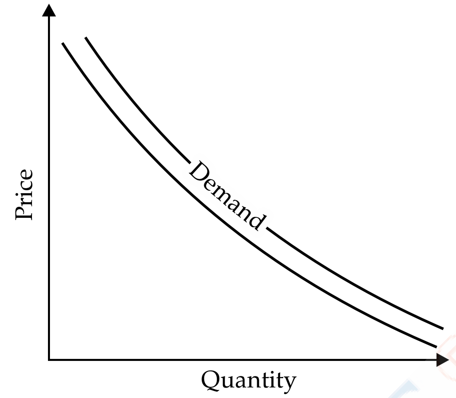
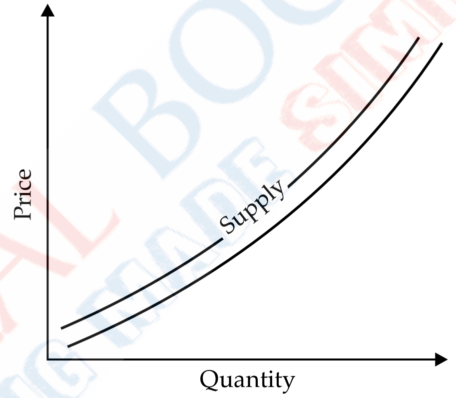
Art Integration

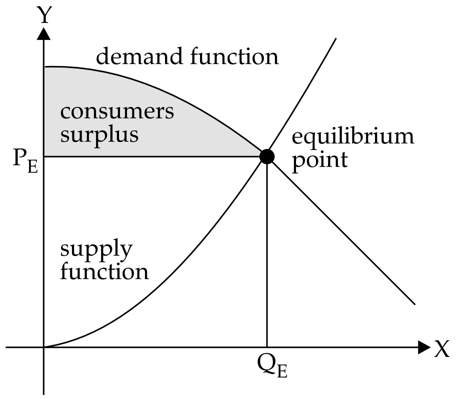
Chapter Covered	Application of the Integrals
Learning Objectives	Students will be able to understand application of integrals in the field of economics.
Material Required	Note book, Pen and Pencil, Scale.
Task Assigned Activity	Teacher will explain the application of integral in the field of economics. **Consumer Surplus Model:** • Consumer surplus is based on the **economic theory of marginal utility,** which is the additional satisfaction a consumer gains from one more unit of a good or service. • It can be defined as the surplus that is retained with the consumer after he purchases a product for which he paid lesser than what he was able to. • This is the difference between what the consumer pays and what he would have been willing to pay. **For example:** If we would be willing to pay Rs. 50 for a ticket to see a drama, but we can buy a ticket for Rs. 40. In this case, the consumer surplus is Rs. 10. • The demand curve is a graphical representation of the relationship between the price of a good or service and the quantity demanded for a given period of time. In a typical representation, the price will appear on the left vertical axis, the quantity demanded on the horizontal axis.



- The **supply curve** is a graphical representation of the relationship between the price of a good or service and the quantity supplied for a given period of time. In a typical representation, the price will appear on the left vertical axis, the quantity supplied on the horizontal axis.



- In the following graph, we can see that consumer's surplus is the area of the region bounded above by the demand function and below by the line that represents the unit market price.



