

Assignments for Jake T.

Math:

- Complete 1 lesson per day

English:

- Read Chapters 1-41
- Complete all questions in packet
- You may work at your own pace

Personal Finance

- Complete all worksheets
- Work at your own pace

Environmental Science

- Write 3 facts per section
- Answer all questions for Chapter 5

Government

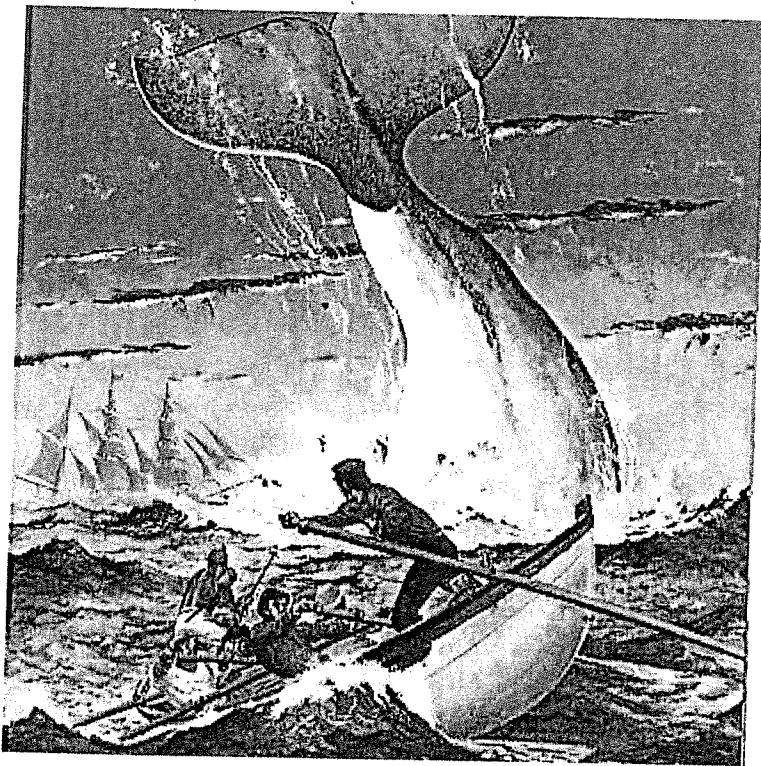
- Read each biography
- Write facts for each President

English

English

Moby Dick

By Herman Melville



Moby Dick Pre-Reading Discussion

Directions: Discuss the following questions with a partner. Write down your thoughts as you both share your ideas. Be prepared to share your thoughts during class discussion time.

What do you know about whales? Have you ever seen one? Would you like to?

Have you ever been on a boat or ship? Describe your experience. If you haven't, what do you think being on a ship for a long time is like? Do you think you would enjoy it?

What could a whale symbolize in literature? What could the search for a whale symbolize?

Think about the characteristics of the ocean. What could the ocean symbolize in literature?

If you could go on an expedition, where would you go and what would you like to find out?

Moby Dick Reading Guide

This reading guide is designed to help you focus on various themes and passages as you read Moby Dick. I suggest you pre-read the guide before you begin each section. The questions will help you focus your reading and formulate your own questions and thoughts in relation to the text.

Etymology and Extracts

- Why does Melville begin his novel with “Etymology”?
- How do you interpret the source of “Extracts”?
- Is there an overall pattern to the extracts?
- What assumptions does Melville make about his readers?

Chapters 1 – 3

- Who is the biblical Ishmael? How would you characterize Ishmael? Why does he go to sea?
- What is the symbolic relevance of the story of Narcissus?
- How does Ishmael characterize New Bedford?
- How does Ishmael describe the Spouter Inn?
- What is your first impression of Queequeg?
- What philosophical principles enable Ishmael to quell his fears before they go to sleep?

Chapters 4 – 6

- What is the symbolic significance of the Counterpane?
- How do you interpret Ishmael’s dream and the supernatural hand?
- How do Ishmael’s view of Queequeg change? Why?
- How would you characterize the whaling industry?

Chapters 7 – 9

- What is Ishmael’s attitude toward religion and the afterlife?
- Does Ishmael want to believe in something divine? Why, or why not?
- In what ways does whaling pervade the discourse and religion in Mapple’s church?
- How would you characterize Mapple’s faith?
- What part of the story of Jonah does Mapple leave out? Why?

Chapters 10 – 15

- What effect does Queequeg have on Ishmael after the sermon?
- How does Ishmael respond to Mapple’s sermon?
- How would you characterize Ishmael’s and Queequeg’s relationship?
- Where is Kokovoko?
- What does Ishmael mean when he says, “It’s a joint-stock world”?

Chapters 16 – 18

- Why does Ishmael not heed the bad omens he sees?
- Why is Ishmael in charge of selecting the ship?
- What is distinctive about the ship, Pequod?
- Who was the biblical Ahab?
- How do you interpret Peleg's characterization of Ahab as a "grand, ungodly, god-like man"?
- What is the purpose of Queequeg's fasting?
- What is a Quohog?

Chapters 19 – 22

- What is the Biblical relationship between Elijah and Ahab?
- Does Ahab have a soul according to Elijah?
- Why does Ishmael pronounce Elijah "crazy" and then "in my heart, a humbug"?
- Why does Ishmael not treat the forebodings about Ahab seriously?
- How is Ishmael's second meeting with Elijah different from the first?

Chapters 23 – 32

- What is Bulkington's role in the novel? Why does Ishmael call him a "demigod"?
- What happens to Bulkington?
- How does Ishmael characterize the profession of whaling?
- Why is the whale-ship Ishmael's "Yale College and my Harvard"?
- What is Starbuck's flaw?
- Why is Stubb's pipe "a sort of disinfecting agent"?
- What is an Isolato?
- How is Ahab described? What does Ishmael think of him?

Chapters 33 – 36

- How do the mates proceed to supper? How do they disengage?
- Why is Flask "a butterless man"? Why does he always go hungry?
- What things do masthead standers look for?
- What happens to you while standing on the masthead?
- Why is Ishmael a lousy masthead stander?
- Why does the Platonist not spot any whales?
- How does Ahab attempt to win over Starbuck?
- How does Ahab win the men over? Why does Starbuck back down?

Chapters 37 – 41

- Why is Ahab "damned in the midst of Paradise"?
- What is Starbuck's predicament?
- Why does Ishmael go along with Ahab? Is he sympathetic to Ahab?

Personal Finance

1610279
Fivane

Survival Skills Review



Matching

In the left-hand column below are some of the important words you've learned in this book. Match these words with the correct definitions on the right. Write the letter for the definition in the blank next to the word.

- _____ 1. punctuality
- _____ 2. goodwill
- _____ 3. quality
- _____ 4. strength
- _____ 5. appearance
- _____ 6. dependable
- _____ 7. concentrate
- _____ 8. reprimand
- _____ 9. tolerate
- _____ 10. quantity
- _____ 11. implement
- _____ 12. initiative
- _____ 13. socialize
- _____ 14. loyalty
- _____ 15. competition
- _____ 16. limitation
- _____ 17. imagination
- _____ 18. consumable
- _____ 19. cooperate
- _____ 20. durable
- _____ 21. safety
- _____ 22. gossip
- _____ 23. adjust
- _____ 24. communicate
- _____ 25. instructions

- A. something you're good at
- B. doing things without being told
- C. faithfulness
- D. creation of a new idea
- E. business rivalry
- F. restriction
- G. needing to be replaced often
- H. warn about inappropriate behavior
- I. long-lasting
- J. being on time
- K. work in harmony with others
- L. amount
- M. listening to or spreading rumors
- N. degree of excellence
- O. put into effect
- P. how you look
- Q. change
- R. pay close attention to
- S. exchange ideas
- T. written or oral directions
- U. reliable
- V. freedom from danger
- W. the value of a company's reputation
- X. being friendly with others
- Y. put up with

True or False

Read the following statements. Write **T** if the statement is true or **F** if the statement is false.

- _____ 1. When beginning a job, you should find out who to contact if an accident occurs.
- _____ 2. Very few occupations require an employee to have basic math skills.
- _____ 3. Maintaining good eye contact is important when speaking to a customer.
- _____ 4. Employers are not permitted to have regulations about length of hair of workers.
- _____ 5. Most employers will tolerate an employee who is absent an average of two days per month.
- _____ 6. Listening requires a person to concentrate and pay close attention to what is being said.
- _____ 7. OSHA can't shut down a company for violating safety standards.
- _____ 8. In most occupations it's not necessary for workers to be able to get along with other workers.
- _____ 9. High productivity means completing a large quantity of good-quality work.
- _____ 10. The military services offer training in many types of occupations.
- _____ 11. It's not important for unskilled workers to know company operating procedures.
- _____ 12. To make a sale, a salesperson may need to determine the customer's needs and wants.
- _____ 13. Criticizing your employer in front of friends or relatives may damage your company's reputation.
- _____ 14. A doctor can't detect high blood pressure during a routine physical examination.
- _____ 15. The first step in decision-making is determining the problem.
- _____ 16. Employers usually permit workers who complete tasks ahead of time to socialize with co-workers on the job.

- Now rewrite all the false statements to make them true.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Answer the questions below.

-

2. What are six areas of personal appearance workers should examine?

3. What are seven guidelines an employee can follow in getting along with co-workers, supervisors, and the general public?

4. What are seven areas you can examine in maintaining good health?

Math Drill

Place the correct answers in the spaces provided below. Reduce to lowest terms whenever possible. Use extra sheets of paper to calculate answers if necessary.

1.
$$\begin{array}{r} 869 \\ + 47 \\ \hline \end{array}$$

2.
$$\begin{array}{r} 37,642 \\ + 8,989 \\ \hline \end{array}$$

3.
$$\begin{array}{r} 4,621 \\ + 975 \\ \hline \end{array}$$

4.
$$\begin{array}{r} 38,416 \\ - 9,503 \\ \hline \end{array}$$

5.
$$\begin{array}{r} 454,802 \\ - 398,525 \\ \hline \end{array}$$

6.
$$\begin{array}{r} 39 \\ \times 7 \\ \hline \end{array}$$

7.
$$\begin{array}{r} 986 \\ \times 45 \\ \hline \end{array}$$

8.
$$\begin{array}{r} 3,841 \\ \times 862 \\ \hline \end{array}$$

9. $23 \overline{)486}$

10. $982 \overline{)45,683}$

11.
$$\begin{array}{r} 12.25 \\ + 6.80 \\ \hline \end{array}$$

12.
$$\begin{array}{r} 539.82 \\ 75.9 \\ + 3.63 \\ \hline \end{array}$$

13.
$$\begin{array}{r} 385.22 \\ 283.19 \\ + .65 \\ \hline \end{array}$$

14.
$$\begin{array}{r} 86.28 \\ - 7.89 \\ \hline \end{array}$$

15.
$$\begin{array}{r} 386.42 \\ - 98.85 \\ \hline \end{array}$$

16.
$$\begin{array}{r} 76.2 \\ \times 8.6 \\ \hline \end{array}$$

17.
$$\begin{array}{r} 383.45 \\ \times 98.85 \\ \hline \end{array}$$

18.
$$\begin{array}{r} 9,683.42 \\ \times 861.08 \\ \hline \end{array}$$

19. $9.2 \overline{)361.7}$

20. $35.5 \overline{)863.75}$

21. $\frac{5}{8} \times \frac{3}{4} =$

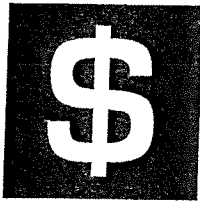
22. $4\frac{1}{3} \div \frac{3}{8} =$

23. $\frac{4}{5} + \frac{9}{10} + \frac{1}{4} =$

24. $3\frac{2}{5} + 28\frac{3}{8} =$

25. $106\frac{5}{9} - 32\frac{1}{3} =$
26. $.25 = \underline{\hspace{1cm}}\%$
27. 20% of $50 = \underline{\hspace{1cm}}$
28. 200% of $36 = \underline{\hspace{1cm}}$
29. 5.2% of $130 = \underline{\hspace{1cm}}$
30. 20% of $.42 = \underline{\hspace{1cm}}$
31. 1 mile $= \underline{\hspace{1cm}}$ feet
32. $\underline{\hspace{1cm}}$ pints $= 1$ gallon
33. $\underline{\hspace{1cm}}$ pounds $= 1$ ton
34. $\underline{\hspace{1cm}}$ millimeters $= 1$ centimeter
35. $\underline{\hspace{1cm}}$ centiliters $= 1$ liter

Student Activities



Lesson Two

Making Money

name: _____

date: _____



assess your personal interests, abilities and career goals.

based on your personal situation, answer the following questions:

- 1:** What topics of study do or did you enjoy most in school?

- 2:** What skills do you do well? What do you feel to be your most distinguishing skill or area of specialty?

