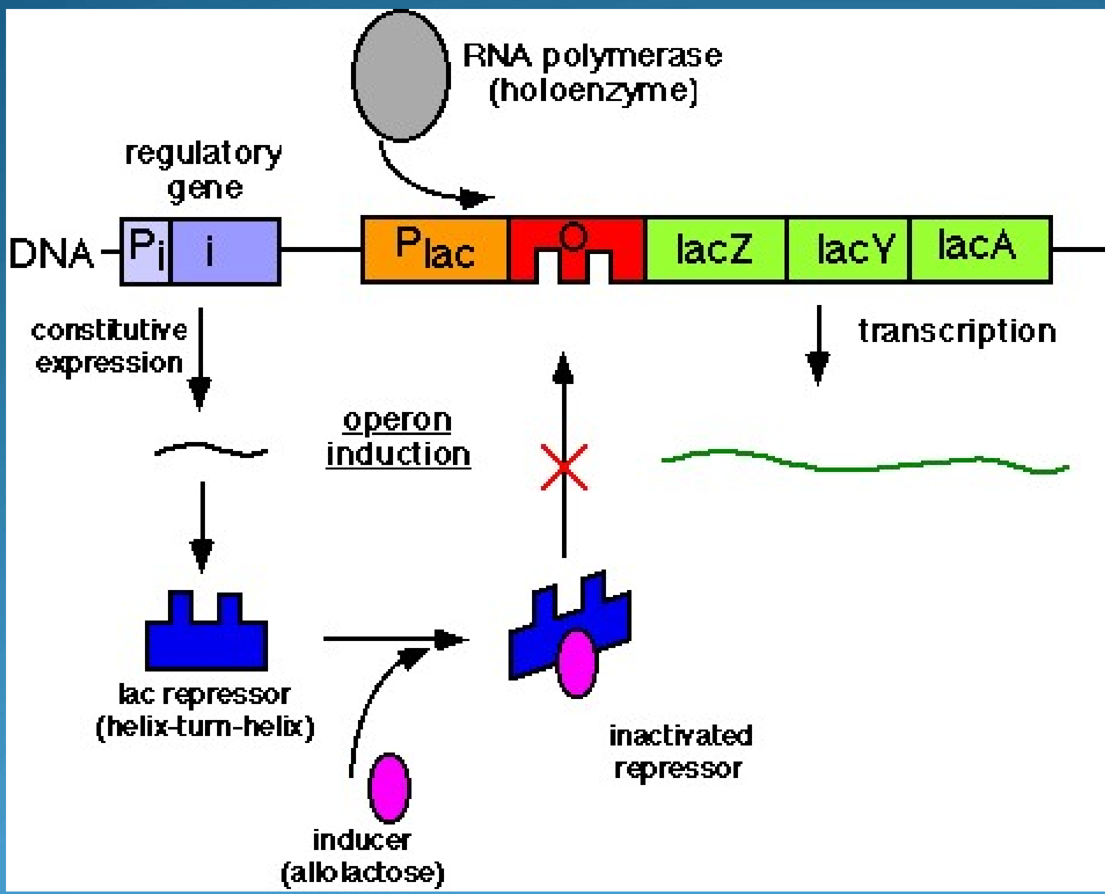
2.1.5 The *lac* operon



What you need to know

Explain the genetic control of protein production – using the *lac* operon as an example

Key terms you need to know…….

- ***Operon*** – length of DNA made from structural genes and control sites
- ***Structural genes*** – code for protein
- ***Control sites*** – operator and promoter region of the DNA

2.1.5 The *lac* operon

We know that.......

- mRNA – codes for a particular protein

- The code on the mRNA is complementary to the base sequence on the DNA template strand

- Therefore that code on the mRNA is a copy of the base sequence on the DNA coding strand

<u>Proteins are specified by mRNA</u>

Background information

Bacteria can synthesize different enzymes (proteins) depending on what food substrate they are growing on

E.Coli can synthesize over 3000 different enzymes

Enzymes involved in basic cell functions are synthesized at a constant rate

Inducible enzymes are synthesized as and when they are needed

Background information

E.Coli can adapt to its environment by producing enzymes to metabolize certain nutrients……….

but only when those particular nutrients are present

E.Coli normally respires using glucose but can also respire using lactose (sugar found in milk/disaccharide)