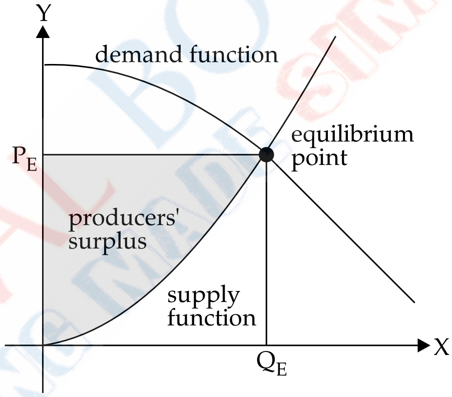
- The consumers' surplus is given by

$$CS = \int_0^{Q_e} D(x)dx - Q_e.P_e$$

Where, D(x) = Demand Function

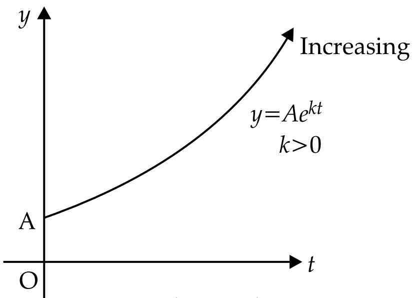
Q_e = Quantity Sold

P_e = Unit Market Price

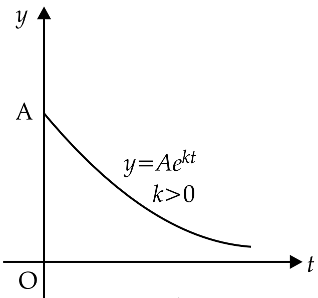
Learning Outcomes	• Students will learn the concept of Demand and Supply. • They can understand the design of consumer's surplus model. • They can find the consumer surplus for different demand curves.
Self Evaluation and Follow Up	• They can correlate the demand and supply functions. • They can discuss their views with their classmates. • They will try to explore the application of integrals in different subjects.
Ideas	In the same way, students can understand the **Producer's Surplus Model**. • Producer's Surplus Model can be defined as the surplus that is retained with the producer after he sells a product for which he accepted more than what he was expected to receive. • This is the difference between the price a firm receives and the price it would be willing to sell it at. **For example:** If a firm would sell a good at Rs. 4, but the market price is Rs.7, the producer surplus is Rs. 3.  • In the graph, we can see that producer's surplus is the area of the region bounded above by the line that represents the price and below by the supply curve. The producer's surplus is given by $PS = Q_e.P_e - \int_0^{Q_e} S(x)dx$ Where, $S(x)$ = Supply Function Q_e = Quantity Supplied P_e = Unit Market Price
Resource/Links	Consumer and Producer Surplus Calculation of Consumer's and Producer Surplus

Art Integration

Chapter Covered	Differential Equations
Learning Objectives	Students will be able to understand applications of differential equations in real life.
Material Required	Note book, Pen and Pencil, Scale.
Task Assigned **Activity**	Teacher will explain the applications of differential equations in Growth and Decay Model; Compound interest. **Growth and Decay Model:** • Exponential growth is a mathematical change that increases without limit based on an exponential function. • Exponential decay is found in mathematical functions where the rate of change is decreasing. • The mathematical model for exponential growth or decay is given by $f(t) = A\ e^{kt}$ or $y = Ae^{kt}$ Where: t represents time A the original amount y or $f(t)$ represents the quantity at time t k is a constant that depends on the rate of growth or decay If $k > 0$, the formula represents exponential growth If $k < 0$, the formula represents exponential decay



Exponential Growth



Exponential Decay

Suppose that $P(t)$ is the number of individuals in a population (of humans or insects or bacteria) having constant birth rate α and constant death rate β

Then the rate of change of population $P(t)$ with respect to time is given by

$$\frac{dP}{dt} = (\alpha - \beta)\ P,$$

$$\frac{dP}{dt} = k\ P, \text{ where } \alpha - \beta = k$$

$$\int \frac{dP}{P} = \int k\ dt$$

$$\log P = kt + c$$

$$P = e^{kt + c}$$

$$P = e^{c}\ e^{kt}$$

$$P = A\ e^{kt} (\text{Where } e^{c} = A)$$

$$\therefore \quad P(t) = A\ e^{kt}, \text{ for all real } t$$

Compound Interest:

- A person deposits an amount A(t) at a time t (in years) in a bank and suppose that the interest is compounded continuously at an annual interest rate r.
- To obtain the differential equation that governs the variation in the amount of money A in the bank with time t, we follow these steps: During a short time interval the amount of interest added to the account is approximately given by

