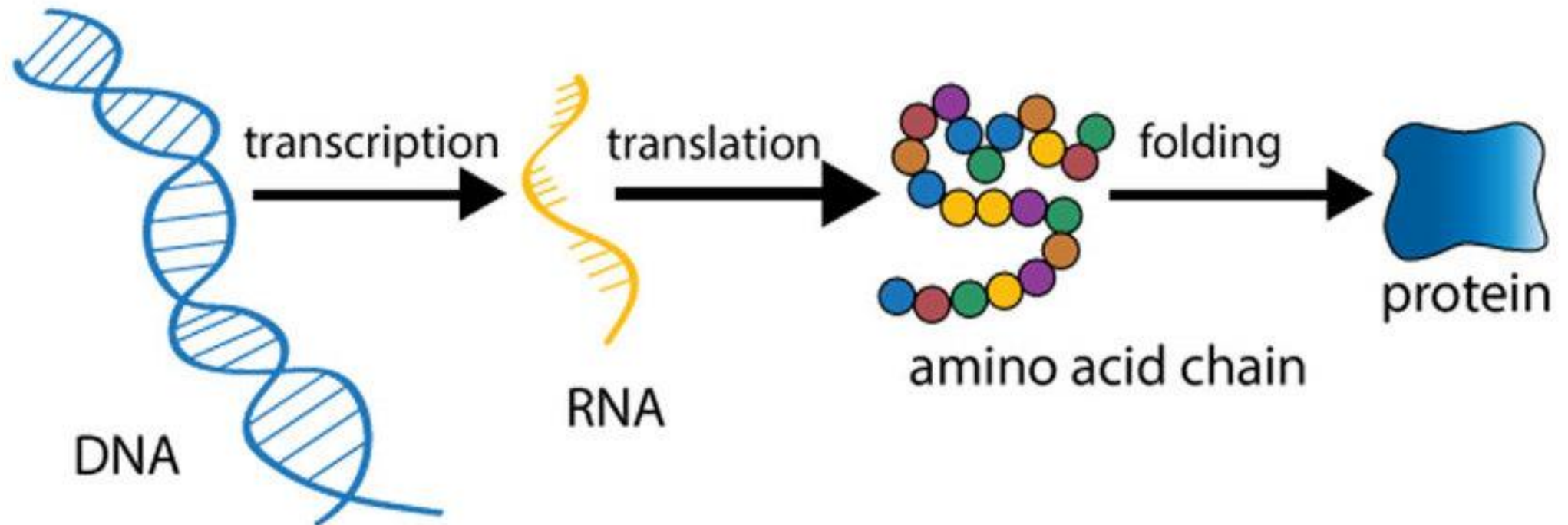


# Gene Regulation and Expression

- factors in the internal or external environment can “turn a gene on or off” which can affect the production of a protein



