

The Progress of Science:

A HISTORICAL SEARCH FOR THE DEFINITION OF A GENE

Concept: An online exploration of the historical events that led up to and continue to influence the definition of a gene explicitly addressing the frequent and persistent misconception of the one gene, one protein hypothesis.

Learning Objectives:

- Identify the major historical events that have influenced and continue to impact the modern definition of a gene.
- Name individuals whose research has shaped the way we understand how DNA sequences function
- Develop a well-constructed challenge to the 'one gene, one protein' traditional definition of gene.
- Craft a modern definition of a gene based on how scientific knowledge has changed over the past 200 years
- Explain how tRNA, introns and other non-coding DNA sequences have influenced the definition of a gene

Students will need the following:

- Access to the HudsonAlpha Progress of Science <http://timeline.hudsonalpha.org>
- Definition of a Gene Worksheet

General Instructions:

1. Write a definition of the term 'gene' in your own words on the Definition of a Gene worksheet.
2. Navigate to the HudsonAlpha Progress of Science using the web browser of your choice (<http://timeline.hudsonalpha.org>).
3. Using the clue in the left column and any other information provided to guide your search through history, locate the corresponding event on the timeline.
4. Fill in any missing data in the "When?", "Who?" and "What?" columns, using information discovered on the timeline. You may need to click associated links to find additional information. Include as much information as can be found for later synthesis.
5. Once those columns are complete, look through the information and complete the "How?" column. From the history you have uncovered, explain how each event or discovery affected our understanding of 'gene' and gene function.
6. Think about how you might define the term gene in the most modern way possible. Revise your definition to account for gene regulation and external control, as well as

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nonprotein products that have biological function. Record your more modern definition in the space provided.

7. Read the description of the faculty disagreement between Archibald and Craig. Which researcher do you support? Use evidence from your Timeline research to explain your support.

Questions for Discussion:

1. How does this compare to what you thought the definition was before beginning the activity?
2. How does it compare to the definition provided by your textbook or other resources you have?
3. Does the one gene, one protein definition accurately represent what we currently know about functional DNA sequences?

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In your own words define the term 'gene'.

A gene is _____

Clue	When?	Who?	What?	How? How does this event or discovery affect our understanding of "gene" and gene function ?
We go together like carrots and peas!	18__		Factors are passed from parent to offspring in a predictable pattern	
Not your jeans, your genes!	19__			Firmly defined the term used to describe special conditions, foundations and determiners of organism characteristics
No roads on this map, just genes (the first genetic cartographer)	19__	Thomas Hunt Morgan		
He is not a black insect with six legs	19__		Provided scientific evidence in support of the one gene -- one enzyme theory through experiments with bread mold	
Not the 'peripheral catma of biology'	19__	Crick and Gamov		

Clue	When?	Who?	What?	How? How does this event or discovery affect our understanding of "gene" and gene function?
Regulators, enhancers and promoters, OH MY	19__	Jacob and Monod		
You might find this guy just hanging around with Ivy during the Holidays	19__		Discovered tRNA, the first non-coding gene product discovered	
Between the exons	19__			Even within a protein coding gene, there are regions of DNA that are not used for protein production
<i>Drosophila</i> Down	20__	Zipursky, et al.		
Obstructing the RNA	20__	Andrew Fire and Craig C Mello	Discovered double stranded RNA that silences protein production after transcription has occurred.	
Good thing this encyclopedia is online	20__			

Clue	When?	Who?	What?	How? How does this event or discovery affect our understanding of “gene” and gene function?
The Cat Got Apples	20__		Map genome changes in major human cancers to understand how those changes cause cells to become cancer.	
Makes targeted changes to DNA	20__	Jennifer Doudna		

Based on your research, construct a definition of ‘gene’ that encompasses both historical and modern discoveries. Your definition can be more than a single sentence.

A gene is _____

Two researchers, Archibald and Craig, are disagreeing with each other at a faculty event. Early researchers thought that humans would have millions of genes to code for the myriad of proteins found in the human body. Current scientific thinking is that the number of genes is around 20,000. Both agree with the current calculations of the total number of genes in the human genome. Their point of disagreement revolves around the actual number of proteins produced by a human body.

“Look,” Craig says, “ Each of those genes produces one type of protein. There may be some differences because of alternative splicing or post-translational modification, but they are the same type of protein. Call it a family of proteins that come from one gene, they may have slightly different functions, but they are basically the same protein. This means that humans produce about 20,000 types of proteins in total. The rest is just details.”

“I don’t agree,” says Archibald, “Each gene can produce multiple types of proteins. Alternative splicing gives you a different sequence of amino acids, which is the fundamental definition of a protein. These proteins are dramatically different from each other in both structure and function. This means that humans produce hundreds of thousands, if not millions, of different proteins.”

Which researcher do you support and what evidence from your timeline research can you use to settle the dispute?