- 3:** What are your interests away from school or work?

- 4:** Describe a situation in which you helped organize the work of others.

- 5:** Describe a situation in which you worked with a team to achieve a goal.

- 6:** Describe the kind of job you might like.

based on your answers to the above items, describe two or three jobs that meet your criteria:

A.

B.

C.

name: _____

date: _____



evaluating the current employment market

Select two career areas that interest you. Using library information, the internet, and interviews with others, obtain answers to the following questions:

career 1

career 2

1. What are the general activities
and duties of this job?

2. What are the physical
surroundings, work hours,
and mental and physical
demands of this type of work?

3. What training and educational
background is needed for this
area of employment?

4. Will these career areas be in
demand in the future?

5. What are the starting
and advanced salaries for
this industry?

6. What makes these careers
attractive to you?

name: _____

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creating a resume

A resume is a personal data sheet commonly used to apply for a job. It lists your skills and experience so that future employers can see what you have already done and whether your experience meets the job's requirements. Fill out the following categories to assist you in preparing your resume.

education

degree/programs completed, school, location, areas of study, dates

work experience

title, organization, dates, responsibilities

other experience (*volunteer work, school, and community activities*)

title, organization, dates, responsibilities

honors/awards

title, organization, dates

name: _____

date: _____



read and interpret pay stubs

directions

Answer the following questions using the pay stubs on the following pages:

1. What is the name of Jane Brown's employer?
2. How much did Jane earn before taxes?
3. What is Jane's hourly wage?
4. List Jane's deductions.
5. What pay period does Peter Smith's check cover?
6. How much federal income tax has been taken out of Peter's check so far during 1999?
7. How much did Peter contribute to a retirement plan from this paycheck?
8. How much is Peter's take-home pay?
9. Where does Mary Stone work?
10. How much is Mary's salary?
11. How much money was deducted from Mary's paycheck?
12. How much has Mary been paid in total during 1999?



read and interpret pay stubs

HAMBURGER PALACE ENTERPRISES, INC.

NAME JANE BROWN **PAYROLL ENDING** 3/14/09 **CHECK NO.** 9343

EMPLOYEE NO. L4325 **AMOUNT** \$87.50

EARNINGS			TAXES WITHHELD			OTHER DEDUCTIONS	
Description	Hrs.	Amount	Tax	Current	YTD	Description	Amount
Regular	20	120.00	Fed Income Tax	12.72	174.90	MEALS	7.00
			Social Sec	7.44	102.30		
			Medicare	1.74	23.93		
			State Income Tax	3.60	49.50		
CURRENT		120.00					
YTD		1650.00					

THE BANANA BREADBOX **EMPLOYEE PETER SMITH**
SSN 999-99-9999
PAY PERIOD 8/06/09 TO 8/12/09
PAY DATE 8/15/09
CHECK NO. 3259
NET PAY \$182.41

EARNINGS			TAXES WITHHELD			OTHER DEDUCTIONS	
Description	Hrs.	Amount	Tax	Current	YTD	Description	Amount
Regular	40	140.00	Fed Income Tax	35.28	429.84	401(K)	30.00
Overtime	6	54.00	Social Sec	18.23	222.08	HEALTH	15.00
Current		194.00	Medicare	4.26	51.94		
YTD		3582.00	State Income Tax	8.82	107.46		

read and interpret pay stubs (continued)

EMPLOYEE	Mary Stone	DANCE-O-RAMA
EMPLOYEE #	A5926	
PAY PERIOD	7/01/09 TO 7/15/09	
PAY DATE	7/14/09	
CHECK NO.	3691215	
NET PAY	\$349.21	

EARNINGS			TAXES WITHHELD			OTHER DEDUCTIONS	
Description	Hrs.	Amount	Tax	Current	YTD	Description	Amount
Regular		448.00	Fed Income Tax	49.95	385.62		
Salary			Social Sec	27.79	361.09		
Current		448.00	Medicare	6.50	84.45		
YTD		5824.00	State Income Tax	14.56	182.28		



lesson two quiz: making money

true-false

1. ____ The career planning process starts with assessing your personal interests, abilities, and goals.
2. ____ Interviewing is the final phase of the career planning process.
3. ____ Travel costs to work are considered to be "hidden" job costs.
4. ____ Worker's compensation is a common employee benefit received by most workers.
5. ____ Gross pay results from deducting various deductions from your earnings.

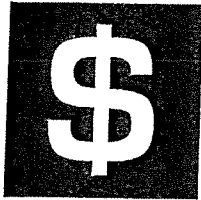
multiple choice

6. ____ The first phase of the career planning process is to:
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 - C. assess personal interests and abilities.
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7. ____ After applying for an available position, the next step usually involves:
 - A. interviewing.
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 - C. comparing employee benefits.
 - D. preparing a personal data sheet (resume).
8. ____ A hidden cost of a job might involve:
 - A. gross pay.
 - B. uniform fees.
 - C. employee discounts.
 - D. retirement benefits.
9. ____ Which of the following employee benefits would a working parent find most useful?
 - A. stock options
 - B. tax deferred retirement plan
 - C. Social Security benefits
 - D. parental leave
10. ____ A common deduction on a person's pay stub would be:
 - A. gross pay.
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 - C. federal income tax.
 - D. excise tax.

case application

Sue Smith has worked for nine years in retail sales. She is considering going back to school to change career fields. What factors should be considered before making this decision?

Student Activities



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Making Money

name: _____

date: _____



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Math

44M

Functions as Ordered Pairs

EXAMPLE

Is this set of ordered pairs a function?

$(5, 4), (7, 2), (9, 0), (11, -2)$

The set of ordered pairs is a function because no x -coordinates have been repeated.

Directions Tell whether the sets of ordered pairs are functions or not.

Write *yes* or *no* and explain your answer.

1. $(1, 0), (4, 2), (7, 4), (10, 6)$

4. $(9, -2), (8, 1), (7, 4), (6, 7)$

2. $(5, -2), (5, -1), (5, 0), (5, 1)$

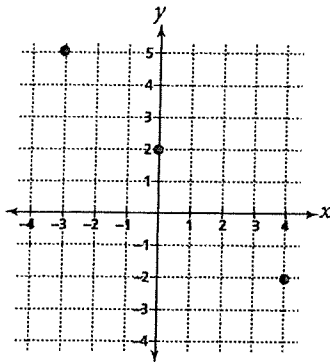
5. $(0, 0), (-1, 2), (1, 0), (1, 2)$

3. $(-3, 3), (-2, 2), (-1, 1), (0, 0)$

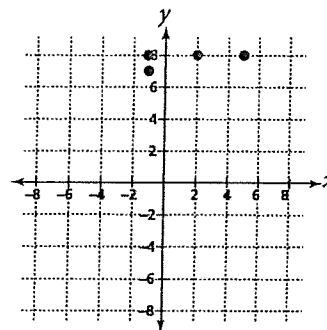
Directions If a vertical line passes through two or more points of a graph, the graph does not represent a function. Use this vertical line test to determine if the graph is a function or not.

Write *yes* or *no*.

6.



7.


EXAMPLE

Write the domain and range of this function.

$(7, -2), (1, 4), (3, 6), (-4, -1)$

The domain is 7, 1, 3, -4. The range is -2, 4, 6, -1.

Directions Write the domain and range for each function below.

8. $(1, -2), (0, 2), (-1, 6), (-2, 10)$ _____

10. $(0, 4), (2, -1), (4, -6), (-2, 8)$ _____

9. $(5, 0), (3, -2), (1, -4), (-1, -6)$ _____

Functions as a Rule

EXAMPLE

Calculate $f(x)$ for the given domain values.

$$f(x) = 3x; x = 1, 3, 8, 10, 100$$

$$f(x) = 3, 9, 24, 30, 300 \text{ for the given domain values.}$$

Directions Calculate $f(x)$ for the given domain values.

1. $f(x) = 5x; x = 4, 6, 8, 10, 20$

6. $f(x) = \frac{1}{2}x - 5; x = 0, 4, 10, 50, -100$

2. $f(x) = -3x; x = 0, -1, -2, -3, -4$

7. $f(x) = 4x + 8; x = 1, 11, 21, 31, 101$

3. $f(x) = \frac{1}{6}x; x = 6, 12, -12, -42, 60$

8. $f(x) = -2x - 14; x = -1, -5, -10, -15, 12$

4. $f(x) = 5x + 2; x = 0, 1, 2, 3, 4$

9. $f(x) = \frac{1}{3}x + 22; x = 9, 6, 3, 0, -3$

5. $f(x) = 7x - 11; x = 3, 6, 9, 12, 15$

10. $f(x) = \frac{7}{8}x - 12; x = 16, 24, 48, -8, -64$

EXAMPLE

Choose any number; then multiply it by 7.

$f(x) = 7x$ is a rule in function notation for the example above.

The reason that it is a function is that each x has one and only one $7x$.

Directions Write a rule using function notation, $f(x) = \underline{\hspace{2cm}}$.

Then give a reason why it is a function.

11. Choose any number; then divide it by 6.

12. Choose any number; then multiply it by 4.

13. Choose any number; multiply it by 3, then add 15.

14. Choose any number; then subtract 9.

15. Choose any number; then divide it by -2 .

16. Choose any number; then multiply it by -5 .

17. Choose any number; multiply it by -8 , then subtract 7.

18. Choose any number; divide it by 3, then add 13.

19. Choose any number; multiply it by 4, then subtract 52.

Directions Solve the problem.

20. Each month Daisy shoots eight rolls of film. Write a rule that shows how many rolls of film she shoots for a given number of months. Write the rule in function notation.

Zeros of a Function

EXAMPLE $f(x) = 3x - 6$ Find the zeros of $f(x)$.Let $f(x) = 0$ and solve for x .

$$0 = 3x - 6$$

$$6 = 3x$$

$$2 = x$$

Check: $f(2) = 3(2) - 6$

$$f(2) = 6 - 6$$

$$f(2) = 0$$

Directions Find the zeros of $f(x)$.

1. $f(x) = -2x + 12$ _____

2. $f(x) = \frac{2}{5}x - 10$ _____

3. $f(x) = 4x - 4$ _____

4. $f(x) = \frac{1}{3}x - 9$ _____

5. $f(x) = x + 8$ _____

6. $f(x) = x^2 - 64$ _____

7. $f(x) = \frac{1}{4}x + 3$ _____

8. $f(x) = 5x - 10$ _____

9. $f(x) = -x - 8$ _____

10. $f(x) = 6x + 42$ _____

11. $f(x) = 9x - 9$ _____

12. $f(x) = 7x - 3$ _____

13. $f(x) = \frac{3}{8}x - 1$ _____

14. $f(x) = x^2 - 81$ _____

15. $f(x) = 8x + 4$ _____

16. $f(x) = \frac{2}{7}x - 4$ _____

17. $f(x) = x^3 - 125$ _____

18. $f(x) = \frac{3}{4}x + 12$ _____

19. $f(x) = 10x + 25$ _____

20. $f(x) = x^3 - 27$ _____

21. $f(x) = 2x + 10$ _____

22. $f(x) = \frac{1}{10}x + 100$ _____

23. $f(x) = 7x + 91$ _____

24. $f(x) = 6x + 15$ _____

25. $f(x) = \frac{10}{21}x - 1$ _____

26. $f(x) = 30x - 450$ _____

27. $f(x) = x^4 - 81$ _____

28. $f(x) = \frac{1}{6}x + 2$ _____

29. $f(x) = 15x + 75$ _____

30. $f(x) = x^5 - 32$ _____

Graphs of Linear Functions

EXAMPLEGraph $f(x) = 3x + 5$.**Step 1** Let $x = 0$.

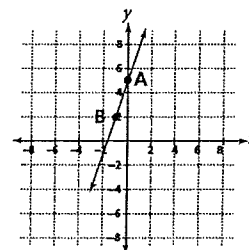
$$f(0) = 3(0) + 5 = 5 \rightarrow (0, 5) \text{ is point A.}$$

 $y = 5$ is the y -intercept.**Step 2** Let $x = -1$.

$$f(-1) = 3(-1) + 5 = 2 \rightarrow (-1, 2) \text{ is point B.}$$

Step 3 Graph the two points; then draw the

$$\text{line } y = f(x) = 3x + 5.$$

**Directions** Graph each linear function and label the y -intercept.(Use graph paper. Label the x - and y -axes first.)

- | | |
|------------------------------|--------------------------------|
| 1. $f(x) = 2x$ | 11. $f(x) = \frac{2}{7}x$ |
| 2. $f(x) = 3x + 2$ | 12. $f(x) = 4x - 5$ |
| 3. $f(x) = -4x$ | 13. $f(x) = -\frac{1}{5}x + 3$ |
| 4. $f(x) = 2x - 4$ | 14. $f(x) = x + 10$ |
| 5. $f(x) = 5x + 1$ | 15. $f(x) = \frac{1}{4}x - 6$ |
| 6. $f(x) = \frac{1}{4}x$ | 16. $f(x) = 6x + 6$ |
| 7. $f(x) = -3x - 8$ | 17. $f(x) = \frac{7}{10}x$ |
| 8. $f(x) = 2x + 7$ | 18. $f(x) = 10x - 8$ |
| 9. $f(x) = \frac{3}{8}x + 2$ | 19. $f(x) = \frac{1}{5}x + 2$ |
| 10. $f(x) = 5x - 2$ | 20. $f(x) = 8x + 8$ |

The Slope of a Line, Parallel Lines

EXAMPLE

Calculate the slope of $f(x) = 3x + 4$.