# Gene Regulation and Expression

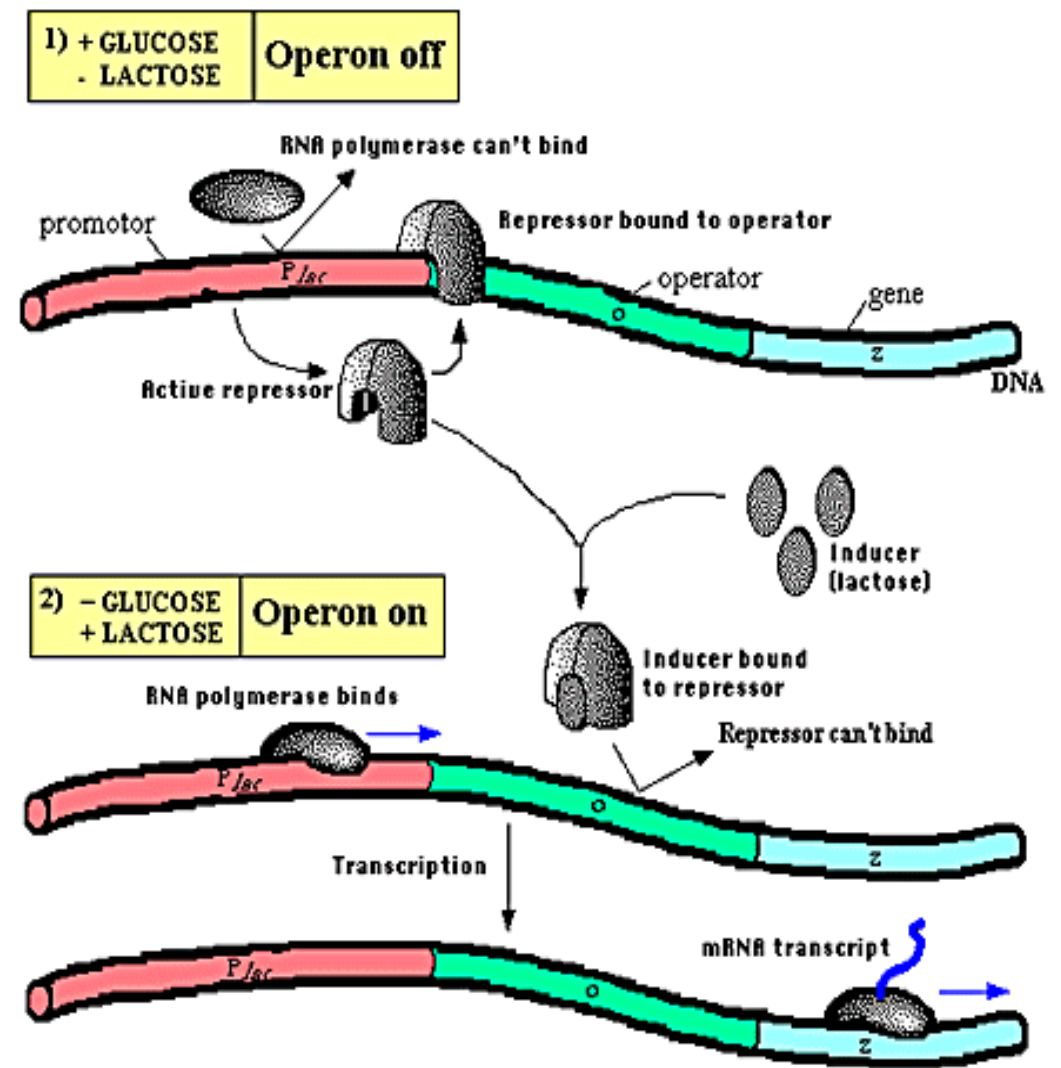
- All cells of an organism have the same DNA / genes
- Cells only express certain genes to produce certain proteins

Ex. Your eyes don't express the gene to make hydrochloric acid, your stomach cells do!



# Gene Regulation

- factors in the environment can “turn a gene on or off”
- can affect the production of a protein
  - Ex. Prokaryotic Lac Operon activates lactase production only when lactose is present in the cell environment



## Induction of the *lac* Operon

[Video: The Lac Operon](#) (gene expression)

[Video - Gene Expression & Order of Operon \(Amoeba Sisters animation\)](#)

