Do all cells have the same DNA (chromosomes) in them?

yes -

Are the same genes being read all the time in all of the cells?

No

What molecule is the end result of a gene being read? (what is made that the cell uses)

Protein

What happens to the amount of protein made when an activator is added onto a gene?

More

Upcoming: Next Tuesday you will have a 35 pt Lab Evaluation on all of the labs/activites from Wed (yesterday)- Monday.

It will be OPEN NOTES. It is how your labs are being graded.

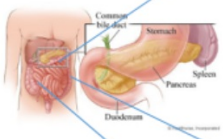
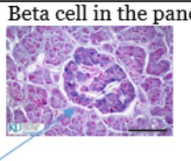
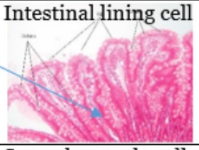
Agenda: Warm Up
Complete Cell Differentiation Lab

Homework: Microarray Background Information (skip top part that goes w/ video)

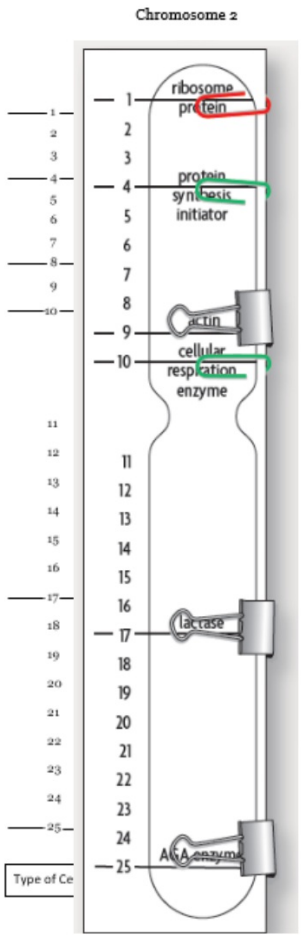
Identify which person in your group of 4 is which cell.

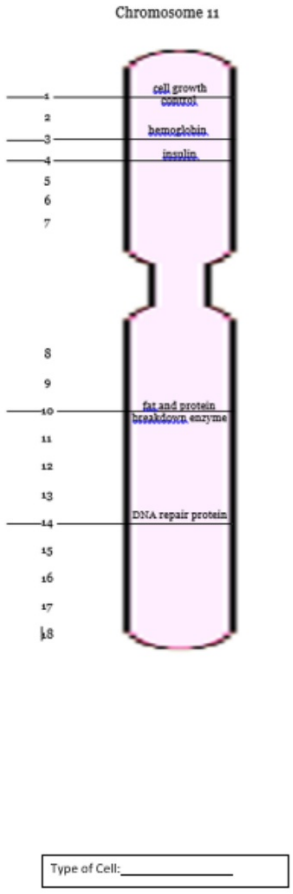
Part A: Gene Expression in Differentiated Cells

1. Each member of your group will look at gene activity in **one of four kinds of specialized cells** shown below. With your group, decide who will investigate each type of cell.

Location in body	Cell Type	Function	Student Name
	Beta cell in the pancreas 	Beta cells in the pancreas which produce the protein hormone insulin, which regulates cellular uptake and metabolism of sugars and fats	
	Red blood cell (circulatory system) 	Red blood cells produce hemoglobin, a transport protein that carries oxygen to every other cell in the body.	
	Intestinal lining cell 	Intestinal lining cells produce enzymes that contribute to specific steps of digestion	
	Smooth muscle cell in the digestive system 	Smooth muscle cells in the digestive system contract or relax in waves that move food through the digestive tract	

Each person needs 1 cup which contains:
4 binder clips
7 red paper clips
7 green paper clips





Cut out the large chromosomes

Label your cell type on the bottom of you chromosomes

Place the binder clips on the genes that are permanently turned off in your cell.

