Eukaryotic Gene Regulation

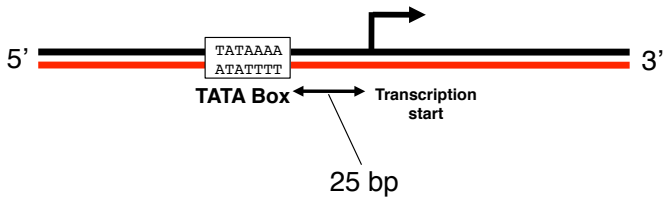
1. RNA polymerase only works with **transcription initiation complex** bound to gene.
2. Gene expresion is controlled by **upstream promoter elements** and **transcription factors** (i.e. not by blockade of the RNA polymerase.)

1

1. Transcription initiation complex

Almost all eukaryotic genes have TATA boxes just before transcription start.

Eukaryotic RNA polymerase only binds to DNA after transcription factors bind to the TATA box.

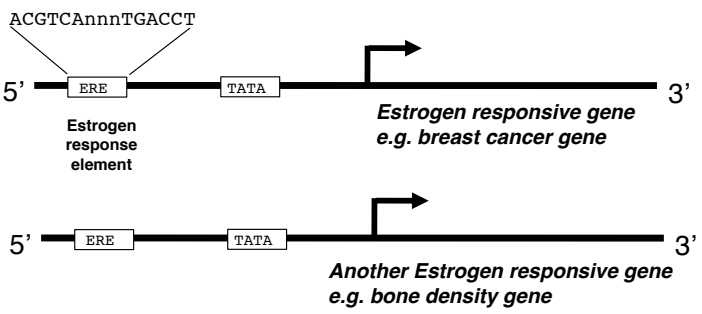


2

2. Transcription Factor Binding

Genes are turned off and on by binding of transcription factors to promoter control elements.

e.g. **estrogen receptor** in presence of estrogen binds to **estrogen response element**



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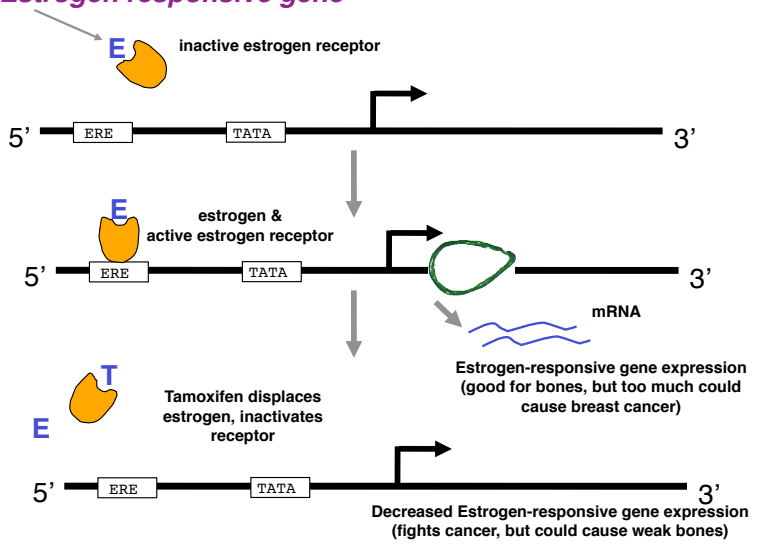
Estrogen responsive gene



4

Notes

- Transcription factors can be positive or negative, turning genes on or off.
- There are 1000's of transcription factors in each cell, and 1000's of control elements in each promoter of each gene.
- Transcription factors are proteins too, so they are encoded by genes which are regulated by transcription factors too (genetic networks.)
- The phenotype of a cell is determined by the transcription factors expressed in a cell: estrogen responsive cells express the E-receptor, other cells do not.