Step 1 Find two points.

$$f(1) = 3(1) + 4 = 7 \rightarrow (1, 7) \text{ is point 1.}$$

$$f(0) = 4(0) + 4 = 4 \rightarrow (0, 4) \text{ is point 2.}$$

Step 2 Calculate $m = \frac{(y_1 - y_2)}{(x_1 - x_2)}$.

$$m = \frac{(7 - 4)}{(1 - 0)} = \frac{3}{1} = 3$$

$$m = 3$$

Directions Calculate the slope of each line. Remember, $m = \frac{(y_1 - y_2)}{(x_1 - x_2)}$.

1. $f(x) = x + 5$ _____

2. $f(x) = 4x - 2$ _____

3. $f(x) = -3x$ _____

4. $f(x) = 5x$ _____

5. $f(x) = -2x - 7$ _____

6. $f(x) = \frac{1}{2}x$ _____

7. $f(x) = \frac{3}{7}x + 5$ _____

8. $f(x) = -7x - 2$ _____

9. $f(x) = -\frac{2}{9}x + 1$ _____

10. $f(x) = x - 6$ _____

11. $f(x) = \frac{2}{5}x + 1$ _____

12. $f(x) = 2\frac{1}{2}x + 6$ _____

13. $f(x) = -4x - 9$ _____

14. $f(x) = -\frac{1}{15}x + 3$ _____

15. $f(x) = 10x - 1$ _____

16. $f(x) = -15x - 25$ _____

17. $f(x) = \frac{2}{15}x + 8$ _____

18. $f(x) = -4x - 11$ _____

19. $f(x) = -\frac{8}{11}x + 5$ _____

20. $f(x) = 18x + 1$ _____

EXAMPLE

Given $f(x) = 5x$ and $g(x) = 5x - 4$, show that the lines are parallel by showing that their slopes are equal.

$$f(1) = 5(1) = 5 \rightarrow (1, 5) \text{ is point 1.}$$

$$f(0) = 5(0) = 0 \rightarrow (0, 0) \text{ is point 2.}$$

$$m = \frac{(5 - 0)}{(1 - 0)} = \frac{5}{1}$$

$$m = 5$$

$$g(1) = 5(1) - 4 = 1 \rightarrow (1, 1) \text{ is point 1.}$$

$$g(0) = 5(0) - 4 = -4 \rightarrow (0, -4) \text{ is point 2.}$$

$$m = \frac{(1 - (-4))}{(1 - 0)} = \frac{5}{1}$$

$$m = 5$$

Directions Show that the lines are parallel by showing that their slopes are equal.

21. $f(x) = 2x + 5$ and $g(x) = 2x$ _____

23. $f(x) = \frac{1}{3}x - 4$ and $g(x) = \frac{1}{3}x + 4$ _____

22. $f(x) = -6x$ and $g(x) = -6x + 7$ _____

24. $f(x) = -x + 100$ and $g(x) = -x - 8$ _____

Directions Solve the problem.

25. A hill has a height of 450 feet. The horizontal distance covered between the bottom of the hill and the top is 1,800 feet. Find the slope of the hill.

The Formula $f(x) = y = mx + b$

EXAMPLE

$5x + y = 2$

Change to $y = mx + b$. Give m and b .Solution: Subtract $5x$ from both sides.

$y = -5x + 2$

$m = -5, y\text{-intercept} = 2$

Directions Change the given equation to the form $y = mx + b$.
Give the value of m and b .

1. $2x + 4y = 8$ _____

2. $-2x + y = 1$ _____

3. $-4x + 4y = 4$ _____

4. $-x + 3y = 9$ _____

5. $3x + y = -7$ _____

6. $-2x + 2y = 2$ _____

7. $x - 4y = 2$ _____

8. $-3x + 6y = 12$ _____

9. $4x + 8 = y$ _____

10. $-6x + 10 = y$ _____

11. $-6x - 3y = 9$ _____

12. $-\frac{1}{3}x + 6y = 2$ _____

13. $\frac{2}{5}x + \frac{1}{5}y = 5$ _____

14. $-x + \frac{1}{3}y = 4$ _____

15. $-3x + \frac{1}{5}y = -4$ _____

16. $2x + \frac{1}{5}y = 0$ _____

17. $x - \frac{1}{10}y = 1$ _____

18. $\frac{1}{5}x + 2y = 8$ _____

19. $-10x + 8 = 5y - 2$ _____

20. $\frac{1}{3}x + 9 = \frac{1}{3}y + 6$ _____

21. $-x + \frac{3}{4}y = -2$ _____

22. $-6x + 9y = 3$ _____

23. $x + \frac{1}{8}y = -4$ _____

24. $-3x - y = 6$ _____

25. $\frac{1}{2}x + 2y = 8 - 2y$ _____

26. $x + \frac{1}{6}y = 6$ _____

27. $-\frac{1}{10}x + y = 10$ _____

28. $-12x - 4y = 2y + 3$ _____

29. $-x + y = 0$ _____

30. $-x + y = 2$ _____

The Distributive Law—Multiplication

EXAMPLE

$$6(x - y) = 6x - 6y$$

Directions Multiply, using the distributive law.

1. $3(8 + 2)$ _____

2. $6(x + y)$ _____

3. $a(b + c)$ _____

4. $x(a + b - c)$ _____

5. $x(3x + 9)$ _____

6. $y(x + y^3)$ _____

7. $x(a - b - c)$ _____

8. $x^2(x^3 + y^3)$ _____

9. $x^4(x + z - y)$ _____

10. $x^3(5x^3 + x^2)$ _____

EXAMPLE

$$(2 + 7)(y - x) = 2y - 2x + 7y - 7x \\ = 9y - 9x$$

Directions Multiply, using the distributive law twice. Simplify by adding like terms.

11. $(6 + 4)(a - b)$ _____

12. $(a - 2)(a + 4)$ _____

13. $(x + y)(a - b)$ _____

14. $(x + 3)(x + 5)$ _____

15. $(y + 4)(y - 4)$ _____

16. $(2a + 4)(a + 5)$ _____

17. $(x - y)(y - x)$ _____

18. $(a + 2b)(4a + b)$ _____

19. $(a + b)(a - b)$ _____

20. $(x - y)(3x + 3y)$ _____

EXAMPLE

$$(x + 3)(x - y + 8) = \\ x^2 - xy + 8x + 3x - 3y + 24 = \\ x^2 - xy + 11x - 3y + 24$$

Directions Multiply.

21. $(x - 5)(x - y + 4)$ _____

22. $(x + y)(6x + y - z)$ _____

23. $(x + y)(3x^2 + 4y + 7)$ _____

24. $(x - 4)(4x + y + z)$ _____

25. $(a - b)(3a + 6b + ab)$ _____

26. $(a + b)(a^3 - b^2 + 1)$ _____

27. $(a - b)(a + 2b - 4ab)$ _____

28. $(x + 3)(3x - y + 8)$ _____

29. $(x + 4y)(x - y + xy)$ _____

30. $(x + y)(x + y - 10)$ _____

The Distributive Law—Factoring

EXAMPLES

$$rb + rc = r(b + c)$$

$$3yx^2 + 6yx - 9y^2 = 3y(x^2 + 2x - 3y)$$

Directions Factor the expressions by finding the common factor(s) first.

1. $kl + kj$ _____

2. $9x + 6y$ _____

3. $x^2 - xy - x$ _____

4. $xb - xc + xd$ _____

5. $2x^2 - 6xy + 4x$ _____

6. $ab - ac + a^3$ _____

7. $axy - xy^2$ _____

8. $5xy + 10xya$ _____

9. $4x^2y + 12xy + 10y^2$ _____

10. $g^2 + g^3$ _____

EXAMPLE

Factor $x^2 + 6x + 9$.

Step 1 $x^2 + 6x + 9 = (x + \underline{\quad})(x + \underline{\quad})$

Step 2 The factors of 9 are 3 and 3; 1 and 9; -3 and -9; and -1 and -9.
So the possible factors for $x^2 + 6x + 9$ include
 $(x + 3)(x + 3)$; $(x + 1)(x + 9)$; $(x - 3)(x - 9)$; and $(x - 1)(x - 9)$.

Step 3 Substitute each set of factors in the product and check.

$$\begin{aligned} x^2 + 6x + 9 &= (x - 1)(x - 9) \\ &= x(x - 9) - 1(x - 9) \\ &= x^2 - 9x - x + 9 \\ &= x^2 - 10x + 9 \text{ Incorrect.} \end{aligned}$$

$$\begin{aligned} x^2 + 6x + 9 &= (x + 3)(x + 3) \\ &= x(x + 3) + 3(x + 3) \\ &= x^2 + 3x + 3x + 9 \\ &= x^2 + 6x + 9 \text{ Correct.} \end{aligned}$$

Directions Factor, using the model $(x + \underline{\quad})(x + \underline{\quad})$.
Check by multiplying.

11. $x^2 + 7x + 6$ _____

12. $x^2 + x - 6$ _____

13. $x^2 + 8x + 15$ _____

14. $x^2 - 2x - 15$ _____

15. $x^2 + 2x - 8$ _____

16. $x^2 + 3x - 18$ _____

17. $x^2 - 25$ _____

18. $x^2 + 6x + 5$ _____

19. $x^2 + 6x - 7$ _____

20. $x^2 - 10x + 25$ _____

Solutions to $ax^2 + bx = 0$

EXAMPLESolve for x and check: $2x^2 + 8x = 0$.**Step 1** Factor: $2x^2 + 8x = 0 \rightarrow 2x(x + 4) = 0$ **Step 2** Set each factor equal to 0 and solve for x :

$$2x = 0 \text{ or } x + 4 = 0$$

$$x = 0 \text{ or } x = -4$$

Check:

$$x = 0, 2x^2 + 8x = 0 \rightarrow 2(0)^2 + 8(0) = 0 + 0 = 0$$

$$x = -4, 2x^2 + 8x = 0 \rightarrow 2(-4)^2 + 8(-4) = 32 - 32 = 0$$

Directions Solve for x and check.

1. $x^2 + 12x = 0$ _____

2. $x^2 - 3x = 0$ _____

3. $x^2 - 10x = 0$ _____

4. $x^2 + 25x = 0$ _____

5. $x^2 - 13x = 0$ _____

6. $x^2 - 7x = 0$ _____

7. $x^2 - 19x = 0$ _____

8. $x^2 + 23x = 0$ _____

9. $x^2 + 36x = 0$ _____

10. $x^2 - 45x = 0$ _____

11. $2x^2 - 8x = 0$ _____

12. $3x^2 - 15x = 0$ _____

13. $4x^2 + 4x = 0$ _____

14. $10x^2 - 25x = 0$ _____

15. $8x^2 + 16x = 0$ _____

16. $6x^2 - 21x = 0$ _____

17. $2x^2 + 40x = 0$ _____

18. $3x^2 + 30x = 0$ _____

19. $4x^2 - 36x = 0$ _____

20. $5x^2 - 45x = 0$ _____

21. $2x^2 + 48x = 0$ _____

22. $3x^2 + 48x = 0$ _____

23. $4x^2 - 52x = 0$ _____

24. $5x^2 + 75x = 0$ _____

25. $6x^2 - 90x = 0$ _____

26. $12x^2 - 6x = 0$ _____

27. $20x^2 + 4x = 0$ _____

28. $15x^2 - 3x = 0$ _____

29. $24x^2 + 6x = 0$ _____

30. $35x^2 + 7x = 0$ _____

Solutions to $x^2 + bx + c = 0$ by Factoring

EXAMPLESolve for x by factoring $x^2 + 7x + 10 = 0$. Then check.**Step 1** Factor: $x^2 + 7x + 10 = 0$

$$(x + \underline{\quad})(x + \underline{\quad}) = 0$$

$$(x + 2)(x + 5) = 0$$

Think: Factors of 10 are 2, 5, 1, 10.

Step 2 Set each factor equal to 0: $x + 2 = 0$ or $x + 5 = 0$ Solve for x : $x = -2$ or $x = -5$

Check:

$$x = -2, x^2 + 7x + 10 = 0 \rightarrow (-2)^2 + 7(-2) + 10 = 4 - 14 + 10 = 0$$

$$x = -5, x^2 + 7x + 10 = 0 \rightarrow (-5)^2 + 7(-5) + 10 = 25 - 35 + 10 = 0$$

Directions Solve for x by factoring. Check your answers.