Needs to synthesize ***ß-galactosidase*** & ***lactose permease***

Background information

ß-galactosidase – hydrolyses lactose into glucose & galactose

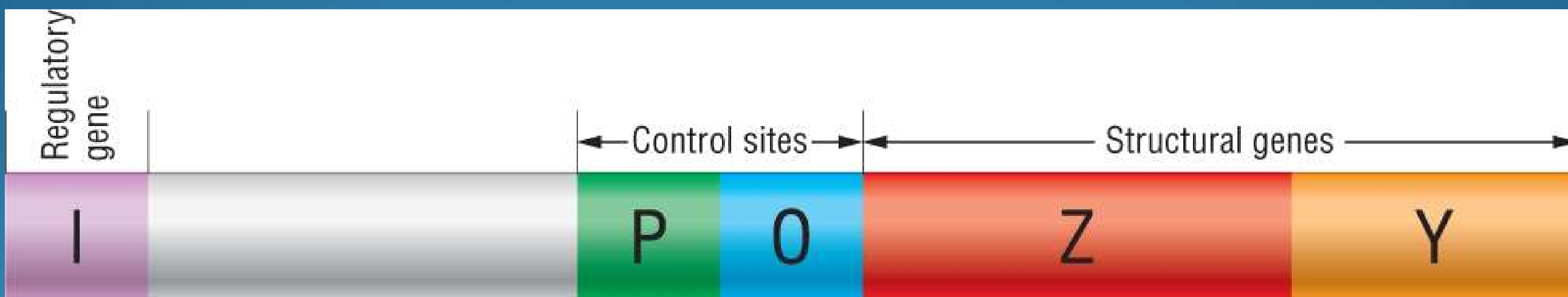
lactose permease – transport protein that becomes embedded in the *e.coli* membrane – helps transport more lactose into the cell

When placed in a lactose substrate, e.coli increases the synthesis of these two proteins by 1000x

Lactose triggers the enzymes production – inducer molecule

The *lac* operon

Lac system genes (in the bacterial DNA) form the operon – consists of structural genes and control genes.