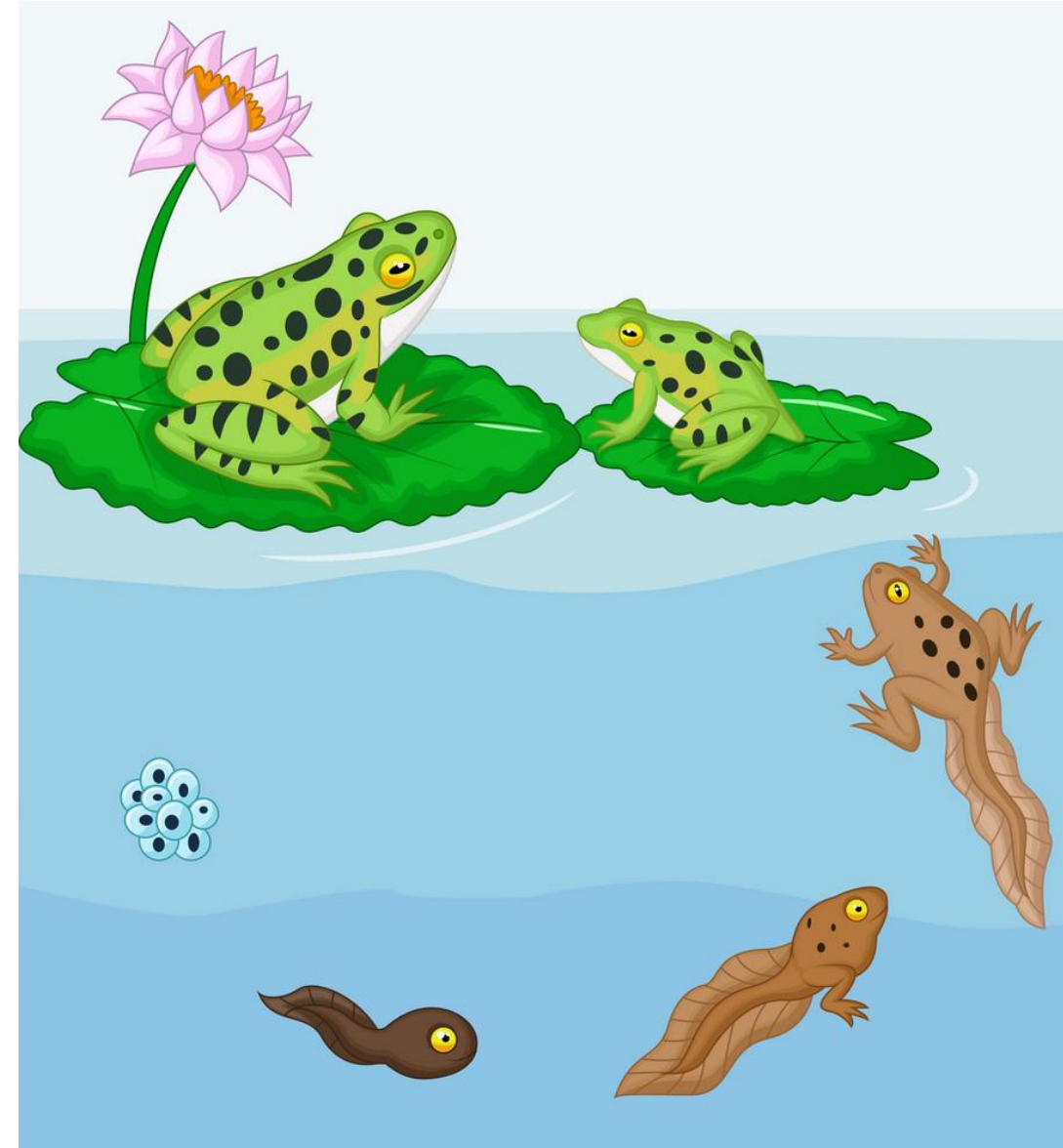
# Interaction of Heredity and the Environment



# Environmental Effects on Gene Expression

## Example 1: Metamorphosis

- Series of transformations from one stage of life to another
- Regulated by both external (environmental) and internal (hormonal) factors
  - Ex. Tadpoles speed up their metamorphosis in a drying pond