$$\Delta A = r\ A(t)\ \Delta t$$

$$\therefore \quad \frac{\Delta A}{\Delta t} = r\ A$$

$$\lim_{\Delta t \to 0} \frac{\Delta A}{\Delta t} = r\ A$$

$$\frac{dA}{dt} = r\ A$$

$$\therefore \quad \int \frac{dA}{A} = \int r\ dt$$

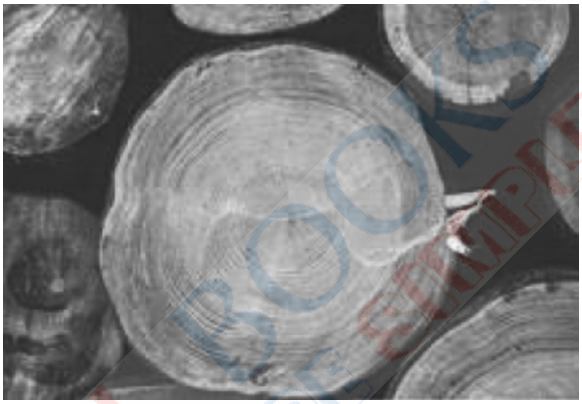
$$\log A = rt + c$$

$$\therefore \quad A = e^{rt + c}$$

Carbon Dating

Carbon 14, also known as radiocarbon, is radioactive form of carbon that is found in all living plants and animals. The radiocarbon disintegrates after the plant or animal dies.

Scientists can find an estimate of age of the remains of plants and animals by comparing the amount of radiocarbon in it with those in living plants or animals. This technique is called carbon dating. Carbon-14 decays exponentially with a half-life of approximately 5700 years, meaning that after 5700 years a given amount of carbon-14 will decay to half of its original amount.



Let $A(t)$ be the mass of carbon-14 after t years

$$\frac{dA}{dt} = -kA$$

$$\int \frac{1}{A} dA = -k\int 1\, dt$$

$$\log A = -kt + c$$

$$A = e^{-kt+c}$$

$$A = A_0 e^{-kt} \qquad (\because A = A_0 \text{ when } t = 0)$$

Resource/Links

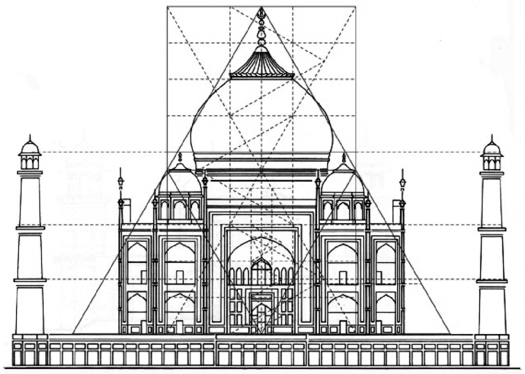
Growth and Decay Model

Compound Interest

Newton's Cooling Law

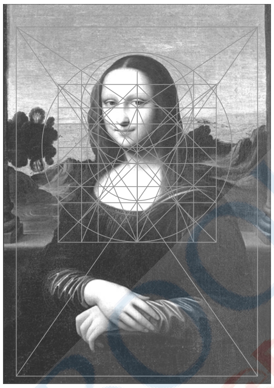
Carbon Dating

Art Integration

Chapter Covered	THREE DIMENSIONAL GEOMETRY
Learning Objectives	Students will be able to understand applications of geometry in day to day life.
Material Required	Note book, Pen and Pencil.
Task Assigned Activity	**Teacher will explain the applications of geometry in every-day life.** **Geometry in Architecture :** • The construction of various buildings or monuments has a close relationship with geometry. • Before constructing architectural forms, mathematics and geometry help put forth the structural blueprint of the building. • The theories of proportions and symmetries shape the fixed aspects for all kinds of architectural designs. • Pythagoras' "Principles of Harmony" along with geometry were employed in the architectural designs of sixth century BC. 

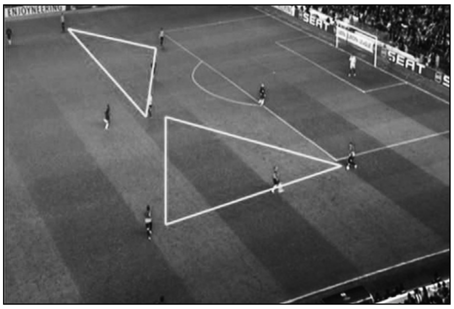
Geometry in Art

- Art encompasses the formation of figures & shapes, a basic understanding of 2-D & 3-D, knowledge about spatial concepts, and contribution of estimation, patterns & measurement.
- The formation of shapes is a result of the use of geometrical forms like circle, triangle, square, mandala, or octagon. Moreover, the contents of paintings or sculptures are largely affected by the choice and shape of frames.