1. $x^2 + 2x - 8 = 0$ _____

2. $x^2 + 2x - 15 = 0$ _____

3. $x^2 - 6x + 9 = 0$ _____

4. $x^2 + 3x - 18 = 0$ _____

5. $x^2 + 4x - 21 = 0$ _____

6. $x^2 - 10x + 25 = 0$ _____

7. $x^2 + 9x + 14 = 0$ _____

8. $x^2 + 3x - 10 = 0$ _____

9. $x^2 + 5x - 6 = 0$ _____

10. $x^2 + 6x - 27 = 0$ _____

11. $x^2 + 11x - 26 = 0$ _____

12. $x^2 + 12x + 35 = 0$ _____

13. $x^2 + 14x + 45 = 0$ _____

14. $x^2 + 2x - 80 = 0$ _____

15. $x^2 + 20x + 100 = 0$ _____

16. $x^2 - 6x - 55 = 0$ _____

17. $x^2 - 8x - 33 = 0$ _____

18. $x^2 + 8x - 65 = 0$ _____

19. $x^2 - 13x + 36 = 0$ _____

20. $x^2 - 14x + 40 = 0$ _____

21. $x^2 + 30x + 29 = 0$ _____

22. $x^2 - 9x - 52 = 0$ _____

23. $x^2 + 16x + 64 = 0$ _____

24. $x^2 + 19x + 84 = 0$ _____

25. $x^2 - 20x - 69 = 0$ _____

26. $x^2 + 3x - 70 = 0$ _____

27. $x^2 + 17x + 30 = 0$ _____

28. $x^2 - x - 56 = 0$ _____

29. $x^2 - x - 72 = 0$ _____

30. $x^2 - 3x - 108 = 0$ _____



Environmental Science

Inventive

Science

CHAPTER**5****Environmental Science :
Pollution and its Factors**

INTRODUCTION

Pollution may be defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that may be harmful to human life and other animals, living conditions, industrial processes and cultural assets. Pollution can be natural or man-made. The agents that pollute are called pollutants.

Pollutants

Pollutants are by-products of man's action. The important pollutants are summarised below:

- **Deposited matter**—Soot, smoke, tar or dust and domestic wastes.
- **Gases**—CO, nitrogen oxides, sulphur oxides, halogens (chlorine, bromine and iodine).
- **Metals**—Lead, zinc, iron and chromium.
- **Industrial pollutants**—Benzene, ether, acetic acid etc., and cyanide compounds.
- **Agriculture pollutants**—Pesticides, herbicides, fungicides and fertilizers.
- **Photochemical pollutants**—Ozone, oxides of nitrogen, aldehydes, ethylene, photochemical smog and proxy acetyl nitrate.
- **Radiation pollutants**—Radioactive substances and radioactive fall-outs of the nuclear test.

Classification of Pollutants

On the basis of natural disposal, pollutants are of two types:

(i) Non-degradable pollutants

These are the pollutants, which degrade at a very slow pace by the natural biological processes. These are inorganic compounds such as salts (chlorides), metallic oxides waste producing materials and materials like, aluminium cans, mercuric salts and even DDT. These continue to accumulate in the environment.

(ii) Biodegradable pollutants

These include domestic sewage that easily decomposes under natural processes and can be rapidly decomposed by natural/ artificial methods. These cause serious problems when accumulated in large amounts as the pace of deposition exceeds the pace of decomposition of disposal.

On the basis of the form in which they persist after their release into the environment, pollutants can be categorized under two types:

- (i) **Primary pollutants** : These include those substances, which are emitted directly from some identifiable sources. This include-
 - (a) *Sulphur compounds*: SO_2 , SO_3 , H_2S produced by the oxidation of fuel.
 - (b) *Carbon compounds*: Oxides of carbon ($\text{CO}+\text{CO}_2$) and hydrocarbons.
 - (c) *Nitrogen compounds*: NO_2 and NH_3 .
 - (d) *Halogen compounds*: Hydrogen fluoride (HF) and hydrochloric acid (HCl).
 - (e) *Particles of different size and substances*: These are found suspended in air. The fine particles below the diameter of 100μ are more abundant and include particles of metals, carbon, tar, pollen, fungi, bacteria, silicates and others.
- (ii) **Secondary pollutants**. The secondary pollutants are produced by the combination of primary emitted pollutants. in the atmosphere. In bright sunlight, a photochemical reaction occurs between nitrogen oxides; oxygen and waste hydrocarbons from gasoline that forms peroxyacetylene nitrate (PAN) and ozone (O_3), Both of them are toxic components of smog and cause smarting eyes and lung damage.
- (iii) **Smog**. The fog deposited with smoke and chemical fumes forms a dark and thick covering, the smog. Smog is very common in almost all the industrial areas as the smog is trapped for many days by the stagnant air. It is harmful both for animals and plants.

AIR POLLUTION

The WHO defines **air pollution** as the presence of materials in the air in such concentration which are harmful to man and his environment. A number of ingredients find their way in the air and these are mostly gases, which rapidly spread over wide areas.

SOURCES OF AIR POLLUTION

Various sources of air pollution are fossil fuels, industries, agricultural activities, wars, natural causes and emissions from vehicles.

(i) Burning Fossil Fuels

Burning of wood, charcoal and other fossil fuels causes air pollution by the release of carbon dioxide (CO_2), carbon sulphur dioxide etc. Petroleum consists mainly of hydrocarbons, sulphur and nitrogen.

(ii) Emissions from Automobiles

Vehicles are mainly responsible for more than 80% of total air pollution. The major

pollutants released from automobiles, locomotives, aircraft etc., include CO, unburnt hydrocarbons and nitrogen oxide.

(iii) Industries

Paper and pulp factories, petroleum refineries, fertilizer plants, and steel industries, thermal power plants are the main sources of air pollution. They add various harmful gases like CO, SO₃, NO, Hydrocarbons etc., to the atmosphere. Textile factories release cotton dust into the air. Cities experiencing this type of pollution are Kanpur, Surat and Ahmedabad. The pesticide and insecticide industries are posing serious threat to the environment. Food processing industries and tanneries emit offensive odors. Release of poisonous gases from accidents also poses serious threats. e.g. Bhopal Gas Tragedy in which methyl isocyanate (MIC) gas leakage killed several people. In Tokyo, about 34 tones of carbon particles mixed with other suspended particles settle per square kilometer every day.

(iv) Agricultural Activities

Spraying of insecticides and weedicides also cause air pollution. These, when inhaled create severe problems to both animals and man.

(v) Wars

Various forms of explosives used in war pollute the air by releasing poisonous gases. This greatly disturbs the ecology of the area. Nuclear explosions pollute air by radioactive rays. The effects of nuclear explosions on Hiroshima and Nagasaki are well-known examples.

(vi) Natural Causes

Gas emissions from active volcanoes, marsh gas, spores of fungi and pollens are the natural causes of air pollution.

COMMON AIR POLLUTANTS

Air pollutants are of two main types ~gaseous and particulate. Oxides of carbon. Nitrogen and sulphur are gaseous pollutants. Particulate pollutants may be solid or liquid particles, larger particles settle down quickly viz., sand and water droplets whereas small dust particles remain suspended in air for a long time. These are added into the atmosphere by the processes of blasting, drilling, crushing, grinding and mixing.

(i) Carbon Dioxide

CO₂ content of air has increased by 20% during the last century. CO₂ causes nausea and headache. It's increase in the air may cause green house effect, rise in the atmospheric temperature. This may melt the polar ice resulting in rise in level of oceans and flooding of coastal regions.

(ii) Carbon Monoxide

It is a very poisonous gas and is produced by incomplete combustion of fuel. If inhaled, it combines with hemoglobin and reduces its oxygen-carrying capacity. This leads to laziness, reduced vision and death.

(iii) Oxides of Nitrogen

These include NO and NO₂, which are released by automobiles and chemical industries as waste gases and also by burning of materials. These are harmful and lower the oxygen carrying capacity of blood.

(iv) Oxides of Sulphur

SO₂ and SO₃ are produced by burning of coal and petroleum and are harmful to buildings, clothing, plants and animals. High concentration of SO₂ causes chlorosis (yellowing of leaves), plasmolysis, damage to mucous membrane and metabolic inhibition. SO₂ and SO₃ react with water to form Sulphuric and sulphurous acids. These may precipitate as rain or snow producing acid rain or acid precipitation.

(v) Photochemical Oxidants

Formed by the photochemical reactions between primary pollutants, viz. oxides of nitrogen and hydrocarbons. Nitrogen oxides in the presence of sunlight react with unburnt hydrocarbons to form peroxyacyl nitrate (PAN), Ozone, aldehydes and some other complex organic compounds in the air.

(vi) Hydrocarbons

These are unburnt discharges from incomplete combustion of fuel in automobiles. These form PAN with nitrogen oxides, which is highly toxic.

(vii) Particulate Matter

Industries and automobiles release fine solid and liquid particles into the air. Fly ash and soot from burning of coal, metal dust containing lead, chromium, nickel, cadmium, zinc and mercury from metallurgical processes; cotton dust from textile mills; and pesticides sprayed on crops are examples of particulate pollutants in the air. These are injurious to respiratory tract.

(viii) Aerosols

Aerosols are chemicals released in the air in vapour form. These include fluorocarbon (carbon compound having fluorine) present in emissions from the Jet aeroplanes. Aerosols deplete the ozone layer. Thinning of ozone layer results in more harmful ultraviolet rays reaching the earth, which are harmful to skin, and can lead to skin cancer also.

(ix) Radioactive Substances

These are released by nuclear explosions and explosives. These are extremely harmful for health.

(x) Fluorides

Rocks, soils and minerals containing fluorides release an extremely toxic gas called hydrogen fluoride on heating. This gas is highly injurious to livestock and cattle.

POLLUTION IN INDIA

India supports a large network of factories and industries. These factories are generally localized in eight or ten large industrial centres. These are also a great source of air as well

water pollution. To be on a safer side delocalisation of industries is the need of the time. This would lead to an even distribution of pollutants and faster degeneration of pollutants. The major pollutants coming out from these industries are -

- (i) *Industrial Pollutants.* The common air pollutants from industries are SO_2 , CO, CO_2 , H_2S and hydrocarbons together with dust, smoke and grit. These are produced by the burning of coal and petroleum and by the combustion of lignite at thermal power stations. The chemical industries release HCl, chlorine, nitrogen oxide and oxides of copper, zinc, lead and arsenic.

The fertilizer factories at Gorakhpur and Ahmedabad; the steel industries at Bhilai, Rourkela, Jamshedpur and Durgapur pollute the air with above-said gases.

- (ii) *Automobile Exhausts.* Automobiles run by petrol and diesel produce CO, nitrogen oxides and hydrocarbons. Hundreds and thousands tons of hydrocarbons and CO are emitted into air daily. Metropolitan cities harbour lakhs and crores of automobiles. Every gallon of petrol consumed by automobiles produces 3 pounds of carbon monoxide and 15 pounds of nitrogen oxide.
- (iii) *Ionizing Radiations from Radioactive Substances.* Ionizing radiations include alpha, beta particles and the gamma rays etc. These are produced by atomic explosions and testing of atomic weapons.

Effects of Air Pollution

Effect on Plants

- (i) SO_2 causes chlorosis and also results in the death of cells and tissues.
- (ii) Fluorides and PAN damage leafy vegetables such as lettuce and spinach.
- (iii) Oxides of nitrogen and fluorides reduce crop yield.
- (iv) Smog bleaches and blazes foliage of important leafy plants.
- (v) Hydrocarbons cause premature yellowing, fall of leaves and flower buds, discoloration and curling of sepals and petals.
- (vi) Smoke and dust cover the leaf surface and reduce photosynthetic capacity of plants.
- (vii) Ozone damages cereals, fruits, and cotton crop.

Effect on Man

The effect of pollutants on animals and man are as follows-

- (i) Ozone causes dryness of mucous membranes, changes eye vision, causes headache, pulmonary congestion and oedema.
- (ii) Ozone has been reported to produce chromosomal aberrations.
- (iii) SO_2 causes drying of mouth, scratchy throat, smarting eyes and disorders of respiratory tract.
- (iv) SO_3 , CO and NO_2 diffuse into blood stream and reduce oxygen transport. CO damages cardiovascular system. Hydrocarbons and other pollutants act, as carcinogens and lead to different cancers.
- (v) Cotton dust leads to respiratory disorders e.g. bronchitis and asthma.
- (vi) Smoking of tobacco causes cancerous growth in lungs.