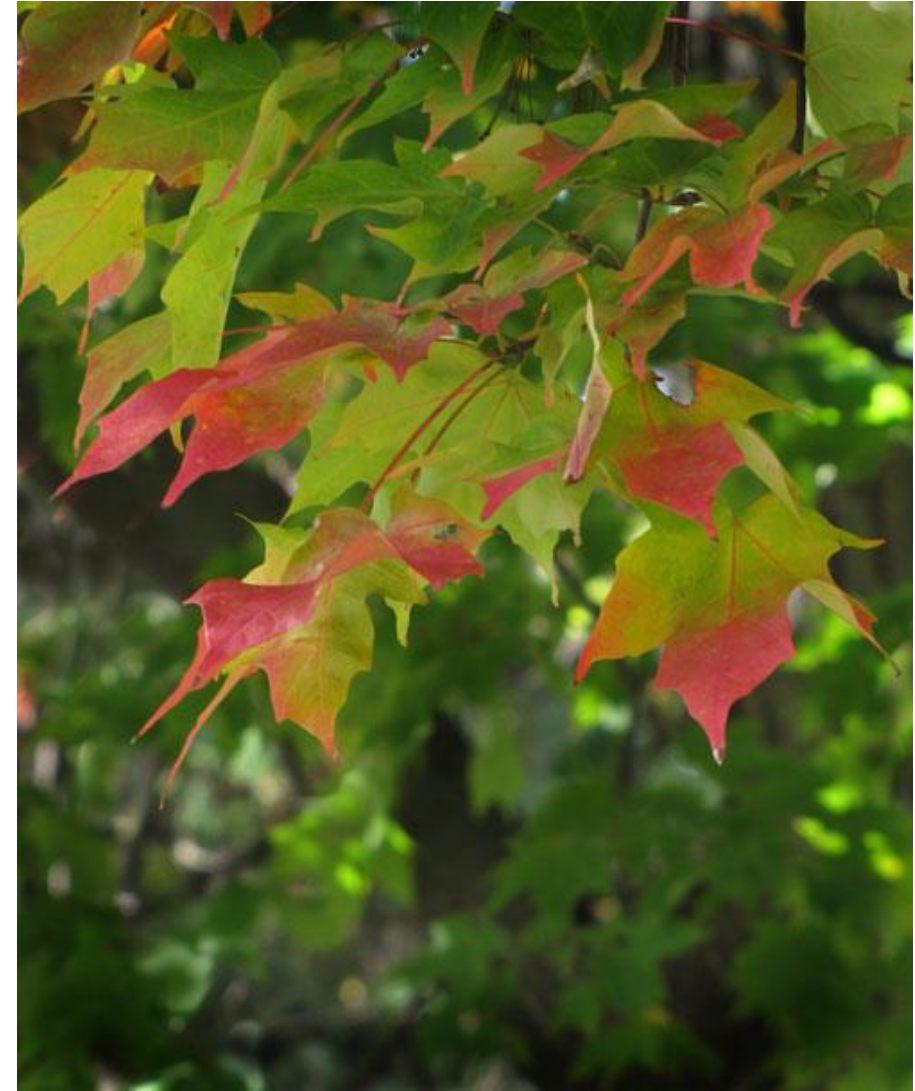
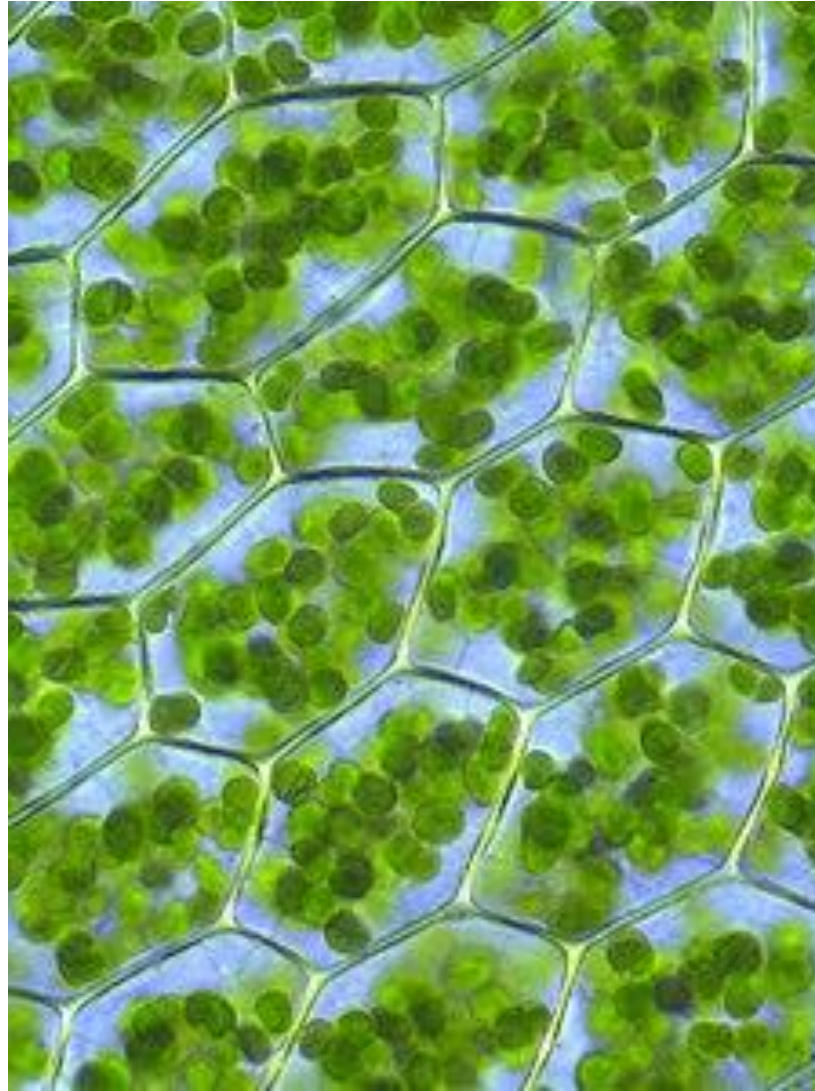
## Example 2: Sunlight on Skin Color