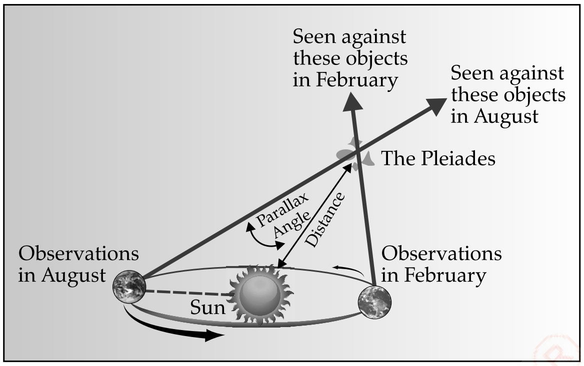
Geometry in Sports

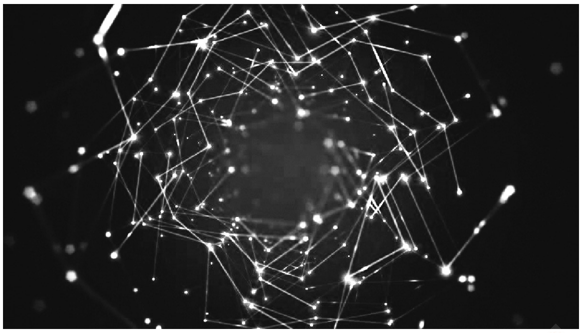
- Sports often do not fail a sole chance to make use of geometrical concepts.
- The buildings of the sports stadiums and athletic fields take into consideration geometric shapes.
- The athletic fields also employ geometry; hockey, soccer, basketball, and football fields are rectangular in shape. The corner kick spots, goal posts, arcs, D-section, and centre circle are marked on the field.
- Similarly, the pitches of various other sports like volleyball and basketball take into consideration the geometrical aspects because these pitches have oval as well as circular arcs marked clearly.



Geometry in Astronomy

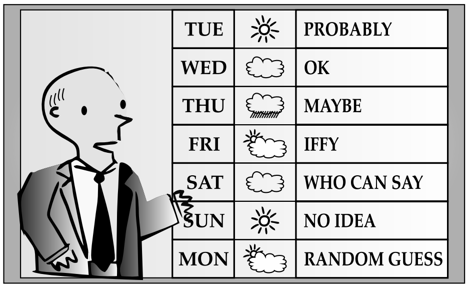
- In astronomy, geometric shapes help to understand the location of different planets, solar system, and different stars.
- Our planets are spherical in shape. The orbits are oval in shape.
- Many geometrical principles and equipments are used in astronomy.

	
Learning Outcomes	• Students can visualize the applications of geometry in their neighborhood. • They can understand that how we can find 2d and 3d shapes in different objects around us. • They will try to create different 3D patterns in their drawing.
Self Evaluation and Follow Up	• Students can summarize the learning and do further discussion. • They enjoy their learning and try to form various 2D and 3D patterns on computer. • They will try to explore other applications of geometry.
Ideas	**1. GEOMETRY IN NATURE** • In the world of natural phenomena, it is the underlying patterns of geometric form, proportion and associated wave frequencies that give rise to all perceptions and identifications. • Different fruits, leaves and flowers have geometrical shape depending upon the area in which they are found. For example, pine leaves are thin and have sharp tip giving it a shape like cone. Fruits like oranges, lemon are spherical in shape whereas cashew fruits have a peculiar shape like in kiwi, orange, apple etc. • Even vegetables have different geometric shapes, like carrot, radish are conical in shape whereas beetroot, tomato, onion are spherical in shape.  **2. COMPUTER GRAPHICS** • The appearance of an object depends largely on its exterior, boundary representations are most commonly used. • Two dimensional surfaces are a good representation for most objects, though they may be non-manifold.

	
Resource/Links	Geometry Applications Geometry In Daily Life Geometry Applications Introduction to Three Dimensional Geometry

ART INTEGRATION

Chapter Covered	PROBABILITY
Learning Objectives	Students will be able to understand applications of probability in everyday life.
Material Required	Note book, Pen and Pencil.
Task Assigned Activity	Teacher will explain the applications of probability in everyday life. **Weather Forecasting:** • Before planning for an outing or a picnic, we always check the weather forecast. Suppose it says that there is a 70% chance that rain may occur. Do you ever wonder from where this 70% come from? • A probability forecast is an assessment of how likely an event can occur in terms of percentage and record the risks associated with weather. • Meteorologists use a specific tool and technique to predict the weather forecast. • They collect the weather forecast database from around the world to estimate the temperature changes and probable weather conditions for a particular hour, day, week, and month.