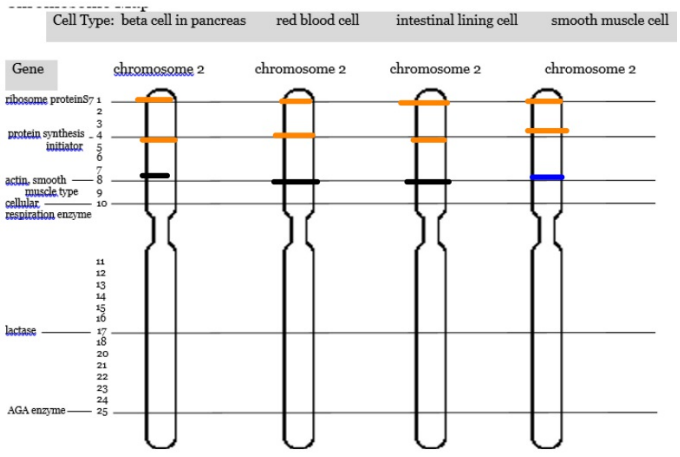
(These are the ones that have a black line across them on the smaller model)

Genes Expressed in Four Types of Human Cells

Key: + = active gene, - = repressed gene

Chromosomes 2

Protein Produced by the Gene	Beta Cell in Pancreas	Developing Red Blood Cell	Intestinal Lining Cell	Smooth muscle Cell in the Digestive System	Function of the Protein
Ribosome protein S7	+	+	+	+	Needed by ribosomes, which are essential for protein synthesis
Protein synthesis initiator	+	+	+	+	Controls the beginning of protein synthesis
Actin, smooth muscle type	–	–	–	+	Most cells produce actin for cell movement and cell division, but muscle cells produce large amounts of specific types of actin



Draw a line on the gene in chromosomes 2 and 11 that match the colors that you used in your chart. If you circled the gene in orange, draw a line in orange on the chromosome.

Instructions:

8) Shuffle the events card deck. Select one person in your group to start. They will take a card from the top and read the event outloud to the group.

9) Based on the events from the cards, place a Green paperclip over the gene if the gene is expressed (turned on). This means that it is causing the cell to make more of that protein. Place a Red paperclip over the gene if the cell needs less of the protein.

10. Key:

Green paper clip= Protein is needed- increasing the rate of transcription
Red paper clip= Protein is no longer needed- decreasing or turning off transcription
No paper clip= Only small amounts of the protein are needed
Binder clip= The protein is NEVER made in that type of cell

11. **For your cell**, in the data table below, record the cellular event (write card # and underlined words), the affected gene, and the result.

12. The next person, clockwise, in your group selects the next card from the top of the deck. Repeat steps 10-11.

Type of Cell Write your type of cell on the top

Cellular event	Affected gene and result	How Does this affect my cell?
Write under lined event	Write what is happening in body	

Key for my cell:

+ Activator added

++ 2 Activators added

-- Suppressor added

X Nothing happening

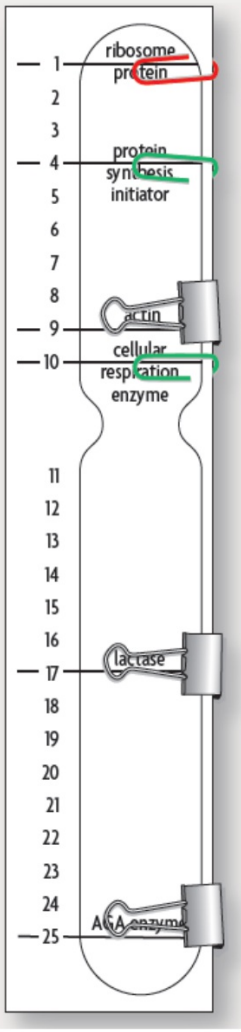
+ Activator removed

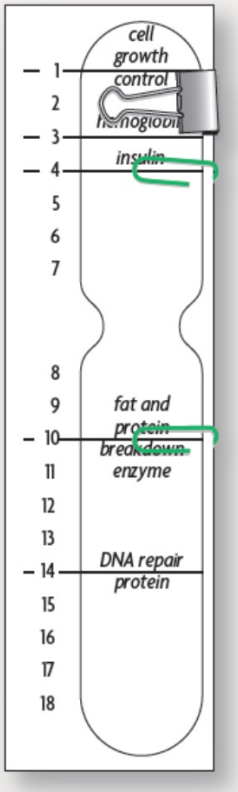
-- Suppressor removed

Ex: #1 All cells require energy, which they obtain by cellular respiration. Attach a green activator to the genefor the cell respiration enzyme in all cell types. This will increase the production of the cellular respiration enzyme. For cellular respiration in smooth muscle, which needs more energy than most cell types, add a second activator.

Type of Cell Smooth Muscle

Cellular event (underlined)	Affected gene and result (what is happening in body)	How Does this affect my cell? (result in my cell)
#1) All cells require energy	Cell respiration enzyme activated in all cells	+ +





Sample Student Response: Cellular Events Affecting All Cell Types

Cellular event	***Affected gene and result***
Cell needs energy (Card 1)	*Cell respiration gene is activated to start cellular respiration.*
Cells have enough ribosomes for now (Card 2)	*A repressor is attached to the ribosomal protein to decrease production of the ribosome protein.*
A full meal of protein and fat (Card 3)	*An activator is added to the gene for fat and protein breakdown enzymes.*
Proteins are needed (Card 6)	*The protein synthesis initiator gene is expressed.*
Meal high in carbohydrates, low in protein and fat (Card 13)	*Activator is removed from the fat and protein breakdown enzyme gene.*

Sample Student Response: Cellular Events Specific to the Pancreatic Beta Cell

Cellular event	***Affected gene and result***
Beta cell released its insulin and now needs more (Card 7)	*The insulin gene is activated to make more insulin.*
The beta cell has enough insulin (Card 8)	*The insulin gene is repressed.*

Sample Student Response: Cellular Events Specific to the Intestinal Lining Cell

Cellular event	***Affected gene and result***
Milk is present in the small intestines (Card 4)	*The lactase gene is expressed to increase production of lactase enzyme.*
There is no milk in the small intestines (Card 5)	*The lactase gene is repressed to decrease production of the lactase enzyme.*
No more intestinal cells are needed (Card 10)	*The cell cycle control gene is activated, and prevents the cell from dividing.*

Leave the green/red activators on your chromosome after you place them on until you are told to take them off.

Rotate who is reading the cards and complete at least 7 cards.

Each person in the group records the event in their chart and makes changes to their chromosomes.

Key for my cell:

+ Activator added

++ 2 Activators added

– Suppressor added

X Nothing happening

+ Activator removed

– Suppressor removed

Complete 8 events. Record them on the chart. Complete the conclusion questions.

Get a stamp when your conclusion questions are completed.

Name:_____ **Type of Cell**_____

Analysis

1) Compare the chromosomes in the four types of cells. Are chromosomes 2 and 11 in the muscle cells the same as chromosomes 2 and 11 in the other cells?

2) Compare the genes that were on the DNA in the four types of cells. Did the chromosomes in the different cells have the same genes located on them?

3) How was the expression of the genes different in the different cells?

4) What kinds of genes were permanently inactivated in some of your cells? Why were they inactivated?

5) Explain why some proteins are made by nearly all cells. Give 2 examples.

5) Explain why some proteins are made by nearly all cells. Give 2 examples.

6) What types of events caused short-term changes in some of the cells that you investigated?