- Increased exposure to sunlight (UV rays) increases production of skin pigment melanin



# Example 3: Effect of Light on Chlorophyll Production

- With more light available, plants turn green (more chlorophyll is produced)



## Example 4: Sex Determination

- Temperature, weather, or location is the determining factor in some organisms

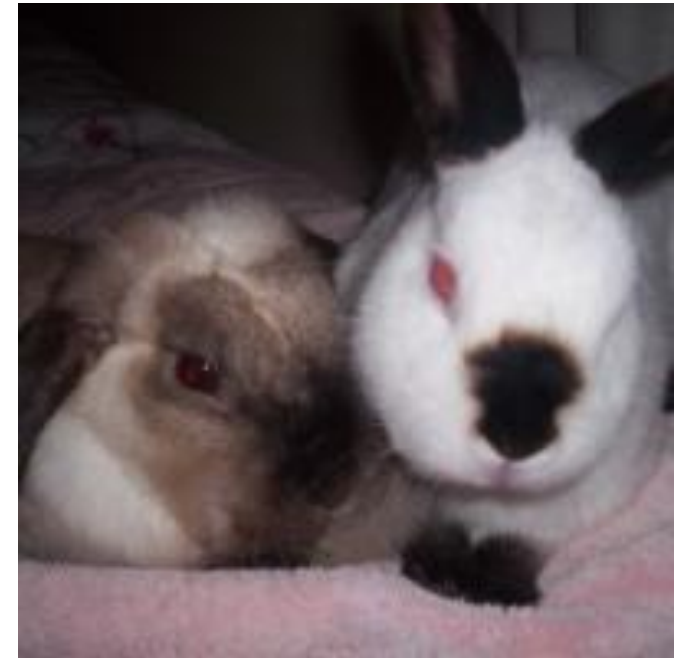
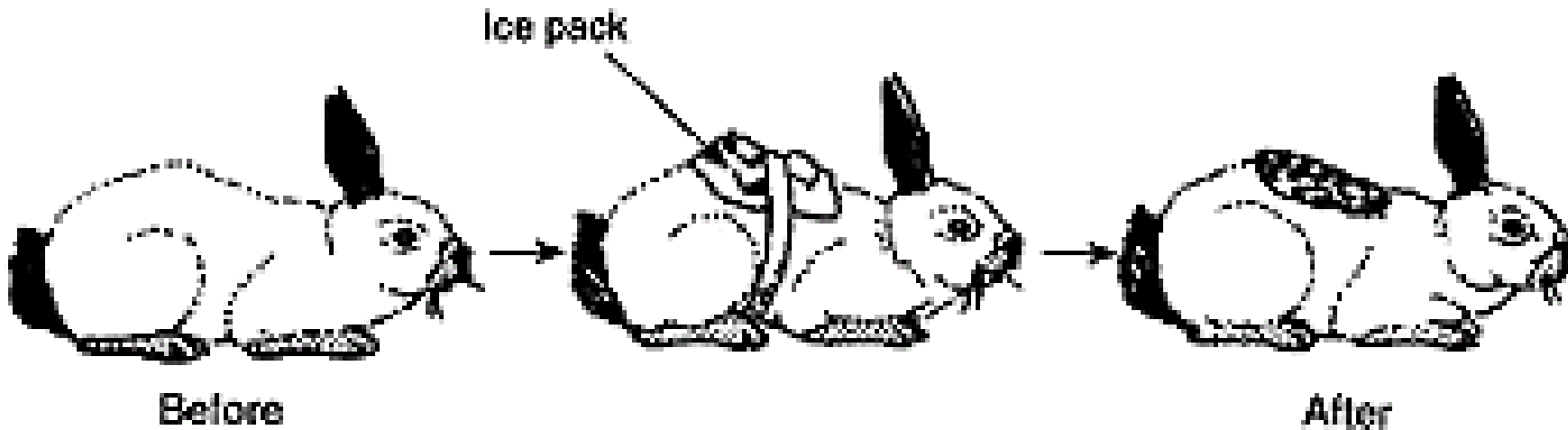
[Video \(start at 3:10\)](#)

