Chemical Biology 03
Oct 26, 2009

Gene Regulation
and Cell Differentiation
Hemoglobin

In adult RBC:

- 0%  
- 1%  ("Hb F")
- 2-3%  ("Hb A2")
- 97%

Other cell types: No hemoglobin
Regulation of Gene Expression: β Globin gene cluster

- Only expressed in Red Blood Cells (cell-type specific expression)
- Expression changes over course of development
- Locus Control Region: crammed with recognition sequences for Regulators
Faustino et al. 2002
Asymptomatic Homozygous Deletion $\beta^o$-Thalassemia in an African Individual
Cell differentiation in multicellular animals

Undifferentiated cells → Differentiated cells

Differential gene expression begins with differences in presence and activity of Regulatory Proteins
Different collections of regulatory proteins in each cell type give rise to unique patterns of gene expression for each cell type.
Combinatorial Control of gene expression

Transcription Regulators work as part of committee allows multiple inputs
one can act as trigger
fibroblast

Skeletal muscle fibers

MyoD

MyoD Master Regulatory Protein

Mbs myosin II

Mbs actin

Mbs acetylcholine receptor

Mbs creatine phosphokinase

Genes OFF

Genes ON
How are the Gene Regulators Regulated?

(A) PROTEIN SYNTHESIS

(B) LIGAND BINDING

(C) PROTEIN PHOSPHORYLATION

(D) ADDITION OF SECOND SUBUNIT

DNA-binding subunit
activation subunit
Steroid Hormones (small hydrophobic)

“Nuclear Receptor” Class of Transcription Regulators

Figure 16-10 Essential Cell Biology 3/e © Garland Science 2010
How are the Gene Regulators Regulated?
How are the Gene Regulators Regulated?
How are the Gene Regulators Regulated (continued)?

**UNMASKING**

- **INACTIVE**
  - inhibitor
  - (E)

- **ACTIVE**
  - (E)

**STIMULATION OF NUCLEAR ENTRY**

- **inhibitory protein**
- **nucleus**
- (F)

**RELEASE FROM MEMBRANE**

- (G)