Change in Climate

CO₂ content of air is increasing due to deforestation and combustion of fuel. This increase is affecting the composition and balance of gases in the atmosphere. Increase in CO₂ concentration may increase the atmospheric temperature, producing green house effect. A rise of global temperature by more than 2-3 degrees may melt glaciers and polar ice. This would lead to a rise in ocean level and consequent flooding and submergence of coastal areas. Rainfall pattern may also change, affecting agricultural output in various regions of the world. Aerosols deplete the ozone layer in the stratosphere. Thinning of ozone layer would permit more of the harmful ultraviolet rays to reach the earth. This may cause, sunburn, blindness and inactivation of proteins, RNA, DNA and plant pigments.

Aesthetic Loss

Dust and smoke spoils the beauty of nature. Especially the mountain environments, which serve as a great attraction for tourists. Foul odours emitted by industries, automobiles, dirty drains and garbage heaps in cities are a great nuisance.

Control of Air Pollution

Following measures have been suggested to control air pollution-

- (i) Some gases, which are more soluble in a particular liquid than air, for example, ammonia in water, can be separated by dissolving in it
- (ii) Particles larger than 50 μ m are separated in gravity settling tanks. Using cyclone collectors or electrostatic precipitators separates fine particles.
- (iii) The height of chimneys should be increased to the highest possible level to reduce pollution at the ground level.
- (iv) SO₂ pollution can be controlled by extracting sulphur from the fuel before use.
- (v) Pollution control laws should be enforced strictly.
- (vi) Trees should be planted on the roadside, riverbanks, parks and open places as they keep the environment fresh.
- (vii) Population growth, which is the main cause of pollution should be checked.
- (viii) Nuclear explosions should be restricted.

Water Pollution

Water is extremely essential for life, this common fact is known to all. It is required to meet our basic needs in day to day life viz., cooking, drinking, bathing, disposal of sewage, irrigation, generating electricity in power plants, cooling and manufacturing different products in industries and the disposal of industrial wastes. During all these processes the undesirable substances are added to the water resources to a great extent. This alters the basic chemistry of water in rivers and streams.

Sources of Water Pollution

(i) Domestic sewage

This includes household's wastes like food wastes, synthetic detergents used for washing clothes and cleaning bathrooms and latrines and water based paints.

(ii) Industrial effluents

The industrial wastes are discharged in the adjoining rivers and streams through flush lines of factories. The textiles, sugar and fertilizers factories, oil refineries, drugs manufacture, rubber, and rayon fibers, the paper industries and the chemical factories all produce Chemical pollution.

(iii) Agricultural source

Increased use of fertilizers has become essential for high yielding crop plants. Excess of nitrates used as fertilizers seep into ground water is carried into lakes and pond. On entering the drinking water supply system these create several health problems.

(iv) Pesticides

These include insecticides, fungicides, nematocides, rodenticides, herbicides and soil fumigants. These contain chlorinated hydrocarbons, organophosphates, metallic salts, carbonates, acetic acid derivatives etc. many pesticides are non-degradable. They pass through the food chains and accumulate in fatty tissues thus causing several health hazards.

(v) Thermal pollution

Power plants and nuclear power stations are the main sources of thermal pollution of water where water is used for cooling and becomes hot. The hot water on entering the main water body raises its temperature, which kills fishes and other aquatic animals and increases the rate of respiration in aquatic plants.

(vi) Pathogenic organisms

Sewage and domestic waste from houses introduces pathogenic organisms viz., protozoa, worms-eggs and bacteria into water. This contaminated water if consumed causes jaundice, typhoid, dysentery, cholera, tuberculosis etc.

(vii) Mineral oils

Oil from oil spills and washings of automobiles finds way into river water through sewers.

(viii) Underground water pollution

Underground water particularly in cities and industrial areas is no more pure and safe. The sources of underground water pollution are sewage, seepage, pits, industrial effluents, septic tanks, fertilizers and pesticides, garbage etc.

(ix) Marine water pollution

River and stream network sources of water ultimately end up ocean and seas. Thus, these acts as the sink of all natural and man-made water based pollutants. The main sources of oceanic pollution are discharges of oil, greases, petroleum products, detergents, sewage and garbage including radioactive wastes.

Effect of Water Pollutants

The main effects of water pollutants are:

1. Compounds of mercury, arsenic and lead are poisonous and chemically harmful as they even affect water treatment plants e.g. organic sulphur compounds interfere with nitrification.

2. Mercury when dissolved in water is absorbed by aquatic plants and enters the food chain. Lead impairs metabolism and brings about congenital deformities, anaemia etc.
3. Cadmium damages kidneys and liver.
4. Inorganic nitrates and phosphates promote growth of oxygen-consuming algae, which result in the death of fishes and other aquatic animals.
5. Presence of dyes and compounds in the discharged water changes the colour of water.
6. Soap, detergents and, alkalis result in foam formation.
7. Industrial effluents containing iron, free chlorine, phenol, manganese, oils, hydrocarbons, ammonia, algae and microorganisms impair the taste and odours of water.
8. The nitrates and phosphates dissolved in water accelerate the growth of microorganisms, which consume much of the dissolved oxygen depriving fish and other aquatic life (Eutrophication).
9. Biomagnifications is the increase of toxic materials at each trophic level of a food chain.

For example, DDT after reaching a water system is absorbed by the microorganisms on which smaller fishes feed. From them, DDT reaches the carnivorous animals. Since bigger fishes consume more food, large amounts of DDT accumulates in their body.

CONTROL OF WATER POLLUTION

- (i) Separate ponds and tanks to be used for cattle and animals.
- (ii) Use of pesticides, insecticides and fertilizers should be done judiciously. Rapid biodegradable substitutes for pesticides should be employed.
- (iii) In towns where sewage facilities are not available, septic tanks should be made in the houses.
- (iv) Rivers and lakes should not be used for bathing or washing as it contaminates water.
- (v) Domestic sewage and industrial wastes should be treated before discharging them into drains.

Treatment of waste Water

Domestic sewage and industrial wastes should be properly treated before these are drained in the mainstream water. Treatment involves the following two steps:

(i) Sewage treatment

It involves following steps:

Primary treatment. It involves physical processing of sedimentation, flotation and filtration where sewage water is passed through screens to remove larger particles and then through grinding mechanism to reduce the larger particles to smaller size. The sewage is finally passed through settling tanks to remove suspended impurities.

Secondary treatment. Sewage obtained after primary treatment is sent to aeration tank where it is mixed with air and sludge laden with bacteria and algae. The algae provide oxygen to the bacteria and decompose organic matter into simple compounds. Chlorination is finally done to remove bacteria.

Tertiary treatment. In the third and last step water is passed through ion exchangers to remove dissolved salts.

(ii) Treatment of industrial effluents

Treatment of industrial effluents involves neutralization of acids and bases, removal of toxic compounds, coagulation of colloidal impurities, precipitation of metallic compounds and reducing the temperature of effluents to decrease thermal pollution.

SOIL POLLUTION

Soil Pollution

Like water and air, soil is also equally important for living organisms. It supports plants on which all other living organisms depend. The process of soil formation is so slow that the soil may be regarded as a non-renewable source. Therefore, the study and control of soil pollution is important. Any substance that reduces soil productivity is called **soil pollutant**.

Sources of Soil Pollution

There are several materials, which adversely affect physical, chemical and biological properties of the soil and thus reduce its productivity. These are

1. Chemicals present in industrial waste.
2. Pesticides and insecticides that are sprayed on crops.
3. Fertilizers and manures that are added to the soil to increase the crop yield.

Effect of Soil Pollutants

Chemicals and pesticides affect the structure and fertility of soil by killing the soil microorganisms. Pesticides are absorbed by the plants and then transferred to other organisms. Hence, they affected food chains and food webs. Excretory products of livestock and human beings used as manure pollute the soil besides giving high yield. The faulty sanitation and unhygienic practices of the people add to the soil pollution. Pathogens present in the wastes and excreta contaminate the soil and vegetable crops causing diseases in man and domesticated animals.

Types of Soil Pollution

It is of the following types-

(i) Positive soil pollution

Reduction in the productivity of soil due to the addition of undesirable substances like pesticides, herbicides, fertilisers, etc. is called positive pollution. These pollutants have cumulative effect and kill the soil organisms.

(ii) Negative soil pollution

It is caused by the removal of useful components from soil by erosion, deforestation and improper methods of agriculture.

Salination of Soil

Increase in the concentration of soluble salts is called **salination**. This adversely affects the quality and productivity of soil. It takes place in two ways: accumulation of salts dissolved in irrigation water on the soil surface due to intensive farming and poor drainage, and deposition of salts as white crust during summer months drawn by capillary action from the lower surface to the top surface.

Control of Soil Pollution

Various measures to control soil pollution are-

1. Transfer stations for bulk shifting of refuse should be constructed in cities and big towns.
2. Pneumatic pipes should be laid for collecting and disposing wastes.
3. Materials like paper, glass and plastics can be recycled.
4. Metals should be recovered from scrap and disposed materials.
5. Use of chemical fertilizers should be reduced by the use of bio fertilizers and manures.
6. Use of pesticides can be reduced by adopting biological control of pests.
7. Use of cattle dung and agricultural wastes in biogas plants should be encouraged.
8. Deforestation can check soil erosion to a great extent.

Land Degradation

Besides pollution, land and soil face several other problems. Removal of topsoil is called soil erosion. Soil erosion factors are water, wind, ocean, waves and glaciers, felling of trees, overgrazing by cattle, over-cropping etc. Erosion occurs both in wet and dry regions. It leads to floods.

Soil Erosion in India

Soil erosion is a worldwide phenomenon, but it is especially high in Central Africa, China, India, Nepal, Australia, Spain, USA and USSR. India loses about 40,000 hectares of land every year as an effect of wind and water erosion. Damage to the topsoil is 18.5% of the total world's loss. This is due to overgrazing by livestock. The population of livestock in India is the highest in the world. Overgrazing damages the topsoil, which reduces soil fertility.

(i) Deforestation of overgrazing

Over-grazing is the main cause of soil erosion in India. Roots of grasses act as binding material and keep the soil intact, which upon grazing are destroyed.

(ii) Desertification

Loss of soil productivity by erosion of top soil results in the formation of deserts. Deserts are spreading in all continents. Desertification takes place by shifting of sand dunes

by wind and over-grazing. That desert in India is spreading at the rate of 12,000 hectares of land every year.

(iii) Shifting cultivation

Tribal communities follow the practice of cutting down trees and setting them on fire and then raising the crops on the resulting ash. This is called *Jhuming* in northeastern India. It is harmful if the Jhuming cycles are longer than ten years but short cycles destroy forests and cause soil erosion. e.g. Asia and Africa.

(iv) Developmental activities

Large areas of fertile and productive croplands, woodlands and grasslands are lost to various developmental activities such as rapid urbanization, building of airports, industries, railways, roads, mining and construction of dams.

Control of Land Degradation

Following ways can control Land degradation

1. Restoration of forests and grass cover can help in prevention of soil erosion and floods.
2. By replacing shifting cultivation with crop rotation, mixed cropping or plantation cropping. Providing adequate drainage to irrigated and flood-prone lands can prevent salinity.
3. Desertification can be controlled by spread of appropriate plant species and by raising trees as wind breaks.

Noise Pollution

Noise can be defined as unwanted/unpleasant sound. So noise pollution is unwanted sound dumped into the atmosphere without regard to the adverse effects it may have. In our country urbanization and industrialization have become twin problems. Cities and towns have sprouted up where industries are concentrated. Lack of town planning had led to residential, commercial and industrial areas being mixed up. Houses, schools and hospitals are situated near industries. All the boons of industrialization and civilization such as motors, horns, heavy and light machinery, work and movement, blaring radios, supersonic aeroplanes have become disturbing and irritant. Our ears can hear ordinary conversation between 30-60 decibels. Modern conversation has a noise value of 60 decibels. A decibel value greater than 80 decibels causes noise pollution. Noise becomes troublesome above 140 decibels.

Effect of Noise Pollution

1. Constant noise affects a man physically and mentally. Physical effects include blood vessels to contract, skin to become pale, muscles to constrict and rise in blood pressure leading to tension and nervousness.
2. High intensity sound emitted by industrial plants, bottling machines, supersonic aircrafts, when continued for long periods of time not only disturbs but also permanently damages hearing.
3. Offices, industries and crowded places where constant noise prevails can produce temper tantrums, headaches, fatigue and nausea.

4. Loud and sudden noise affect the brain. Intermittent noise leads higher incidence of psychiatric illness and also a danger to health of pregnant mothers and small infants.
5. Noise has harmful effects on nonliving materials too, *e.g.* cracks develop under the stress of explosive sound.