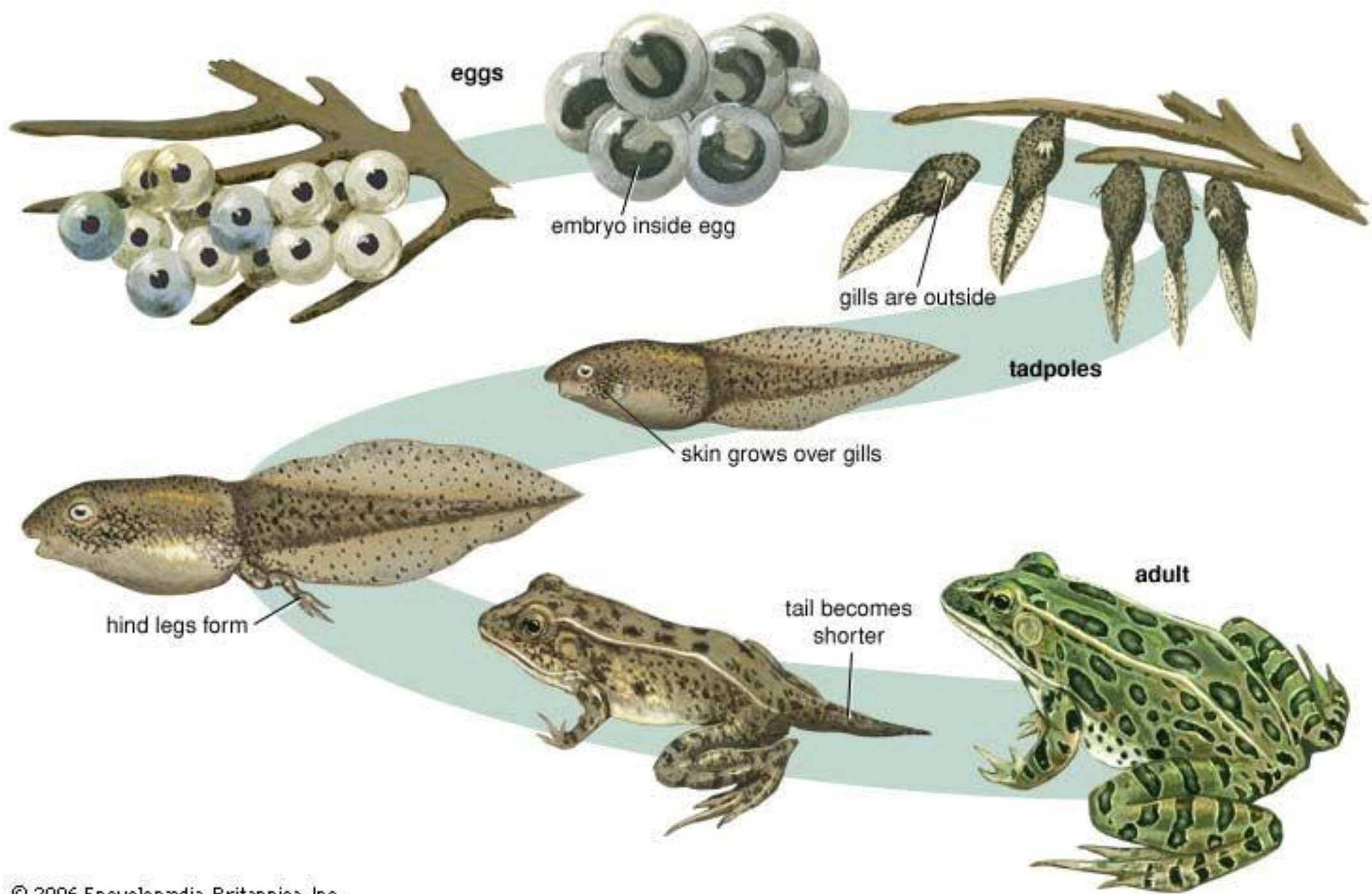




## Example 5: Effect of Temperature on hair color in the Himalayan rabbit

- Ice applied to normally white haired area causes it to grow black





# Example 6: Identical Twin Studies

- identical twins may have differences in height, weight, intelligence due to:
  - diet
  - altitude
  - exposure to chemicals, radiation, education, gravity, etc.



