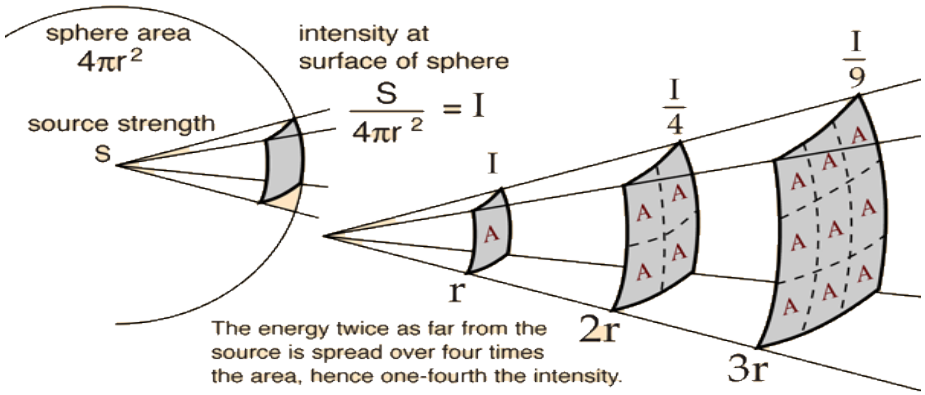
Finote Ethio-Canadian Information Centre In Toronto
ፍኖተ ኢትዮ-ካናዳውያን የኢንፎርሜሽን ማዕከል በቶሮንቶ

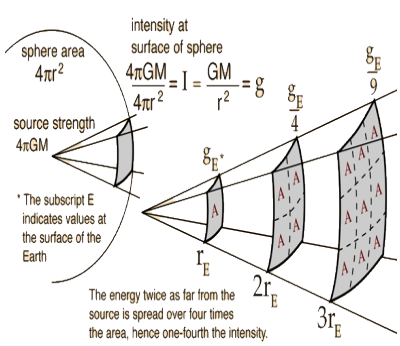
E-mail: torontofinote@gmail.com

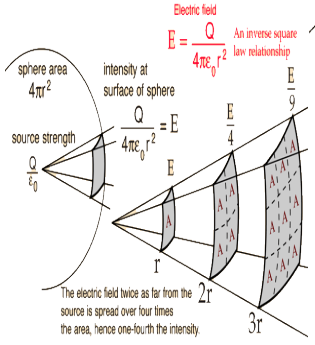
Physical laws that govern *pathogen*

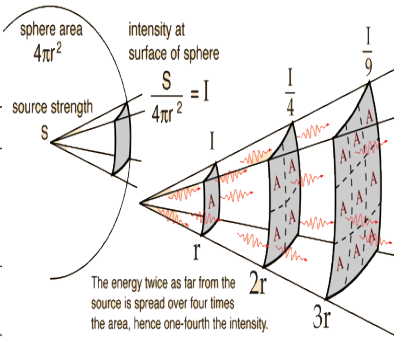
Any point source, sound, light, any field, diseases, etc., which spreads its influence equally in all directions without a limit to its range will obey the inverse square law. This comes from strictly geometrical considerations. The intensity of the influence at any given radius r is the source strength divided by the area of the sphere. Being strictly geometric in its origin, the inverse square law applies to diverse phenomena. Point sources of gravitational force, electric field, light, sound or radiation obey the inverse square law. It is a subject of continuing debate with a source such as a skunk on top of a flag pole; will its smell drop off according to the inverse square law?



1. As one of the fields which obey the general inverse square law, the gravity field can be put in the form shown below, showing that the acceleration of gravity, g, is an expression of the intensity of the gravity field.
2. As one of the fields which obey the general inverse square law, the electric field of a point charge can be put in the form shown below where point charge Q is the source of the field. The electric force in Coulomb's law follows the inverse square law.
3. As one of the fields which obey the general inverse square law, a point radiation source can be characterized by the relationship below whether you are talking about Roentgens , rads, or rems . All measures of exposure will drop off by inverse square law



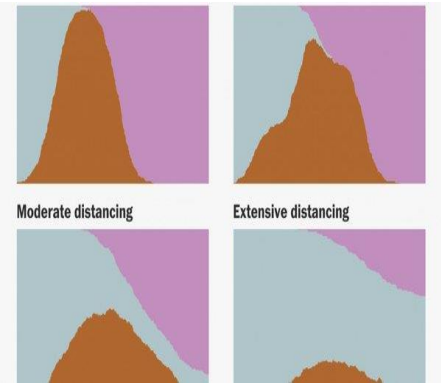




Inverse Square Law, Gravity Inverse **Square Law, Electric field** **Inverse Square Law, Radiation**

The source is described by a general "source strength" S because there are many ways to characterize a radiation source - by grams of a radioactive isotope, source strength in Curies, etc. For any such description of the source, if you have determined the amount of radiation per unit area reaching 1 meter, then it will be one fourth as much at 2 meters.

