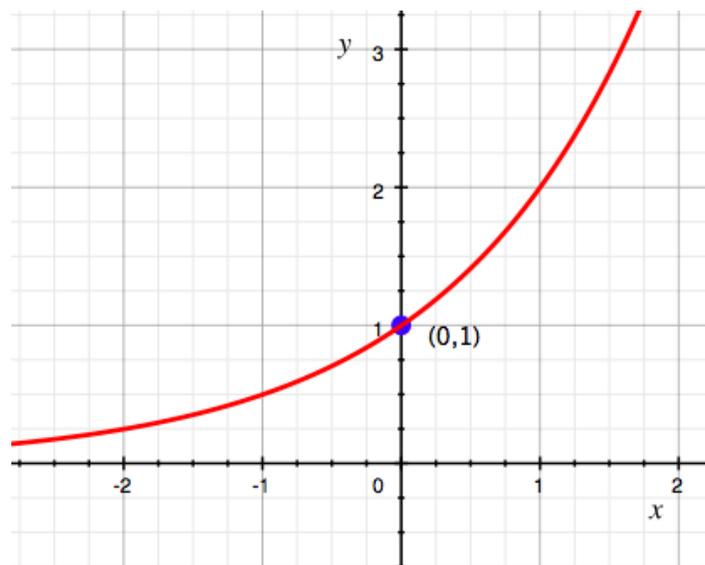


Algebraic and Transcendental Functions

Exponential Growth and Decay: Multicultural Project

By: Arq. Ma. Teresa Cantú Elizondo

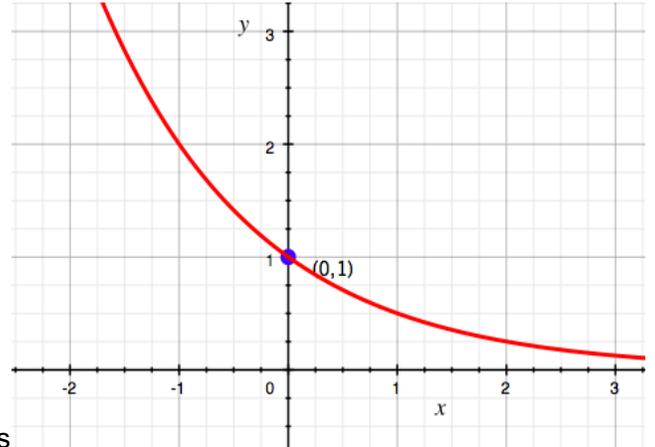
Part I: Students in teams of 4 (from a different campus, same campus or the same classroom), make a visual / graphic summary where they clearly show and explain the basic graph that represents an exponential function that includes its reference point, its domain and its range.



The graph above represents the parent function of the exponential function.

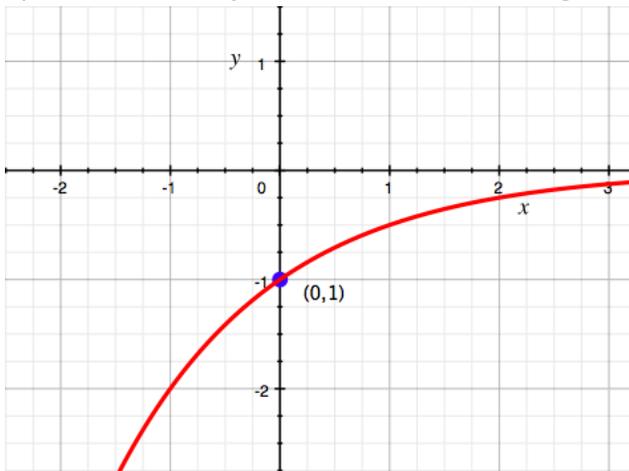
An exponential function is a function that has a horizontal asymptote which is defined by the equation $y = \underline{\hspace{1cm}}$. It is known that the reference point is 1,0 and this one may change due to the vertical and horizontal translations. In the following example $y = a^{(x-h)} + k$, by isolating x in the parenthesis you will define the horizontal shift and the value of k will determine the vertical shift. Another important concept to consider are the reflections. If a function only has a reflection over the x axis this will change in a decreasing way representing a decay, if it has only a reflection over the y the behavior will be the same since it will change to a decay graph. The domain will always be real numbers, and the range will be limited by the horizontal asymptote. Finally, if the function has both reflections this will represent an increasing graph which will be interpreted as an exponential growth.

The following graphs will describe the behaviors due to the reflections.