[ABC News - Nasa Twin Study with Astronaut Scott Kelly](#)

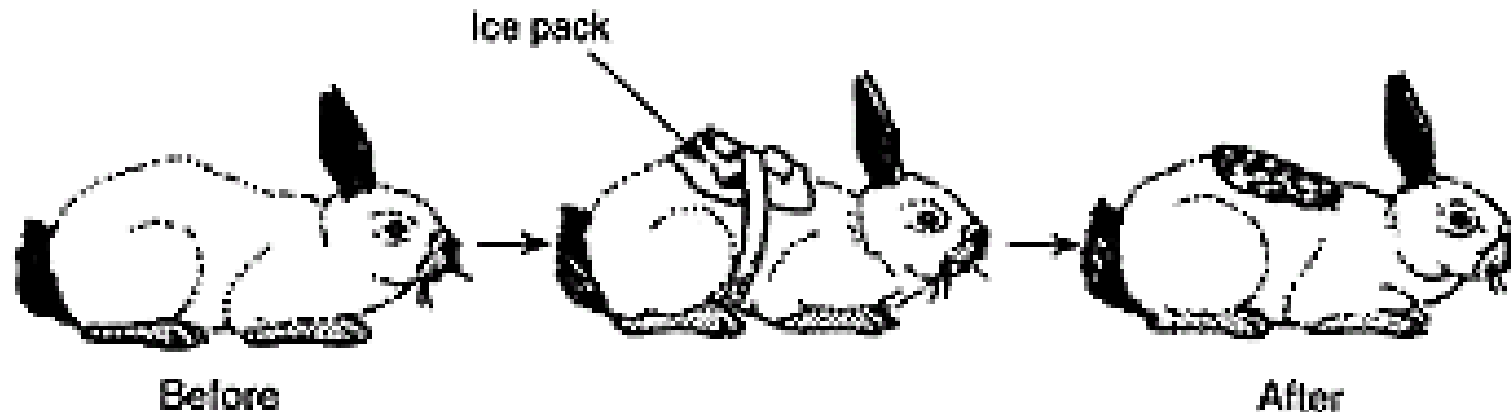
2) The diagram below illustrates what happens to the fur coloration of a Himalayan hare after exposure to a low temperature. This change in fur coloration is most likely due to

1. the effect of heredity on gene expression

2. environmental influences on gene action

3. the arrangement of genes on homologous chromosomes

4. mutations resulting from a change in the environment



3) Scientists conducted a study of identical twins who were separated at birth and raised in different homes. They found that in some sets of twins the individuals showed a marked difference in intelligence. The most likely explanation for this difference is that

1. expression of inherited traits can modify the environment
2. environment can influence the development and expression of inherited traits
3. intelligence is a sex-linked trait
4. nondisjunction occurred in the autosomes of one twin but not the other twin

4) A garden hose that had been lying on a green lawn for several days was removed. Which statement best explains the presence of yellow grass in the area where the hose had been?

1. The lack of sunlight under the hose altered the genotype of the grass.
2. The hose altered genes in the grass, causing the grass to switch from autotrophic to heterotrophic nutrition.
3. Gene expression is not affected by the environment.
4. The lack of sunlight under the hose affected chlorophyll production.

5) In fruit flies with the curly wing mutation, the wings will be straight if the flies are kept at 16°C, but curly if they are kept at 25°C. The most probable explanation for this is that

1. fruit flies with curly wings cannot survive at high temperatures
2. high temperatures increase the rate of mutations
3. the environment influences wing phenotype in these fruit flies
4. wing length in these fruit flies is directly proportional to temperature

# Epigenetics

- The study of potentially heritable changes in gene expression
- does NOT involve changes to the DNA sequence (a change in phenotype without a change in genotype)
- Chemical “tags” bind to DNA and affect how cells read the genes

[Video - Epigenetics \(brief animated explanation\)](#)

[Video - Epigenetics Ted Talk](#)

[Video - Epigenetics \(Bozeman Science\)](#)

[Video - Epigenetics and Influence of Our Genes](#)