Control of Noise Pollution

Following methods can control noise pollution:

1. Limited use of loudspeakers and amplifiers.
2. Exercising control over noise producing vehicles.
3. Industrial workers should be provided with ear plugs.
4. Delocalisation of noisy industries far away from dwelling units.
5. Within a radius of 10 miles of airport, no buildings or factories should be allowed.
6. Plants and trees should be planted all around the hospitals, libraries and schools and colleges.
7. Personal protection against noise can be taken by using, cotton plugs in the ear.

Radiation

The radiations from the atomic blasts cause several health hazards. The radiations carry high energy and remove electrons from atoms and attach them to other atoms producing positive and negative ion pairs. Hence, they are known as ionizing radiations. The ionization property of these radiations proves to be highly injurious to the protoplasm. The ionizing radiations of ecological concern are classified as follows:

Corpuscular Radiations

These consist of streams of atomic or subatomic particles, which transfer their energy to the matter they strike.

(i) Alpha particles

These particles are large and travel few centimeters in the air. These cause large amount of local ionization.

(ii) Beta particles

These are small particles characterized by having high velocities. They can travel a few meters in space. These are capable of entering into the tissues for few centimeters.

Since alpha and beta particles have low penetration power they can produce harmful effects only when absorbed, ingested or deposited in or near living tissues.

(iii) Electromagnetic radiations

Electromagnetic radiations include waves of shorter wavelengths. These are capable of traveling long distances and can readily penetrate the living tissue. These include gamma rays. These can penetrate and produce effect even without being taken inside.

Other Types of Radiations

Besides radioactive radiations, some other radiations are also present in the atmosphere.

(i) Neutrons

These are large uncharged particles, which do not cause radiation by themselves, but they produce radioactivity in non-radioactive materials through which they pass.

(ii) X-rays

These are electromagnetic waves very similar to gamma rays, but originate from the outer electron shell of radioactive substances, which are not dispersed in nature.

(iii) Cosmic rays

These are radiations from the outer space, which contain alpha and beta particles together with gamma rays.

Sources of Radiations

The radiations are produced from the radioactive elements, which are known as radionuclides or radioactive isotopes, e.g. Uranium, Radium, Thorium, and Carbon-14. These contribute to background radiation. But isotopes of certain metabolically important elements like Carbon-14, Cobalt-60, Calcium 45, Iodine-131, Phosphorus-32, etc. are not ecologically harmful but are used as tracers. The third category of radionuclides comprises of fission products of uranium and certain other elements. These are cesium, strontium, and plutonium etc.

Biological Effects of Radiation

The effects of radiation have revealed that acute doses are found to be deleterious and may kill the organisms, whereas the increase in radiation in biological environment leads to different kinds of mutations. The effects of Cobalt-60 or Cesium-137 gamma radiations have now been studied on communities and on ecosystems at different places. The research concludes that Irradiations eliminate varieties in species. The sensitivity of cells, tissues and organisms to radiation varies. The cells with larger chromosomes are more sensitive. Herbaceous communities and early stages of succession are resistant than the mature forest.

Nuclear Fall Outs or Radioactive Fall Outs

The atomic blasts not only produce the local ionizing radiations at that time but the radioisotopes produced as a result of explosion enter the atmosphere and continue to fallout gradually over broad geographic areas for a very long time. These are known as nuclear fallout or radioactive fallout. These are dangerous for life as they also produce ionizing radiations.

Biological Effects of Fall outs

The fallout of radionuclides combines with various metals and dust and from colloidal suspension combines with organic compounds to form complexes. The smaller particles of radionuclides adhere tightly to the leaves of plants and produce radiation damage to leaf tissue besides entering the tissues also. Through grazing animals these enter the food chain directly at the primary consumers level. Radionuclides, which combine with organic substances, enter the food chain through producer tropic level. Therefore, the radionuclides fall out manages to enter the body of all living organisms. Radioactive Strontium-90 poses a health hazard in human beings and other higher vertebrates. It continues to deposit in the bones and causes bone cancer and leukemia. Radioactive Cesium-137 is known to cause

irreversible genetic changes in different organisms. The fallout radiations do cause changes in the genetic constitution of organisms, resulting in gene mutations and chromosomal aberrations. Their considerable, doses may kill, cripple and alter the animals and plants in the areas.

Control of Radiation Pollution

Following measures can help in controlling the radioactive pollution:

- (i) Workers in nuclear plants should be provided with nuclear gadgets and safety measures against accidents.
- (ii) Leakage of radioactive elements from nuclear reactors, laboratories, transport, careless handling and use of radioactive fuels should be checked.
- (iii) Level of radiation pollution should be monitored regularly in risk areas.
- (iv) Disposal of radioactive wastes deserves special attention.

Case studies

Hiroshima and Nagasaki Episode

The tale of Hiroshima and Nagasaki is a painful experience. It is for the first time that an atomic bomb has been exploded over human population. The incident took place on August 6, 1945 at 8:15 a.m. The bomb with an approximate temperature of around 100 million $^{\circ}\text{C}$ was exploded on a fine morning in Hiroshima (Japan). The temperature of the city hiked like anything, almost like an oven. After three days, Nagasaki too suffered the ravages of a nuclear attack. More than 1,00,000 people were reported to die just after the event took place. Since radiations from nuclear elements remain active even after, the generations to follow up also suffered from various diseases. Even the babies in the mother's womb were affected and a few perished. Blindness, deafness, skin diseases and cancers, distortion of bones and other parts became the fortune of human civilization.

Chernobyl Accident

This incident took place in Ukraine on April 26, 1986. There was a Chernobyl nuclear power plant in Ukraine after which the event has been named. Approximately four million people had been reported to suffer from the accident. The accident contaminated neighboring environment up to several kilometers. The sites were evacuated and resettlement was done for the affected people. The radiations released affected ground water and surface waters, affecting large areas of Europe. 131 Iodine and 137 Cesium are the most dangerous amongst the 20-odd radioactive elements released during Chernobyl disaster. As per the Soviet Health Ministry, 31-persons died shortly after the disaster. Of the 276,614 people who worked for rehabilitation and cleaning operations, a total of 1065 died by the end of 1990.

Marine Pollution

All river drainages end up in the seas. On the way to sea, rivers carry large amounts of sewage, garbage, and agricultural discharge, biocides, including heavy metals. Besides this discharge of oils and petroleum products and dumping of radionuclides waste into sea also cause marine pollution. Huge quantity of plastic is being added to sea and oceans. Over 50 million lb plastic packing material is being dumped in sea of commercial fleets. Many marine birds ingest plastic that causes gastro-intestinal disorders. The chemical principle in

PCBs causes more damage as thinning of eggshell and tissue damage of egg. Radionuclide waste in sea includes Sr-90, Cs-137, Pu-239, and And Pu-240.

The pollutants in sea may become dispersed by turbulence and ocean currents and finally becomes a part of food chain. Bioaccumulation in food chain may result into loss of species diversity. The pollution in Baltic sea along the coast of Finland, took place largely from sewage and effluents from wood industries. This pollution effect brought changes. in species diversity in the bottom fauna. In less polluted water there was rich species diversity, which tended to decrease with increasing pollution load. In heavily polluted areas, macroscopic benthic animals were absent, but chironomy larvae occurred at the bottom. In marine water the most serious pollutant is oil. Spill of oil or petroleum products due to accidents/ deliberate discharge of oil polluted waste brings about pollution. About 285 million gallons of oil are spilled each year into ocean, mostly from transport tankers. Oil pollution causes damage to marine fauna and flora including algae, fish, birds, and invertebrates. About 50,000 to 2,50,000 birds are killed every year by oil. The oil is soaked in feathers, displacing the air and thus interferes with buoyancy and maintenance of body temperature. Hydrocarbons and benzpyrene accumulate in food chain and consumption of fish by man may cause cancer. Detergents used to clean up the spill are also harmful to marine life.

Thermal Pollution

The increase in water temperature by industrial units such as steel and iron factories, electric powerhouses and atomic power plants may be called as thermal pollution. Some of the industries generate their own power supply where water is used to cool the generators. This hot water is released into the main stream, causing a warming trend of surface waters. If the drainage is poorly flushed, a permanent increase in the temperature may result.

Many organisms are killed instantly by the hot water resulting into a high mortality. It may bring other disturbance in the ecosystem. The eggs of fish may hatch early or fail to hatch at all. It may change the diurnal and seasonal behaviour and metabolic responses of organisms. It may lead to unplanned migration of aquatic animals. Macrophysics population may also be changed. As temperature is an important limiting factor, serious changes may be brought about even by a slight increase in temperature in a population. Heat stress (5-1 one above the normal growing temperature of organism) induces expression of specific gene families called heat shock genes, which lead to the synthesis of a new set of proteins called heat shock proteins. Heat shock proteins have been found in every organism from unicellular prokaryotes to multicultural organisms including Homo sapiens. Heat Shock Proteins synthesis lead to acquired thermo tolerance, i.e. the ability of an organism to withstand a normally lethal temperature. Thermo tolerant genotypes show adaptations at various levels of organization besides showing qualitative and quantitative differences in heat shock proteins as compared to the thermo sensitive genotypes.

Solid Waste Management

Environmental problems also include solid waste disposal. At all levels of development human beings produce domestic wastes. These comprises of kitchen wastes, ashes from fires, broken utensils and worn-out clothing. The industrial revolution leads to the concentration of people in urban areas with very high population density. This resulted in addition of new sources of wastes from shops, institutions and factories. In developed countries

services for the regular removal of domestic and trade wastes have been in operation for last many years.

Many changes have taken place in our society. The character of the wastes has altered with rising living standards, changes in retail distribution methods and fuel technology. Grave environmental concerns have come up with rise in construction of new buildings, supermarkets, and industrial wastes of many kinds. In the industrialized countries, therefore, basic health and environmental problems have been solved in the storage and collection of solid wastes, although major problems remain in regard to resource recovery and disposal. The technology of wastes handling is now highly developed. The substantial sectors of industry are engaged in the production of equipment with regard to removal of wastes. Many institutions give technical training and support. However developing nations like India are facing the problems of urbanization with high population densities. The developing countries are aware of the importance of avoiding the environmental pollution. The quality of urban environment is a matter of growing concern and the importance of solid wastes management is increasingly being recognized.

Sources and Characteristics

Solid wastes generally refer to describe non-liquid waste materials arising from domestic, trade, commercial, industrial, agriculture and mining activities and from the public services. Disposal of sludge's (liquid waste) of some kind fall within the scope of solid waste management. These arise primarily from industrial sources and from sewage treatment plants. Solid wastes comprise countless different materials; dust, food wastes, packaging in the form of paper, metals, plastics or glass, discarded clothing and furnishing, garden wastes and hazardous and radioactive wastes. The method and capacity of storage, the correct type of collection vehicle, the optimum size of crew and the frequency of collection depend mainly on volume and density. Just as solid wastes comprise a vast number of materials, they arise from a multitude of separate sources as well as many kilometers of streets upon which solid wastes accumulate. Thus, the four main aspects of solid wastes management are: (i) storage at or near the point of generation, (ii) collection, (iii) street cleansing, (iv) disposal.

The main constituents of solid wastes are similar throughout the world, but the proportions vary widely. As personal income rises, paper increases, kitchen wastes decline, metals and glass increase, total weight generated rises and the density of the wastes declines. Clearly, the amount of work involved in refuse collection depends upon the weight and volume of wastes generated and the number of collection points from which the wastes have to be removed.

Health and environmental implications

Improper handling of solid wastes results in increased potential risks to health and to the environment both. Direct health risks concern mainly the workers in this field, who need to be protected, as far as possible, from skin contact with wastes. For the general public, the main risks to health are indirect and arise from the breeding of disease vectors, primarily flies and rats. More serious, however, and often unrecognized, is the transfer of pollution to water, which occurs when the leachate from a refuse dump enters surface water or wastes, either in the open air, or in plants that lack effective treatment facilities for the gaseous effluents. Traffic accidents can result from wastes accumulated and dispersed on to

streets and roads. They have caused death and injury to people in the surrounding areas. There also persists the specific danger of the concentration of heavy metals in the food chain. These metals can be taken up by the plants growing on land on which sludge has been deposited, creating risks to the animals which graze and the humans who consume these animals.

Economic implications

Labour and transport absorb the major part of the operating cost of solid wastes management services. The level of mechanization that should be adopted for solid wastes management systems relates directly to the cost of labour, as compared to that of plant and energy. There is not much variation, worldwide, in energy or mechanical plant costs, but there is wide variation in the range of labour costs. Thus, there are no universally applicable solid wastes management systems. Every country must evolve indigenous technology based on the quantity and character of the wastes, the level of national wealth, wage rates, equipment, manufacturing capacity, energy costs etc. It is necessary to deploy a complete set of technical skills, which derive from several professional disciplines. These include civil and mechanical engineering, chemical engineering, transport organization, land use planning and economics.

Refuse Collection

A refuse collection service requires vehicles and labour. For their efficient development, three components are basic:

- (1) Travel to and from the work area,
- (2) The collection process, and
- (3) The delivery process.