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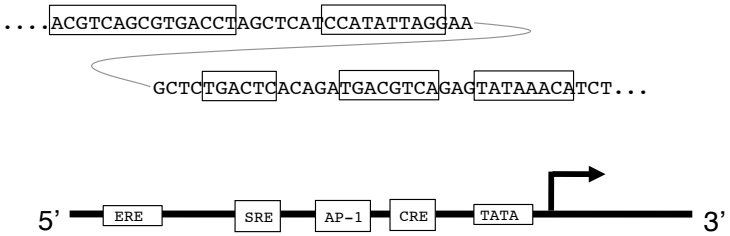
Thousands of Transcription Factors...

```
ACGTCAnnnTGACCT  = ERE: Estrogen response element
       TGACGTCA  = CRE: Cyclic AMP response element
        TGACTCA  = AP-1: Activator Protein-1 site
     CCATATTAGG  = SRE: Serum response element
```



...many Control Elements in the promotor of each gene

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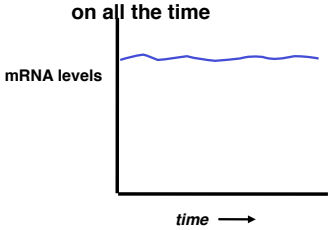
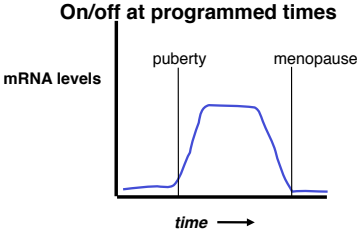
Regulation of Gene Expression

Three basic patterns of gene expression:

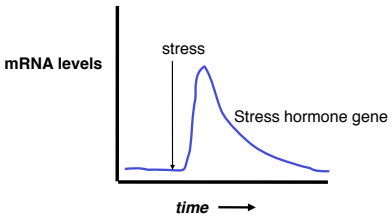
Constitutive
on all the time



Developmental
On/off at programmed times



Inducible:
Turned on/off by the environment



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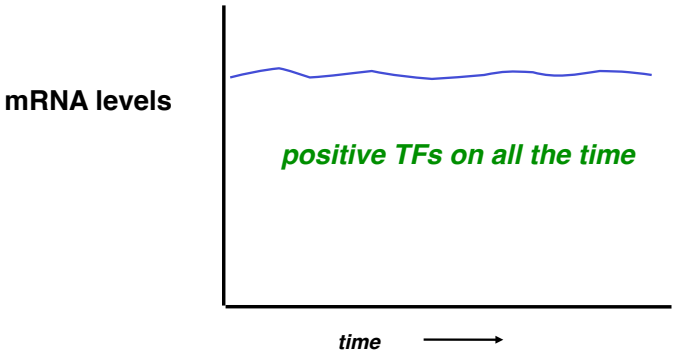
Regulation of Gene Expression

Constitutive
on all the time



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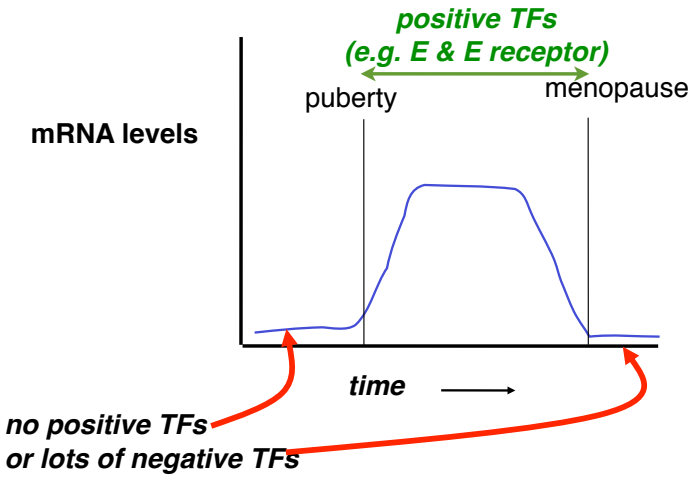
Developmental
On/off at programmed times