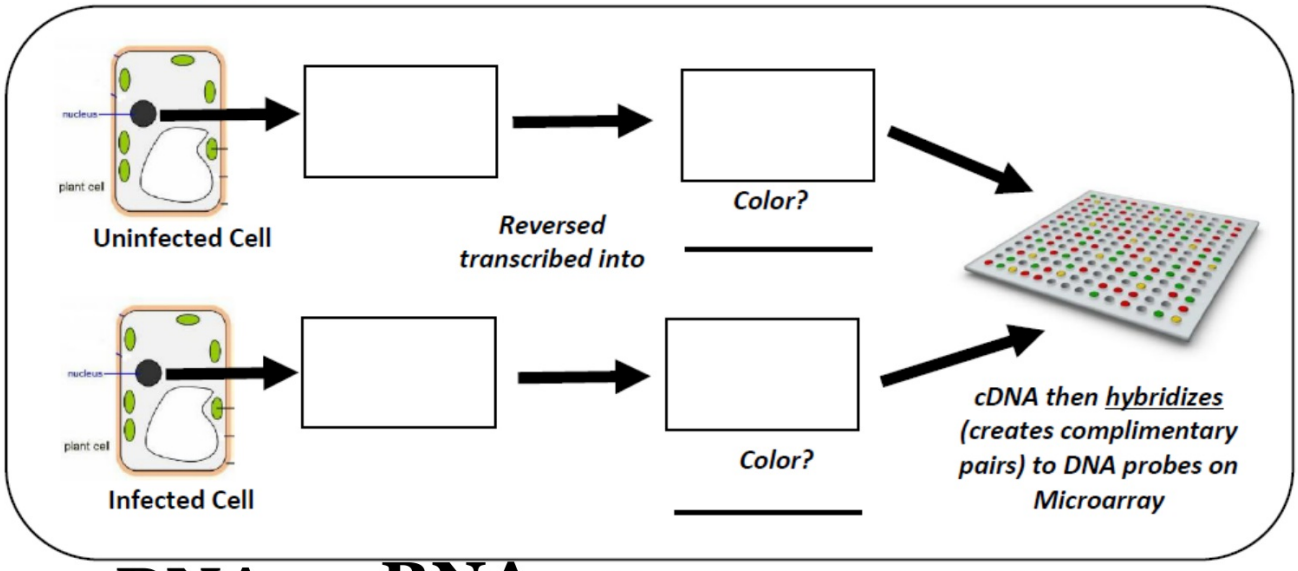
7) For your cell, explain how gene expression related to the cell's ability to perform its functions in the body.

8) For the human cell that you were the expert for, explain the connection between our DNA and disease. What would happen if a vital gene were repressed (turned off) on your chromosome?

Introduction to Microarray

Microarray Background Information
Capture Sheet

Use the video clip to fill in the flowchart below.



mRNA mRNA
cDNA cDNA Red Green

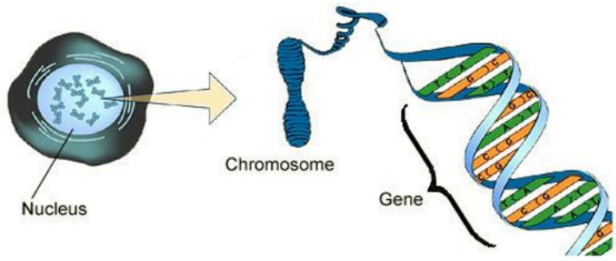
Video Clip: Introduction to Microarray (1:30 min.)

Introduction to Microarray

Read the "A Review of Protein Synthesis" and "How Microarrays are made." portion of *The Microarray Background Information* capture sheet **individually** and **answer the questions within the reading**.

A Review of Protein Synthesis

DNA is contained in the nucleus and coiled into chromosomes. In humans, each chromosome contains about 1000 genes. Genes code for proteins which give organisms their characteristics or traits.