"And now the 7-day forecast..."

Sports Strategies :

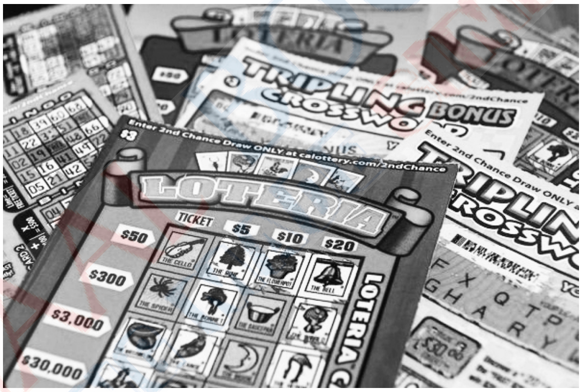
- In sports, analyses are conducted with the help of probability to understand the strengths and weaknesses of a particular team or player.
- Analysts use probability and odds to foretell outcomes regarding the team's performance and members in the sport.
- Trainers even use probability to gauge the capacity of a particular player in his team and when to allow him to play and against whom.
- Coaches use probability as a tool to determine in what areas their team is strong enough and in which all areas they have to work to attain victory. For instance, by tracking the record of a batsman in cricket, it is decided at what place or rank, he should play.

Politics:

- Many politics analysts use the tactics of probability to predict the outcome of the election's results.
- For example, they may predict a certain political party to come into power; based on the results of exit polls.

Insurance:

- Insurance companies use the theory of probability or theoretical probability for framing a policy or completing at a premium rate.
- The theory of probability is a statistical method used to predict the possibility of future outcomes.
- For example: Issuing health insurance for an alcoholic person is likely more expensive compared to the one issued to a healthy person. Statistical analysis shows high health risks for a regular alcoholic person, ensuring them is a great financial risk given a higher probability of serious illness and hence filing a claim of premium money.
- Nowadays people are getting their mobile phones insured because they know that the chances of their mobile phones getting damaged or lost are high.

Learning Outcomes	• Students will understand the applications of probability in different real life situations. • They can correlate probability with every life. • They change their view about classical learning of mathematics and draw their conclusions.
Self Evaluation and Follow Up	• They can talk about these applications with their family members and friends. • They get pleasure from their learning by exploring applications. • They will try to discover other applications of differential equations in their everyday life.
Ideas	**Lottery Tickets** • Winning or losing a lottery is one of the most interesting examples of probability. In a typical Lottery game, each player chooses six distinct numbers from a particular range. If all the six numbers on a ticket match with that of the winning lottery ticket, the ticket holder is a Jackpot winner- regardless of the order of the numbers. The probability of this happening is 1 out of 10 lakhs.  **Are we likely to die in an accident?** Rates of car accidents have increased rapidly in the past decades. For example, if a city has a population of one lakh, and the death rate in car accidents is 500. So, the chance of being killed in a crash is 500/1 lakh is 0.05%. Thus, a person has a 0.05% chance to die in a car accident. 

	Medical Decisions : When a patient is advised to undergo surgery, they often want to know the success rate of the operation which is nothing but a probability rate. Based on the same the patient takes a decision whether or not to go ahead with the same. **Traffic Signals:** Concepts of probability are used to control and observe the flow of traffic on the highways. Also, people may apply the concept of probability to know about waiting time at the signals. For example if a traffic light at a certain road crossing starts green at 06:30 hours and continue to be green till 06:32 hours and again turns green at 06:36 hours and continuous green till 06:38 hours. This cycle is repeated throughout the day. If a person's arrival time at this crossing is random and uniform over the interval 18:20 to 18:35 hours, then the chances that he may have to stop at this signal can easily be envisioned by probability. 
Resource/Links	Application of probability Application of probability in life insurance policy Application of probability in predicting weather