From physics perspective: Inverse square law governs flattening the curve: *Social distancing is an application of inverse square law-we can model this by intensity of COVID-19 patient's with non-COVID-19.*



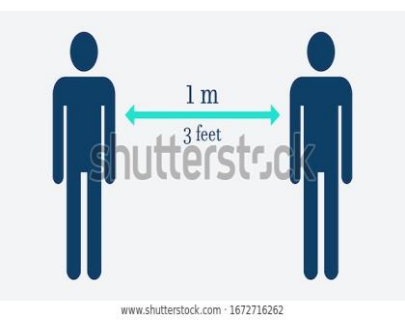


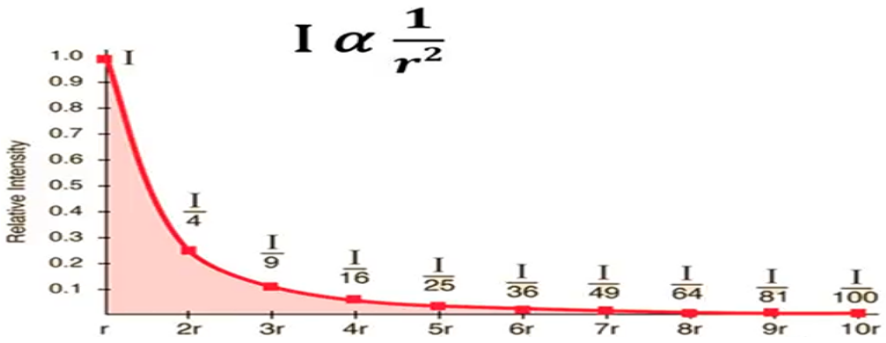
Diagram taken from Washington post; Social distancing flattening the virus as its intensity of proximity decreases. Denote two people by D_c and D_{nc} by virus infected and non-covid respectively

$$F_{infected-noninfected} \propto \frac{D_c D_{nc}}{r^2} = \mathrm{I}$$

where r (in meter or fit) is the distance between any two individuals, **I** is the **relative intensity of the virus**, and the proportionality constant can be the intensity strength of the type of virus. As the distance between them increases the intensity of covi-19 decreases, in other words when they are far apart the probability of being infected is decreasing and asymptotically approaches zero. Let us prepare a chart:

Distance (r-meter)	r^2	$\frac{1}{r^2}$	Intensity (I) unit
1	1	1	I
2	4	$1/4$	0.25I
3	9	$1/9$	0.11I
4	16	$1/16$	0.06I
...	...	....	...
∞	∞	$1/\infty$	$\rightarrow$ 0I

The above chart displays the reality of social distancing from each other to minimize the covid-19 transmission from one individual to another. Though there is a tail of inverse square law, the strength decreases as the social distance increases so as to flatten the curve.

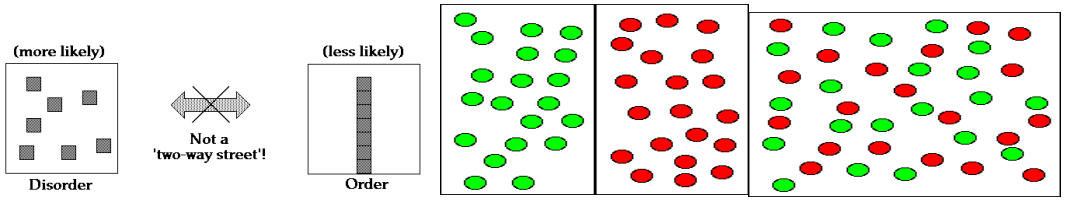


Inverse Square law: The Intensity of COVID-19 is inversely proportional to the square of the social distance. Notice in the diagram that as the distance doubles, the area quadruples and thus, the initial field strength of amount is spread over that entire area and is therefore reduced, proportionately.