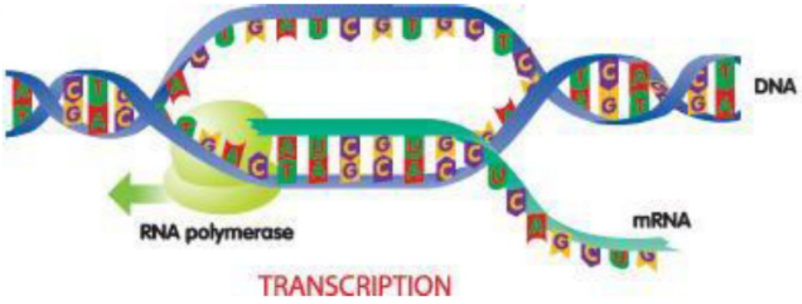


1. What do genes do?

2. Where is DNA located?

Introduction to Microarray

During gene expression, a segment (part) of DNA called a gene, separates and is copied into mRNA. This process is called transcription. The amount of mRNA copied indicates how much of the protein is needed by the cell. Only the proteins required for a particular cell to function will be transcribed. A heart cell will only make the proteins necessary for a heart cell to function, even though every cell holds the information to make all the genes for every protein in its' genome.



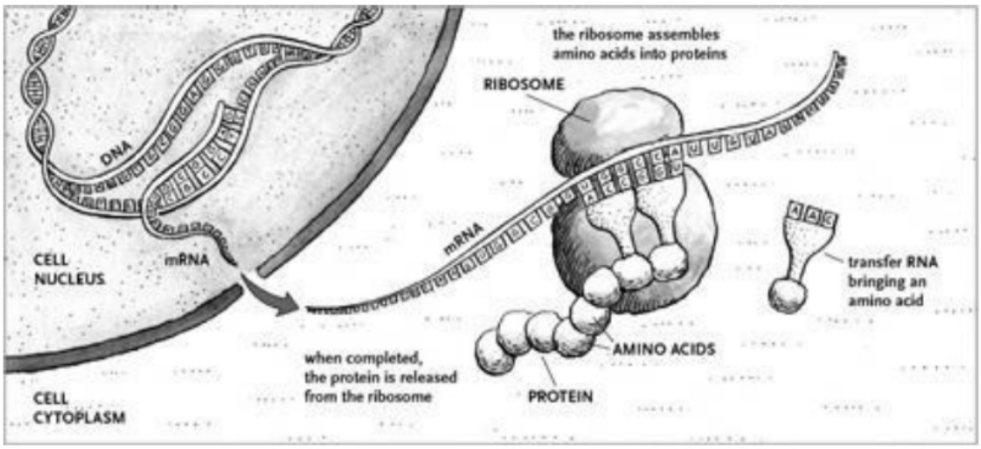
TRANSCRIPTION

3. What is transcription?

4. Why don't all cells make all proteins?

Introduction to Microarray

After the mRNA is made it leaves the nucleus and goes to the ribosome where the mRNA matches up with tRNA to construct the polypeptide chain or protein. This process is called translation. Transcription and translation are the two processes of protein synthesis.



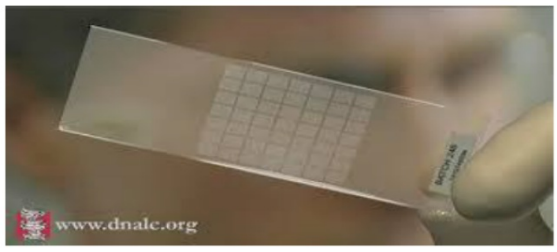
5. Where are proteins made?

6. What processes make up protein synthesis?

Introduction to Microarray

How Microarrays are Made

If a cell is expressing a gene to make a protein then it has to make mRNA. Scientists use this cellular information to study which genes are being expressed by measuring the amount of mRNA present in a cell. This tool is known as a **microarray**, which allows a scientist to measure the gene activity in a cell all at one time.



A microarray slide can hold an organisms' entire genome with small sections of DNA from every gene attached to a section or circle on the slide. These attached sections of genes are called probes. They are single-stranded DNA, so they are ready to pair up with their complimentary strands.

7. What must a cell make in order to make a protein?

8. What does a microarray measure?

9. What is a DNA probe? What is unique about a DNA probe compared to normal DNA?