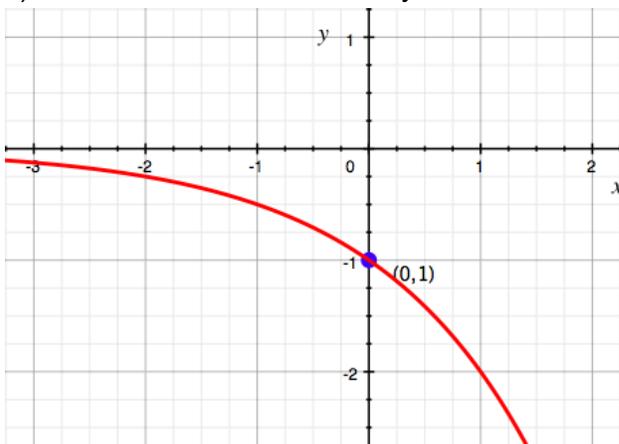
a) reflection over y. It is a decay because it decreases
Range: $(0, \infty)$ Domain: $(-\infty, \infty)$

b) reflection over y and x and it is increasing.



Range: $(-\infty, 0)$ Domain: $(-\infty, \infty)$

c) reflection over x. It is a decay because it decreases



Range: $(-\infty, 0)$ Domain: $(-\infty, 0)$

ACTIVITY

Kickoff: Teacher in the classroom or as flipped class asks the following questions;

Why hasn't it been possible to contain the nuclear energy and substances generated by the nuclear reactor's explosion in Chernobyl in 1986?

The amount of nuclear waste that was released from the meltdown was immense. Nuclear waste had an exponential growth effect, and it made it really difficult to clean it up. The nuclear waste will eventually fall in exponential decay, but it will take it at least 20,000 years for it to clean up and for Chernobyl to be an habitable place.

What is that makes nuclear energy to be so dangerous?

Meltdowns release enormous amounts of radiation at an amazing speed, making it really dangerous and difficult to evacuate. Nuclear waste remains radioactive for a very long time, and takes many years to decompose. It contaminates ecosystems and water we can use. Nuclear waste makes harmful human health impacts.

Why is it said that a nuclear reaction generates an exponential growth of the atoms?

It is a nuclear chain reaction. Each nuclear reaction causes one or more subsequent nuclear reactions, leading to the possibility of propagating a series of these reactions. These chain reaction if responsible for exponentially increasing rates in reactions, increasing the number of atoms, as produced in chemical explosions.

When will all the nuclear energy and substances released by this explosion be dissolved, can they be cleaned out completely?

Radioactive waste naturally decays over time, it has to be isolated and confined in appropriate facilities for enough time. There is long-lived radiation surrounding the former Chernobyl Plant. The area won't be safe for human habitation for at least 20,000 years. Exponential decay will do its work, but it will take it a very long time to clean out the waste completely.

Part II: To be done by students in teams of 4 (from a different campus, same campus or the same classroom):

Watch the following videos that contain documentaries with more information on the topic. They are to be watched and discussed by all team members. As a team, you must make a summary that contains facts, consequences and implications of the Chernobyl Nuclear Reactor Disaster to this day and in a global context.

<https://www.youtube.com/watch?v=5WGUbzr31s> , <https://www.youtube.com/watch?v=ITEXGdht3y8> and <https://www.youtube.com/watch?v=p5GTvaW34O0>

SUMMARY

1:23 A.M., April 26th, 1986, the world was seconds away from its worst nuclear accident. Reactor number 4 exploded. The disaster brought death and disease. It made clear the dangers of nuclear power. Chernobyl accident is the most serious accident in history of nuclear history. Fires continued for 10 days, and it led to huge amounts of radioactive materials being released into the environment and a radioactive cloud spreading over much of Europe. The most contaminated area around the reactor is Belarus, Russia and Ukraine.

The accident affected 600,000 people in emergency, containment, cleaning and recovery operations. Approximately 1000 people, workers, were affected directly from radiation on the first days of the accident.

More than 5 million people that lived in the areas are considered to be contaminated with radioactive materials. 116,000 people lived in the Exclusion Zone, which was the closest to the power plant and they were evacuated in the spring and summer of the same year.

During the accident, blast effects caused 2 deaths within the facility, later 134 were hospitalized with acute radiation symptoms, of which 28 firemen and employees died in the days-to-months afterward from the effects of acute radiation syndrome, in addition, approximately 14 cancer deaths amongst this group of initially hospitalized survivors was to follow within the next ten years. Whilst among the wider population, an excess of 15 childhood thyroid cancer deaths had been documented as of 2011.

They built the “Object Shelter”, often known as the sarcophagus, with its purpose to reduce the spread of radioactivity from the wreckage and to protect it from the elements. It wasn't intended to be a radiation shield, but it was built quickly for safety.