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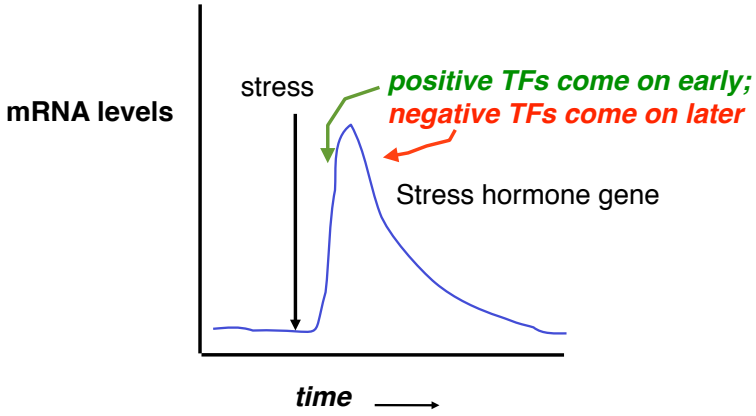
Inducible:
Turned on/off by the environment



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Transgenics:
Mix Promoters and Coding Regions

Combine the promoter for one gene with the coding region of a different gene.

Can be used to:

- **alter phenotype of a cell**
- **increase production of a specific protein**
- **label cells using a reporter gene.**

Example:
Add a gene with an estrogen-sensitive promoter that controls green fluorescent protein expression.
If cell expresses estrogen-regulated protein, it will glow in the dark.

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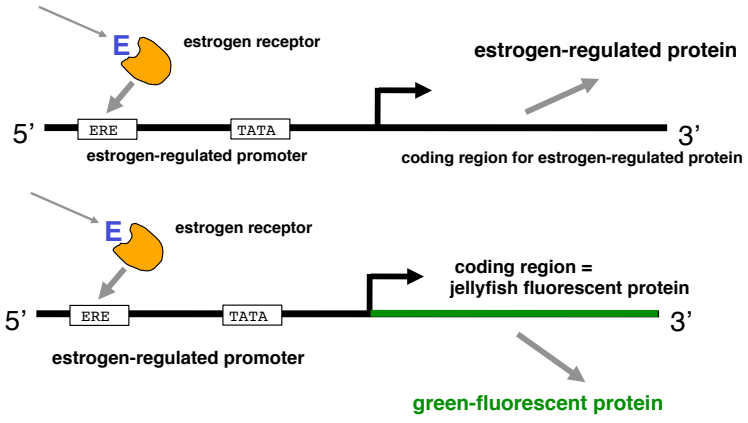
Transgenics:
Mix Promoters and Coding Regions



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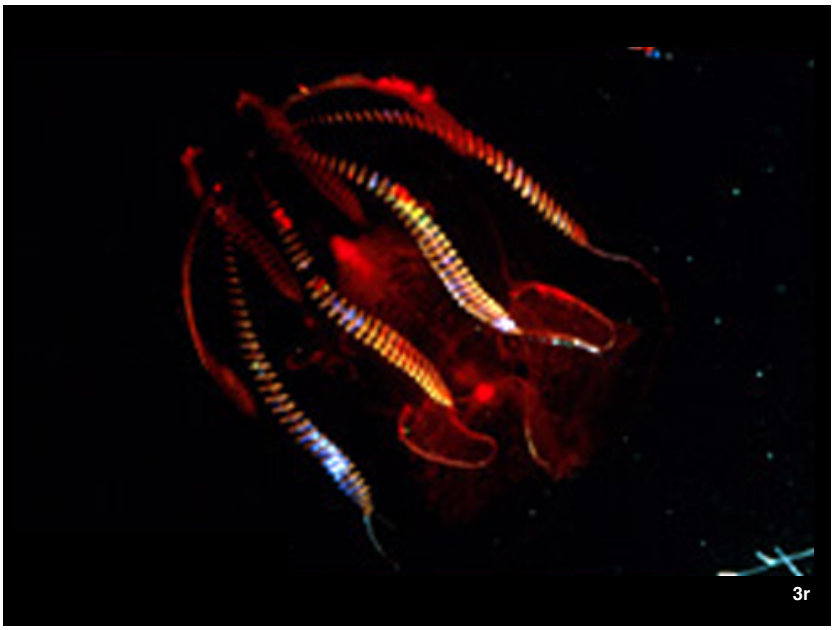