The use of large, widely spaced communal storage sites is usually a failure because the demand placed on the householder goes beyond his willingness to cooperate. Communal storage points should, therefore, be at frequent intervals, Madras and Bangalore provide fixed concrete containers. They are fairly successful because they place reasonable and acceptable duty on the residents, thus very little domestic waste is thrown in the street.

In another system of block collection, a collection vehicle travels a regular route at prescribed intervals, usually every two days or every three days, and it stops at every street intersection, where a bell is rung. At this signal the residents of all the streets leading from that intersection bring their wastes containers to the vehicle and hand them to the crew to be emptied. A crew of one or two men is adequate in number, as they do not need to leave the vehicle.

Sanitary Landfill Disposal

Land disposal (burying of wastes) is the only approved method of disposal, which is performed at a single site. Incineration, composting, and salvage are either a form of refuse handling or processing. They are not complete methods of disposal, and they require disposal of residue. Sanitary landfill can be defined as the use of solid wastes for land-reclamation, a typical example being the restoration, by filling to the original level of man made surface dereliction such as a disused surface, mineral excavation. Solid wastes may also be used to improve natural features by raising the level of low-lying land to enable it to be used or

cultivation or industrial development. Thus, sanitary land filling has two essential features, which differentiate it from crude dumping:

- (i) Only sites that will be improved not degraded, by a change of level are selected.
- (ii) Simple engineering techniques are used to control the manner in which the wastes are deposited, so that dangers to public health and the environment are avoided.

Unfortunately most of the world's wastes are disposed off by uncontrolled dumping which blights the land for any future use and causes serious risks of water pollution and vector breeding. Very few cities operate sanitary land filling to standards, which totally control health and environmental dangers; most of those that do are in the industrialized countries.

Control of Hazards

- (i) Control over pathogens is dependent upon a rigorous policy of covering the wastes soon after deposit. This serves both to isolate the wastes and to retain the heat, which is quickly generated during aerobic decomposition.
- (ii) The main source of insects will be the eggs of flies. Which have been deposited in the wastes before they arrive at the site. Most of these will be buried deep in the wastes and will succumb to the temperature increase.
- (iii) Fire at a sanitary landfill can arise from innumerable causes, hot ashes in a vehicle delivering wastes: a cigarette thrown by a worker; the sun's ray through a fragment of glass on the surface. With some kinds of wastes the consequence of fire may be very serious and underground fires have been known that ultimately caused the collapse of the surface into voids caused by the fire.
- (iv) The pollution of static water, ditches, river or the sea occurs when a sanitary landfill adjoins a body of water. The normal source of the leachate causing this pollution is rain falling on the surface.

Incineration

Open burning, barrel burning, and other related uncontrolled forms of burning have a long history of use. Many liquid wastes and pathological wastes are best disposed of by incineration. Originally, solid waste incineration was practiced to reduce the quantity of refuse or disposal. After it was proven that heat could destroy most pathogens, incinerators were used in hospitals for destruction of pathological wastes. With few exceptions, incinerators are not "good neighbors," and the environmental nuisances of dust. Noise and air pollution have provoked communities to an anti-incinerator philosophy. To overcome this negative community feeling is going to require that incineration prove its worth and that imagination be used in the design of future units. Incineration of solid wastes yields the highest percent of volume reduction except for Pyrolysis. Unlike a sanitary landfill, incineration of solid wastes can be performed on the premises of apartments, supermarkets, departments' stores, and similar establishments.

Composting

Composting involves the biological stabilization of solid matter either under aerobic or anaerobic conditions. The end product of composting is an organic material, which could have beneficial value as a soil conditioner or plant mulch. In addition to producing a modified

solid waste material, which can be useful in land reclamation, composting does yield a volume reduction of solid waste by about 40-60% of the compostable fraction *pyrolysis*

Pyrolysis is a thermal process where oxidation of the organic fraction is not allowed to occur. Instead, the organic matter is evolved from the refuse with heat, leaving an ash consisting mostly of carbon and any inorganic matter, e.g. metal and glass are not removed before Pyrolysis. Some of the gases, which have been volatilized, are condensed while the remainder is burned to supply the heat (energy) needed to pyrolyze the material. Since oxidation is prevented, the Pyrolysis process must be performed in an atmosphere of argon, helium or nitrogen.

Role of an Individual in Prevention of Pollution

Which are the most viable, efficient and economical ways to eliminate pollution problems? We very often see people blaming public and government sectors to control pollution through controlling market mechanisms and government blaming people to avoid and check pollution. Who would control whom? Many ecologists and environmental scientists believe in that pollution problems can be overcome by using market mechanisms to reduce pollution rather than rigid rules and regulations. However, on the other hand man should identify and gear up his own potential to curb down pollution. Man could achieve this by identifying his own role at individual level in prevention of pollution. This is possible through environmental awareness, education and enlightenment.

Ways and means by which pollution problems can be greatly reduced at individual level are:

1. Masses at personal level should determine to consume optimum level of resources, which would lead a comfortable life. Because excessive resource consumption is in some way related to pollution problems and hazards (natural and anthropogenic both).
2. Waste disposal at personal level should be optimally reduced as waste destruction by any means causes pollution.
3. Maintenance of vehicles should remain proper as to avoid introduction of harmful gases and other pollutants into the atmosphere.
4. Generators and other household gadgets that add to pollution of environment should be kept well maintained.
5. Use of chemical fertilizers should be limited as to avoid water pollution e.g. DDT
6. Timely disposal of waste to prevent decomposition of household refuse as to check foul odours and spread of disease by insects, flies and other pathogenic bacteria.
7. Industrialists should check for proper disposal of treated water from factory units as to avoid thermal pollution of water bodies. They should also deploy a water treatment plant to prevent the flow of hazardous material.
8. Service centres of vehicles should minimize the disposal of organic solvents into the main drains.
9. Music lovers should listen and operate their music systems at optimum levels as to avoid noise pollution.

Disaster Management

Loss of life and property due to natural disasters like tropical cyclones, floods, droughts, tornadoes, earthquakes, volcanic eruptions etc, is very large. Fortunately warning facilities are available today and by mitigation measures, loss of lives and properties can be minimized. National Meteorological Services of the world to provide warnings to the public for some of the weather related natural disasters. It is not possible to forecast a long period ahead precisely when and where a dangerous natural phenomenon will take place. While natural disasters cannot be prevented, taking proper long-term and short-term disaster mitigation measures can minimize the loss of life and property.

Some common disasters known to occur in our country are as under:

Floods

Floods are defined as a relatively high flow of water discharged from river and stream network, which sets the riverbank margins to overflow and lead to the inundation of low land areas surrounding the riverbed. It is essentially a physical phenomenon. Floods arise from abnormally heavy rains, dam failures, snow melts, river blockages. Flood disasters rank second only to droughts in the total number of people affected worldwide.

Types of Floods

Floods can be classified into three categories as under:

(i) River floods

Rivers get charged due to heavy rains over large catchments areas or by melting of snow or sometimes both especially in the mountainous tracts. The floods take place in river systems with tributaries that may drain into large geographic areas and encompass many independent river basins. Amount of flooding depends on moisture in the soil, vegetation cover, and depth of snow and size of catchments basin.

(ii) Coastal floods

Coastal flooding is associated with tropical cyclones/ harsh winds arising at the ocean surface. Coastal floods are often aggravated by wind induced storm surges along the coastline. Sea and ocean 'water floods the inland coasts affecting kilometers of tracts. Ocean tides, storm surges or tsunamis play a definite role. Prolonged and indefinite rains in the rainy season marked from June-September results in extreme flood in coastal river basins.

(iii) Flash floods

These floods occur within six' hours of the beginning of rainfall and; are characterized with rising clouds, thunderstorms and tropical cyclones. These result from runoff from a torrential downpour, particularly if the catchments slope is unable to absorb and hold a significant part of water. Other causes of flash floods include dam failure, sudden break up of glaciers etc. These offer potential threats in the areas where the terrain is steep, surface runoff is high, water flows through canyons and where severe rainstorms are likely.

General Characteristics of Floods

1. Man made structures and forest vegetation exhibits different levels of tolerance towards effects of floods.

2. Intensity of damage is governed by the time interval of standing floodwaters.
3. High velocity of running water may uproot or weaken foundations of buildings.
4. Rate of rise and discharge of a river is important as a basis for flood control.
5. Frequency of occurrence estimated over a length of period would determine the kind of activities the flood plain should be put to.
6. Generally the rainy season is characterized by the floods during which agricultural economy suffers a huge loss.

Effects of Floods

1. Rising water, erosion and the force damages the residential and commercial building. They are dangerous for villages lying in the coastal areas as it sweeps away everything, which comes into its path. In mountainous areas it is the chief cause of landslides.
2. Fisherman, local people, cattle, animals and vegetation suffer a great loss of life and property. Most of the deaths are reported to be from drowning.
3. Fresh water supplies by all sources are nearly destroyed and contaminated hence the areas falling under its impact bear a great risk of suffering from water borne diseases.
4. The destruction of food and fodder crops result in acute food shortage.
5. Floods also make soil infertile, as the topsoil is lost due to erosional activity.
6. Floods are also known to preserve, wetlands and recharge ground water.

Flood Control

1. Depth and width of the riverbed could be increased as its capacity to carry larger loads increases manifold and thus reduce the area of the flood plain.
2. A network of canals can be established from the river systems, which generally leads to floods. This would also benefit the agricultural economy/ section. Care must be taken in the design and construction because of the possible environmental impact and necessary safety features.
3. Reservoirs should be made for storing floodwater and releasing them at manageable rates. This would require careful engineering. Dams, and reservoirs would further lead to generation of resources.
4. Newly constructed residential as well commercial buildings should have foundations, which are strong enough to respond to flood conditions.
5. Rivers and streambeds should be stabilized with stone, masonry or vegetation at the banks. This should strictly be followed where rivers pass through cities, specially near bridges.

Post Disaster Requirements

The initial response to flooding authorities/community should include:

Search and Rescue operations,	water provision,
Medical assistance, Disaster	epidemiological surveillance assessment, food and and temporary shelter.

The secondary response should include:

Reconstruction of houses,	equipment and tools, supply
Creation of employment,	of animals, and assist with
Assistance to farmers,	recovery of small business
Distribution of farm	and fisheries.

Flood Problem In India

The nature of flood problem varies from one river system to another. Two great river systems are discussed below considering the flood problems in India:

Brahmaputra River

The main problem of flooding in the northeastern region arises from the Brahmaputra river and its tributaries. The river in monsoon season overflows its banks and causes a great damage to life and property both. Several times it has affected Kaziranga wildlife sanctuary where rhinoceros population died due to rising floods. In recent years, the erosion along the banks of the Brahmaputra has assumed serious proportions. The rivers also carry considerable amount of silt and have a tendency to change its course.

Ganga River System

In this region the northern tributaries of the Ganga, namely the Rapti, the Sharada, the Ghaghra and the Gandak cause extensive flooding along their banks. Drainage congestion is confined to the northwestern parts of U.P., Meerut, Mathura and Agra suffers the most. Bihar suffers a considerable amount of damage due to the flooding of the Burhi Gandak, the Baghirati, the Kamla Balan, the Kosi and the Mahananda. In addition to the crop submergence the area experiences traffic dislocation also. In the Bengal region Baghirati, the Ajoy and the Damodar cause extensive flooding. Here the tidal effect of Bay of Bengal also plays a role in flooding. In Delhi and Haryana it is the Yamuna, the biggest tributary of the Ganga, which causes a marginal amount of flooding. Most of these flooding regions suffer from inadequate channel capacity as well as regulation of river water flow in these channels.

Earthquakes and Seismology

An earthquake is a major demonstration of the power of the tectonic forces caused by endogenetic thermal conditions of the interior of the earth. An earthquake is a motion of the ground surface, ranging from a faint tremor to a wild motion capable of shaking buildings apart and causing gaping fissures to open in the ground. The Richter scale devised by Charles F. Richter in 1935 measures the magnitude or intensity of energy released by an earthquake. Good Friday Earthquake of March 27, 1964 in Alaska (USA) measuring 8.4 to 8.6 on Richter scale is among the greatest earthquakes of the world ever recorded.

The science that studies the behaviour and patterns of seismic waves is called seismology. The place of origin of an earthquake is called focus, which is always hidden inside the earth, but its depth varies from place to place. The place of the origin of an earthquake is called 'focus' which is always hidden inside the earth. The deepest earthquake may have its focus at a depth of even 700 km below the ground surface. Major Himalayan earthquakes, such as the Bihar-Nepal earth quake of August 2, 1988, have their focus around 20-30 km deep. The place on the ground surface, which is perpendicular to the buried 'focus' or 'hypocenter',

recording the seismic waves for the first time is called 'epicenter'. The waves generated by an earthquake are called 'seismic waves' which are recorded by an instrument called seismograph. The lines joining the places of equal intensity of seismic waves on the maps are called isoseismal lines.