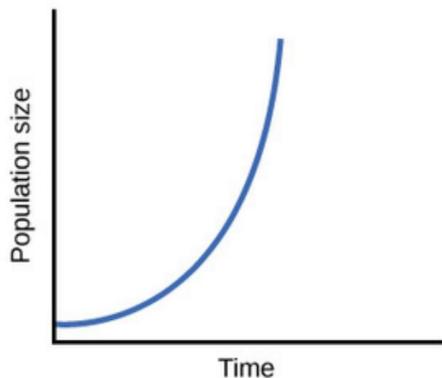
Environmental effects were disastrous, the most affected places were Belarus, Ukraine, Russia, Sweden and Finland. Contamination was scattered irregularly depending on weather conditions. In the end, the release was controlled by the physical and chemical properties of the radioactive elements.

The accident motivated safety upgrades on all remaining Soviet-designed reactors. It also motivated countries to improve their nuclear plant security systems, designing them on an efficient way, getting workers that know what they are doing, and having plans in case of disaster. The option of banning nuclear plants is also considered.

As a team you are to do research and present with facts, at least two different real situations or events that are examples of exponential growth and decay. Clearly justify your examples.

- The best example of exponential growth is seen in bacteria. This is because of the prokaryotes reproducing. If 100 of bacteria get on a flask each will reproduce, from 100 there will be 200 and then 400 and so on, if we graph it it will make an exponential graph. Where the population size, N , is plotted over time, a J-shaped growth curve is produced.

Exponential Growth



- Another example is the population of a country, this is because a country's population can not be linear growth because of the difference of births in every year; an example is the rate of life expectancy of man and woman in Great Britain calculating the years expected to live and the percentage of persons reaching it, makes a exponential graph.



Your teamwork and sharing of information can be done any way you want. You can meet and work together, use google docs, google hangouts, facebook, facetime, skype, whatsapp, etc.

Note: Your final product must include at least 2 evidences that clearly shows how you interacted and worked as a team.

Conclusions: Students in teams of 4 (from a different campus, same campus or the same classroom) write a team's conclusion that must give an answer to each of the following questions:

What is exponential growth? What is the function and graph that models and represents it? What are their main characteristics? (include a picture of your team's visual / graphic summary) What is exponential decay?

- Exponential growth is the growth whose rate becomes ever more rapid in proportion to the growing total number or size.
- All types of equations containing two unknown (x and y) variables may be inserted in a coordinate system. These types of equations are known as functions.
- Exponential decay is the decrease in a quantity according to the law.

What are the implications of using nuclear energy? Do you consider nuclear energy to be clean energy? (justify your answer)

- Nuclear energy is released into the atmosphere which can cause many environmental problems such as global warming. Uranium is not burned in a nuclear power plant as coal is so, there are no emissions from it.

Are you aware that there is a Nuclear Energy Plant in Mexico? Where is it? Do you think it is safe? Do you agree with the fact that there is a Nuclear Energy plant in your country? (Justify your answer)

- There are actually two Nuclear Energy Plants in Mexico, they are located in Laguna Verde, in Mexico City. Nuclear energy is very dangerous, since the meltdowns release radiation in a very high speed and the nuclear waste remains active for a very long time, it takes years to

decompose and that causes health impacts on humans. It also contaminates the ecosystem. But the nuclear energy plant generates a lot of electricity for Mexico, and it is a better way of getting energy.

Could the Chernobyl 1986 nuclear disaster have been prevented? How? It is hard to tell, but the workers could've been better trained and could've had better supervision over the disaster. **Once the explosion happened, was there any way to stop the radiation spread and its pollution?** No since the radioactivity is spread in a very high speed, it can't stop once it is released. **Do you think that the radioactive pollution generated by this disaster reached Mexico?** The disaster was in Ukraine, in Europe, so Mexico was not in the range of the radioactive pollution generated by the disaster. **What are at least 4 environmental consequences (in a global scale) of the Chernobyl 1986 disaster?** One of the consequences caused by this disaster was the contamination of the air in Ukraine and its surroundings caused by the radioactivity, it killed many people over the years and it is still a problem. Another consequence of this disaster was that it was partially responsible for 7,000 cases of thyroid cancer in young teens and adults, 15 children were killed because of their thyroid cancer (from the radiation).

What are the environmental consequences (in a global scale) of other nuclear disasters and use of nuclear weapons?

- Most of the damages are molecularly so it affects in the health of the people, it may create new diseases that scientist will need to study and to develop medicines or treatment it will take years and out of the damages of people it affects also the layers of the atmosphere, mostly the ozone layer that it's already to damaged for us to keep damaging it.