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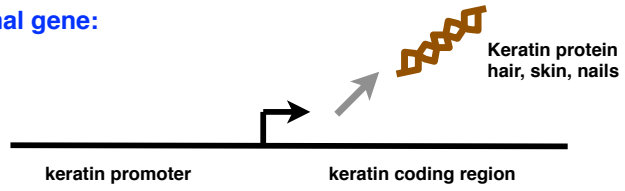
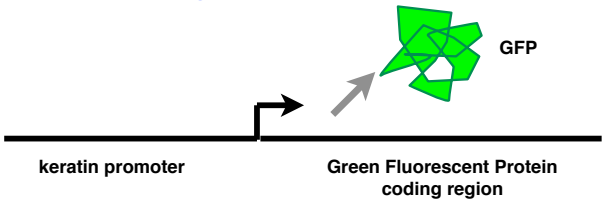
Normal gene:



Inject additional "transgene":



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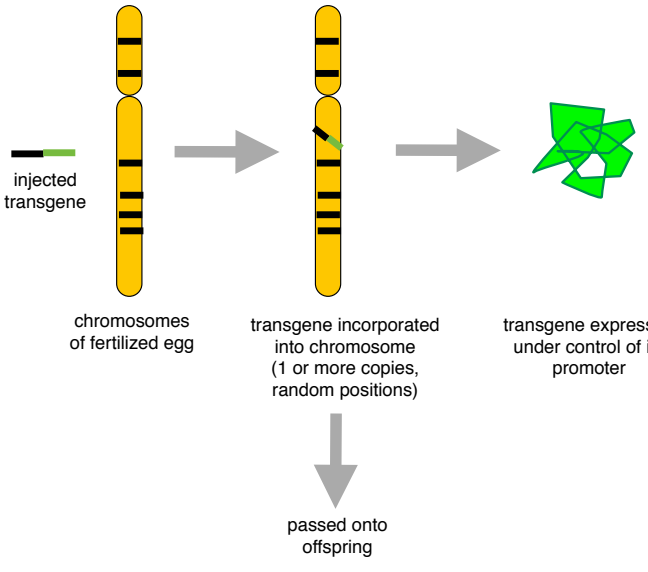

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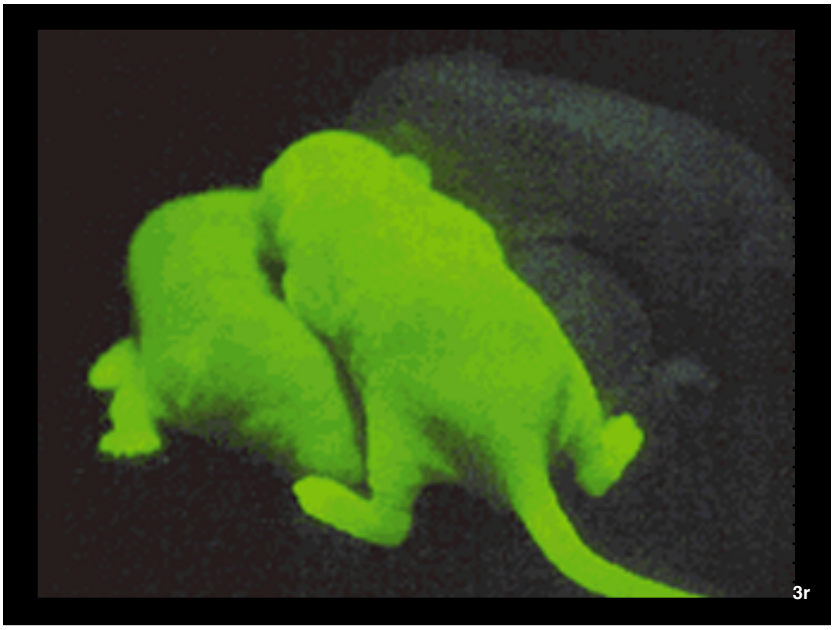
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http://www.nichd.nih.gov/news/releases/images/green_brown_mice.jpg

