# Exponential Growth and Decay

- Any quantity that grows or decays by a fixed percent at regular intervals is said to possess **exponential growth** or **exponential decay**

    - The bigger the system is, the greater the increase
    - The bigger the system is, the faster the decrease

- Real World Examples:
    - Population
    - Bacteria
    - Viruses
    - Radioactive Substances
    - Electricity
    - Temperatures
    - Investments
    - Credit Payments

- Growth: $y = a(1 + r)^x$
- Decay: $y = a(1 - r)^x$

    - a = initial **amount** before measuring growth/decay
    - r = growth/decay **rate** (often a percent)
    - x = number of **time** intervals that have passed

# Compound Interest

- Formula:  $A = P\left(1 + \dfrac{r}{n}\right)^{nt}$

    - "A" represents the amount after time
    - "P" represents the principle or starting amount
    - "r" represents the interest rate
    - "t" represents the time in years
    - "n" is the number of times compounded in one year
        - If interest is annually then n = 1
        - If interest is quarterly then n = 4
        - If interest is monthly then n = 12

1. A bank account balance, "$b$", for an account starting with "$s$" dollars, earning an annual interest rate, "$r$", and left untouched for "$n$" years can be calculated as $b = s(1 + r)^n$. Find a bank account balance to the nearest dollar, if the account starts with $100, has an annual rate of 4%, and the money left in the account for 12 years

2. In 1985, there were 285 cell phone subscribers in the small town of Centerville. The number of subscribers increased by 75% per year after 1985. Create a table of values charting the growth over nine years. How many cell phone subscribers were in Centerville in 1994?

3. Bacteria can multiply at an alarming rate when each bacteria splits into two new cells, thus doubling. If we start with one bacteria which can double every hour, by the end of the day, how much bacteria will we have?

4. Each year the local country club sponsors a tennis tournament. Play starts with 128 participants. During each round, half of the players are eliminated. How many players remain after 5 rounds?

   Hint: use the equation: $y = 128(1 - 0.50)^x$

5. The pesticide DDT was widely used in the US until its ban in 1972. DDT is toxic to a wide range of animals and aquatic life, and is suspected to cause cancer in humans. The *half-life* of DDT can be 15 or more years. *Half-life* is the amount of time it takes for half of the amount of a substance to decay. Scientists and environmentalists worry about such substances because these hazardous materials continue to be dangerous for many years after their disposal.

   Assume that the half-life of DDT is 15 years and you are starting with 50 grams of DDT.

   Create a table documenting the half-life and the grams of DDT remaining over 10 periods of the half-life

   How many grams of DDT will be remaining after 150 years?

6. Suppose Vanessa has $1000 that she invests in an account that pays 3.5% interest compounded quarterly. How much money does Vanessa have at the end of 5 years?

7. Devin wants to have a total of $4000 in two years so that he can put a down payment on a new car. He finds an account that pays 5% interest compounded monthly. How much should Azem put into this account so that he'll have $4000 at the end of two years?

8. Suppose that Joe has $3500 and he wants $4000 to put a down payment on a new car. He finds a bank offering 5.25% interest compounded quarterly. Will he have enough in 2 years?