Entropy and COVID_19

The key to predicting the possibility of a new epidemic is to understand if a particular virus carried by certain animals can mutate/modify, get transmitted, and finally spread among humans. Our lives become more complicated and gradually decline into disorder rather than remaining simple and structured. It drives many of the problems we face and leads to disarray. It is the one force that governs everybody's life: *Entropy*-reflects the degree of disorder. Hence, we define entropy as a measure of disorder. Example:

- A system (such as a room) is in a state of high entropy when its degree of disorder is high.
- As the order within a system increases, its entropy decrease
- For better or for worse, nature 'likes' chaos, disorder, high entropy... In fact, much of our life consists in fighting this disorder



This can be explained in terms of probabilities. Disordered states are simply more likely to exist (or emerge) than ordered states. The spontaneous direction of change is from a less probable to a more probable state, as illustrated above.

The idea that spontaneity requires a negative change in the *Gibbs free energy* of the system served as a powerful resource for framing a discussion about what entropy can contribute to our understanding of biological phenomena. In fact, spontaneity requires a negative change in the Gibbs free energy of a system is one of the most consistently leveraged ideas, and is well coordinated with other elements of our thermodynamic knowledge. Fortunately, under certain conditions one can rewrite the Second Law such that spontaneity is determined by a property of the system, and not by a property of the universe as a whole. At constant temperature (T) and pressure (P), conditions common for biochemical processes, the system property that determines spontaneity is the *Gibbs free energy.* [**Option**al: **Gibbs free Energy (G)** is the energy associated with a chemical reaction that can be used to do work. The free energy of a system is the sum of its enthalpy (*H*) plus the product of the temperature (Kelvin) and the entropy (*S*) of the system: $G = H - TS$ and the change in Gibbs' free energy is given by $\Delta G = \Delta H - T\Delta S$]

When the entropy of the universe increases during a process, the Gibbs free energy of the system decreases, and the process is spontaneous. When the entropy of the universe decreases during a process, the Gibbs free energy of the system increases, and the process does not spontaneously proceed. Unpacking the complex interplay between energy and entropy in determining the sign of the free energy change requires that we develop a set of illustrative and discussion-generating problems that help students understand these sometimes competing effects. The benefit of doing so is that our students will have opportunities to explore a more coherent thermodynamic world.

For some reason, the universe at one time had a very low entropy for its energy content, and since then the entropy has increased. So that is the way toward the future. That is the way toward the future. That is the origin of reversibility, that is the what makes the processes of growth and decay, that makes us remember the past and not the future, remember the things which are close to the moment in history of the universe when the order was higher than now, and why we are not able to remember things where the disorder is higher than now, which we call the future.

It is objective reality that natural tendency of things to travel along the trajectory of disorder. The astronomer Arthur Eddington once stated that:
"The law that entropy always increases holds, I think, the supreme position among the laws of Nature."
Roald Hoffmann (a chemist who shared the 1981 Noble Prize in chemistry) has stated, "*One amusing way to describe synthetic chemistry, the making of molecules that is at the intellectual and economic center of chemistry, is that it is the* ***local defeat*** *of entropy*" [American scientists (1987)].
Local defeat of entropy is apparent when we observe a pine tree with all of its symmetry at so many levels, when we think of the non-randomness of a human body in its form and its function, and when we see a model of the extraordinary structure of DNA. The formation of these decrease in entropy are accompanied by very large increase of entropy in their surroundings.

The local defeat of the entropy of Covid-19 will be apparent by increasing our integrated energy to save universal human life. Because all spontaneous natural processes result in increased disorder as time progresses, it is evident that increasing entropy and time point in the same direction. It is the change from an ordered arrangement to a disordered arrangement which is the source of the irreversibility. (The arrow of time is irreversible!)

Why, then, some young people violate this natural law?

I observed some young people resisting the social distancing model promulgated by medical professionals and the government officials. What I mean is that many people, especially young dynamic of our society, bemoan the ubiquity and pervasive nature of social media, but not all of them are able to put that particular genie back in the bottle. *I will quote Marie Curie:*

"You cannot hope to build a better world without improving the individuals. To that end, each of us must work for his own improvement and, at the same time, share a general responsibility for all humanity, our particular duty being to aid those to whom we think we can be most useful."

In my teaching career, I become recognizant of young people shouldn't be negatively perceived by the public and this is unfair. Young people can be taught to volunteer for their own personal development and the wider benefits to their communities and to the progress of their country. Involving oneself in **self-directed critical learning** and consciousness-raising is not the latest paradigm shift in education, it has been around since the beginning of cognitive development, and a natural pathway to profound understanding and efficacy. Face the challenge and make an opportunity to promote scientific research that will promote technology and fight the war against Viral genes that are encoded in either DNA or RNA molecules .

Science physics is spicy!