Z - ***ß-galactosidase***

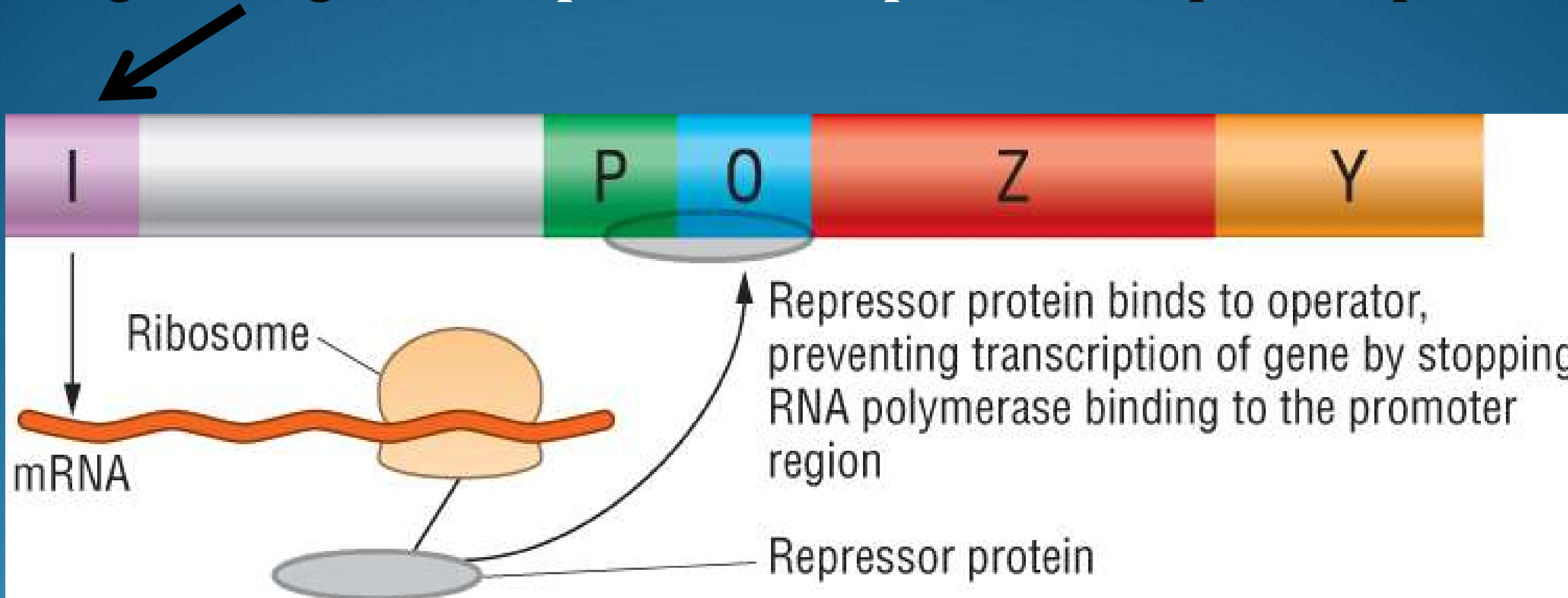
Y - ***lactose permease***

O – operator region – switches Z & Y on and off

P – Binding site for RNA polymerase for transcription of Z & Y

If lactose is absent

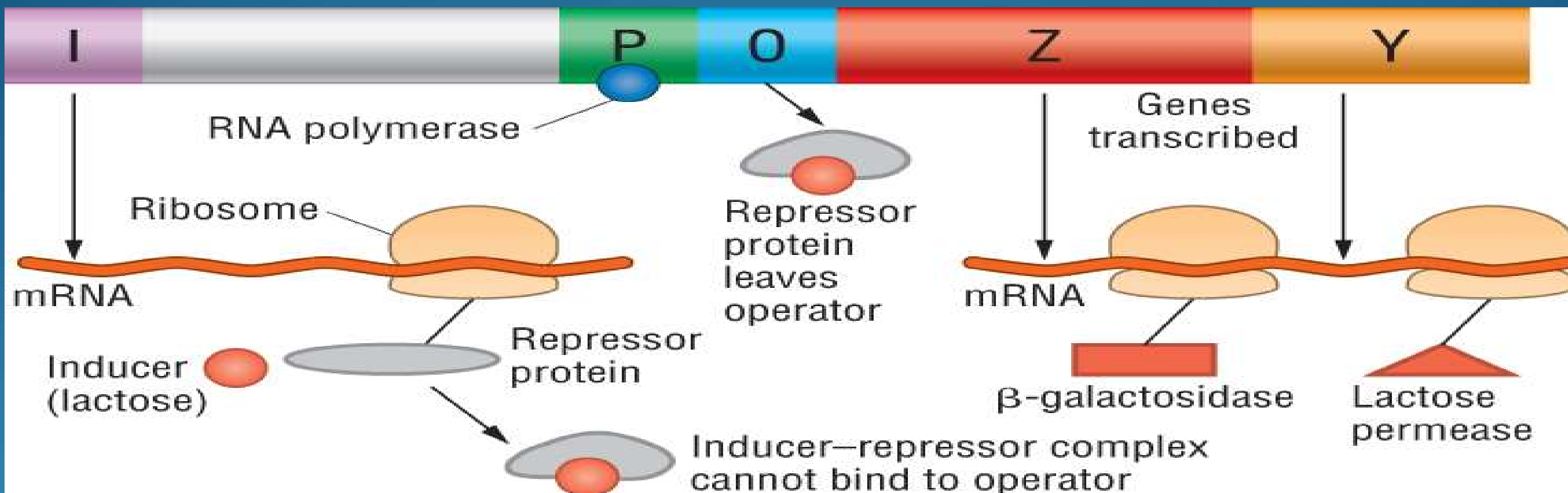
- Regulator gene is expressed and produces repressor protein



- Repressor protein binds to the operator region (P & O)
- Partially covers the promoter region (P)
- RNA polymerase can't bind – Z & Y genes can't be translated
- Z & Y are switched off

If lactose is present

- Inducer molecule (lactose) binds to the repressor protein



- Repressor protein dissociates from the operator region
- Promoter is now unblocked
- RNA polymerase can now bind promoter region
- Z &Y can now be transcribed – mRNA produced
- ***ß-galactosidase /lactose permease*** can now be synthesized

The *lac* operon

- As a result of the 2 enzymes being made, *e.coli* can now…..

- Take up lactose from its environment because ***lactose permease*** acts a transport protein.

- Using ***ß-galactosidase,*** lactose (disaccharide) can hydrolyzed into glucose & galactose

- *E.coli* can use these sugars for respiration

- *E.coli* is gaining energy from the lactose http://www.youtube.com/watch?gl=GB&v=0BwtxdI1zvk

Q.1 match the components with the functions.

Component	Function
A. Structural Gene	1. Produces repressor protein
B. Regulatory gene	2. Binds to repressor
C. Promoter	3. Codes for *lac* enzymes
D. Operator	4. Binds to RNA polymerase

Q.2 What are the functions of:

- Repressor protein
- RNA polymerase
- Regulatory gene

Student task

- Get into groups of 3 or more
- Use the large A2 paper as a story board
- Each person is to cut out the parts of the *lac* operating system on the handout provided
- Arrange the cut out parts to show the story of how the *lac* operon works in both the absence and presence of lactose