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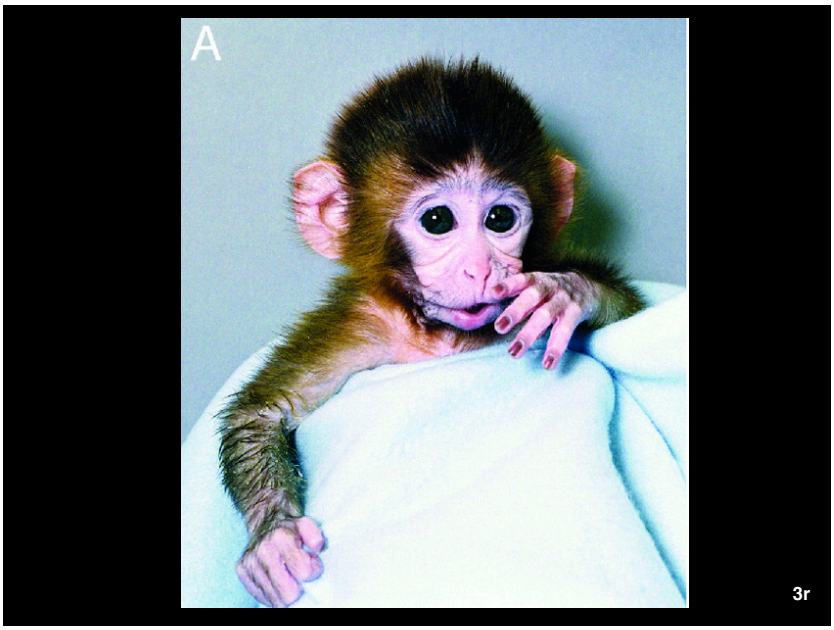

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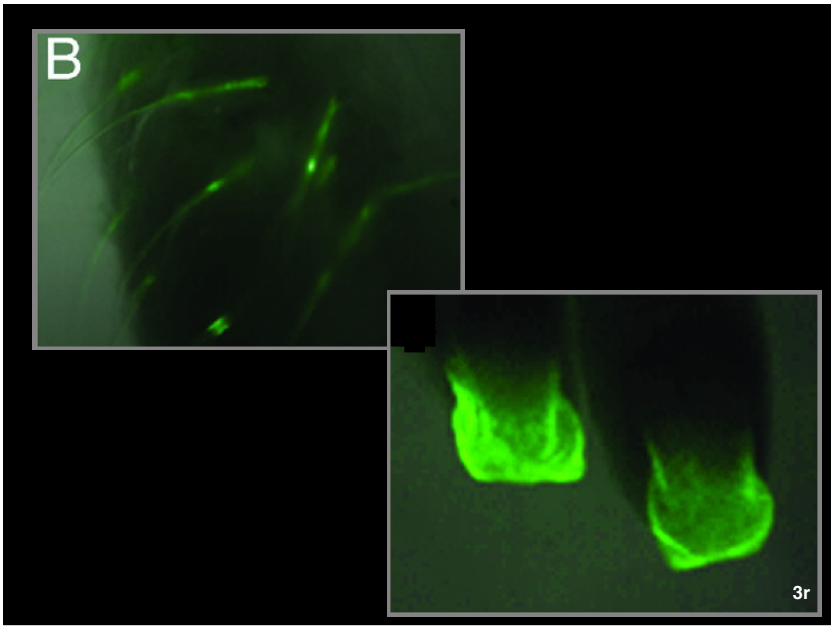

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Prokaryote vs. Eukaryote Gene Replication & Expression

	Prokaryote	Eukaryote
Chromosomes	single circular	multiple linear
Replication Bubbles	single origin	multiple origins
Replication enzymes	<----------Same---------->	
Gene structure	operons	introns & exons
Gene regulation	repressors & operators	transcription factors & promoter elements
Site of transcription	cytoplasm	nucleus
Transcription enzymes	<----------Same---------->	
RNA processing	no	yes: (capping, splicing, polyA tail)
Site of translation	cytoplasm	cytoplasm, rough endoplasmic reticulum
Amino acid code	<----------Same---------->	
Transcription enzymes	<----------Same---------->	
Ribosomes	Yes	Yes

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