What do you think and feel about these consequences?

- In our opinion it's hard to understand why would people nowadays risk their lives just to prove something. This nuclear case was an accident by a military program and it didn't had the enough security to handle the consequences of the experiment, probably the people in charge of the experiment knew that they weren't the capable enough to handle the experiment but the human being always wants to "be better" and that's what causes problems. The Chernobyl case not only caused a lot of deaths, it caused a long temporal damage because of the radiation that may cause new diseases and the damage is not only for the people is also for the planet because it also affects the layers of the atmosphere, causing damage to the world and the living beings.

What would be a solution proposal for this situation?

- A nuclear disaster is way more dangerous than a natural one, because the damage it causes is more molecularly and it's hard for us to see it, for me a solution could be to investigate all the different variables and results at the moment to try an hypothesis and if one of the possible results is an explosion or something that could risk the life of the people, then it can be done somewhere far from society or in a private laboratory. Usually scientifics don't know what the answer or result is going to be but they should know the possible answers for them to know if they want to risk themselves for an experiment or not.

How did we feel working like this?

- It was kind of weird because we don't know each other but it also in a good way to know people and to interact even tho we don't know the other team.

Did we like it?

- Yes because it's a good way to know how other people work and how to get out for the same circle of people that you work with.

Was it difficult?

- No, the only thing that was kinda difficult was to contact with each other.

What did I like the most of working with my teammates in this form?

- That even though we don't know each other and that we don't know the way we all work, we didn't had any problems on working together as a team

References:

1. Fact Sheets. (n.d.). Retrieved October 16, 2017, from <https://www.nei.org/Master-Document-Folder/Backgrounders/Fact-Sheets/Chernobyl-Accident-And-Its-Consequences>
2. Chernobyl Nuclear Accident. (n.d.). Retrieved October 16, 2017, from <https://www.greenfacts.org/en/chernobyl/l-3/1-chernobyl-accident.htm#0p0>
3. Lallanilla, M. (2013, September 25). Chernobyl: Facts About the Nuclear Disaster. Retrieved October 16, 2017, from <https://www.livescience.com/39961-chernobyl.html>
4. Touran, N. (n.d.). Retrieved October 16, 2017, from <https://whatisnuclear.com/articles/nucenergy.html>
5. Nuclear Energy. (n.d.). Retrieved October 16, 2017, from <http://www.greenpeace.org/usa/global-warming/issues/nuclear/>
6. 7 Reasons Why Nuclear Waste Is Dangerous. (n.d.). Retrieved October 16, 2017, from <https://greentumble.com/7-reasons-why-nuclear-waste-is-dangerous/>
7. Nuclear chain reaction. (2017, October 06). Retrieved October 16, 2017, from https://en.wikipedia.org/wiki/Nuclear_chain_reaction

Closure: Teacher in class has a group discussion on the questions that were answered for the project's conclusions.

Final Product: The link to your team's YouTube video is to be uploaded in the corresponding Blackboard Discussion board by Monday October 17, 2016 at 11:59 pm. Be sure that your team's video is uploaded as public so that your teacher is able to watch it. If your teacher is not able to access it and watch it, your grade in the project is going to be zero, no exceptions.

This final product must include the following:

Introduction with complete Names, Id Numbers and campus of all team members must be clearly shown. A brief summary of the project's contents.

Part I with a visual / graphic summary where students clearly show and explain the basic graph that represents an exponential function that includes its reference point, its domain and its range.

Part II with the summary of the Chernobyl Nuclear Disaster and at least two different real events / situations that are also examples of exponential growth and decay. Also include, evidence of the team's interaction and form or work.

Conclusions with the answers to the questions provided in the activity.

Due date: October XXXX, 2017 by 23:59:59 (the latest)

This activity will count as the 2nd Partial Project and will have the corresponding value. The complete project, and its conclusion must be included in each student's portfolio.

RUBRIC

Name: _____ Id#: _____ Group: _____		
Percentage	Product	Points
5%	Video's clarity and quality of image and sound. All team members actively participate in equal portions of the video.	
5%	Communication of ideas, theory, concepts, facts, summaries and explanations is clear and correct. Evidence of team members interaction is included.	
5%	Use and expression of mathematical notations, symbols and representations (both oral and written expressions) is clear and correct.	
10%	Introduction: Name, Id#, Campus and brief summary of project.	
20%	Part I: Visual / graphic summary of the graph that represents exponential functions with all of its elements.	

20%	Part II: Summary of Chernobyl disaster and at least 2 examples of exponential growth and decay with two other real events / situations.	
35%	Conclusions: Answers to all questions and solution proposal.	
Total Points:		