Causes of Earthquakes

Earthquakes are caused mainly due to disequilibria in any part of the crust of the earth. A number of causes have been assigned to cause disequilibria in the earth's crust such as volcanic eruptions, faulting and folding, gaseous expansion and contraction inside the earth, hydrostatic pressure of man-made water bodies like reservoirs and lakes, and plate movements.

(1) Vulcan City

Volcanic activity is considered to be one of the major causes of earthquakes. Volcanic activity and seismic events are so intimately related to each other that they become cause and effect for each other. Earthquakes follow each volcanic eruption and many of the severe earthquakes cause volcanic eruptions. The explosive violent gases during the process of volcanic activity try to escape upward and hence they push the crystal surface from below with great force and thus is caused severe earth tremors of high magnitude.

(2) Faulting and Elastic Rebound Theory

The horizontal and vertical movements caused by endogenic forces result in the formation of faults and folds which in turn cause isostatic disequilibria in the crystal rocks which ultimately causes earthquakes of varying magnitudes depending on the nature and magnitude of dislocation of rock blocks caused by faulting and folding. The 1950 earthquake of Assam was believed to have been caused due to disequilibria in crystal rocks;

(3) Hydrostatic Pressure and Anthropogenic Causes

Certain human activities such as pumping of ground water and oil, deep underground mining, blasting of rocks by dynamites for constructional purposes, nuclear explosion, storage of huge volume of water in big reservoirs etc. also cause earth tremors of serious consequences. The introduction of additional load through the construction of large dams and impounding of enormous volume of water in big reservoirs behind the dams cause disequilibria of adjusted rocks below the reservoirs.

(4) Plate Tectonic Theory

The earth is composed of solid and moving plates having either continental crust or oceanic crust or even both continental oceanic crusts. The earth's crust consists of 6 major plates (Eurasian plate, American plate, African plate, Indian plate, Pacific plate and Antarctic plate) and 20 minor plates. These plates are constantly moving in relation to each other due to thermal convective currents originating deep within the earth. All sorts of disequilibria are caused due to different types of plate motions and consequently earthquakes of varying magnitudes are caused.

CLASSIFICATION OF EARTHQUAKES

Each earthquake differs from the other and thus it becomes difficult to classify all the earthquakes into certain categories.

(1) Classification on the Basis of Causative Factors

- (A) **Natural Earthquakes** are those, which are caused by natural processes i.e. due to end genetic forces. These are further divided into four subcategories.
- (i) **Volcanic Earthquakes** are caused due to volcanic eruptions of explosive and fissure types and are confined to volcanic areas. Severe earthquake caused by violent explosions of Etna volcano in 1968.
 - (ii) **Tectonic Earthquakes** are caused due to dislocation of rock blocks during faulting activity. Such earthquake is very severe and disastrous i.e. 1906 earthquake of California (USA).
 - (iii) **Isostatic Earthquakes** are triggered due to sudden disturbance in the Isostatic balance at regional scale due to imbalance in the geological processes.
 - (iv) **Plutonic Earthquakes** are in fact, deep focus earthquakes, which occur at greater depths.
- (B) **Anthropogenic Earthquakes** are caused by human activities such as pumping of water and mineral oil from underground aquifers. and oil reserves respectively, deep underground mining, blasting of rocks by dynamites for constructional purposes e.g. Koyna earthquake of Maharashtra of 1967 due to Koyna reservoir etc.

(2) Classification on the basis of Focus

On the basis of the depths of their foci these have been divided into 3 types.

- (i) **Moderate Earthquake:** Foci are located at the depths between 0-50 km.
- (ii) **Intermediate Earthquake:** Foci at the depths between 50-250 km.
- (iii) **Deep Focus Earthquake:** Foci at the depths between 250-700 km.

Classification on the basis of Human casualties

- (i) **Moderately Hazardous Earthquakes:** If deaths of human range below 50,000 due to seismic tremors e.g. Tabas earthquake of Iran 1978 A.D. (death toll 25,000).
- (ii) **Highly Hazardous Earthquakes:** If deaths of human range between 51,000-1,00,000 due to seismic tremors e.g. in 1935, Quetta, Baluchistan, (death toll 60,000).
- (iii) **Most Hazardous Earthquakes:** If deaths of human casualties are above 1,00,000 mark e.g., in 1976 Tang-Shan, China (death toll 7,50,000).

World Distribution of Earthquakes

Earthquakes are, in fact associated with the weaker and are statically distributed areas of the world. Most of the world earthquakes occur in the zones of young folded mountains, the zones of faulting and fracturing, the junction of continental and oceanic margins, the zones of active volcanoes and along the different plate boundaries. The world map of the distribution of earthquakes prepared by seismologists show the occurrence of earthquakes along the following belts.

- (i) **Circum-Pacific Belt:** surrounding the Pacific Ocean.

- (ii) **Mid-Continental Belt:** representing epicenters located along the Alpine-Himalayan Chains of Eurasia and northern Africa and epicenters of East African Fault zones.
- (iii) **Mid Atlantic Belt:** representing the earthquakes located along the mid-Atlantic Ridge and its offshoots.

Effects of Earthquake hazardous

Earthquakes and their hazards are determined on the basis of the magnitude of seismic intensity as determined by Richter scale but are decided in the basis of quantum of damages done by a specific earthquake to human lives and property.

(i) Landslides

Weaker landmasses and tectonically sensitive land margins cause landslides and debris falls, which damage settlements and transport systems on the lower slope segments.

(ii) Damage to Life and property

Structures such as buildings, roads, rails, factories, dams, bridges suffer a huge damage thus causing a heavy loss of human life and property both. The vibrations of earthquakes last longer and the amplitudes of seismic waves are greater artificially in filled and leveled depressions, swamp deposits etc. than in the structures of consolidated materials and bedrocks. Two major earthquakes of Bihar-Nepal border in 1934 and 1988 explain the impact of earthquake disasters on human structures and human lives. The damage caused by the Bihar earthquake of 15 January 1934, measuring 8.4 on Richter scale, include 10,700 human deaths, landslides and slumping in an area of 250 km length and 60 km width, ruptures and faults in the ground surface etc.

(iii) Damages to Government Infrastructure

Cities and towns are worst affected due to large concentration of human population, commercial complexes and residential areas. Due to collapse of large buildings there is greater loss of life and property. Due to collapse of buildings ground water pipes are bent and damaged thus water supply is disrupted, electric and telephone poles are uprooted and there is total disruption of power and communication. Other side effects are collapsed sewer system causing epidemics, roadblocks etc.

(iv) Fire Hazard

Earthquakes strongly shake the buildings and thus strong oscillations cause severe fires in houses, mines and factories because of overturning of cooking gas cylinders, contact of live electric wires, churning of blast furnaces, displacement of other electric and fire-related appliances.

(v) Landmass Deformation

Severe earth tremors and resultant, vibrations caused by severe earthquakes result in the deformation of ground surface because of crusts and troughs in the ground surface and faulting activity.

(vi) Flash Floods

Strong seismic events result in the damages of dams and cause severe flash floods. Severe floods are also caused because of blocking of water flow of rivers due to rock blocks and debris produced by severe tremors on the hill slopes facing the river valleys.

(vii) Tsunamis

The seismic waves, caused by the earthquakes traveling through seawater, generate high sea waves and cause great loss of life and property. Since the Pacific Ocean is girdled by the earthquakes and volcanoes tsunamis are more common in the Pacific with a minimum frequency of 2 tsunamis per year.

A CASE STUDY**U.P. Earthquake of 1991**

A severe earthquake occurred in Garhwal region of Uttar Pradesh on 20th Oct. 1991. Intensive tremors were felt at 2.53 a.m., which lasted for about 45 seconds. The magnitude of earthquake was measured 6.6 on Richter scale and its epicenter was at Angola, a place near Uttarkashi. Mild tremors are a regular feature of the area. The worst affected areas have been in the district of Uttarkashi, Tehri Garhwal and Chamoli while it also caused sizeable damage in the districts of Dehradun, Pauri Garhwal and Nainital. The roads and bridges are the chief means of communication in hill region, which underwent heavy damage. The economy of such places is based on tourism to a great extent, which suffered a great set back. The overhead drinking tanks and pipelines had developed cracks. Sources of drinking water had been damaged. The earthquake caused intensive damage to the building of various government departments, Forest, Home, Finance and Rural Development.

Cyclones

Cyclones are the centers of low pressure surrounded by closed isobars having increasing pressure outward and closed air circulation from outside towards the central low pressure in such a way that air blows inward in anticlockwise on northern hemisphere and clockwise in southern hemisphere. They range in shape from circular, elliptical to V shape. From locational viewpoint cyclones are classified into two principal types e.g. i) extra-tropical cyclones/temperate cyclones ii) tropical cyclones.

(I) Temperate Cyclones

Temperate cyclones are atmospheric disturbances having low pressure in the centers produced in the middle latitudes characterized by converging and rising air, cloudiness and precipitation. They are formed in the regions extending between 35°- 65° latitudes in both hemispheres due to convergence of two contrasting air masses e.g. After their formation temperate cyclones move in easterly direction under the influence of westerly winds and control the weather conditions in the middle latitudes.

(i) Shape, Size and Speed

Temperate cyclones are of different shapes e.g. circular, semi-circular, elliptical, elongated or V, but all of them are characterized by low pressure in their centres and closed isobars. The pressure difference between the centre and periphery is about 10-35 mb. It means that pressure increases from the centre towards outer margin. Average large diameter of an ideal cyclone is about 900 km while short diameter measures 400 km. The temperate cyclones move eastward under the influence of westerly winds with average velocity of 32 km per hour in summer and 48 km per hour in winters.

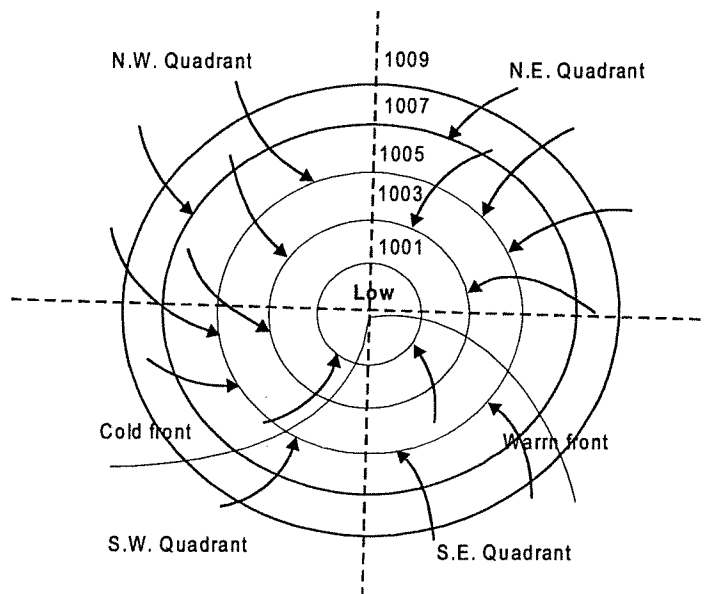


Figure 5.1: A generalized temperate cyclone in northern hemisphere.

(ii) Wind Systems

Since there is low pressure in the centre of temperate cyclone and air pressure increases outward and hence winds blow from the periphery towards the centre but these winds do not reach the centre straight rather they cut the isobars at the angle of 20° to 40° due to friction and Coriolis force and thus wind direction becomes anticlockwise in the northern hemisphere and clockwise in the southern hemisphere. Since temperate cyclones are formed due to convergence of two contrasting air masses and hence it is natural that there are variations in the nature and direction of winds in different parts of the cyclones.

(iii) Temperature

Different temperatures are noted in different parts of temperate cyclones because of their origin due to convergence of two thermally contrasting air masses. The southern part of cyclone records higher temperature because of the dominance of warm air while the north-eastern, northern and north-western parts record low temperature because of the dominance of cold polar air mass. The western part records lowest temperature.

(iv) Source Regions and Tracks of Movement

The areas frequented by temperate cyclones mostly lie in the middle and high latitudes extending between 35° - 65° latitudes in both the hemispheres. These cyclones move, on an average, in easterly direction. (1) Cyclones after originating in the north Pacific off the north-east and eastern coasts of Asia move in easterly and north-easterly direction towards the Gulf of Alaska and ultimately merge with Aleutian Lows from where they follow southerly direction and reach as far south as southern California. The cyclones moving inland dissipate and are occluded at the windward western slopes of the Rocky Mountains.

(v) Origin of Temperate Cyclones

Though the formation and development of temperate cyclones is a quick process but it passes through a series of successive stages. The period of a cyclone from its inception

(cyclogenesis) to its termination (proteolysis or occlusion) is called the 'life cycle of cyclone'; which is completed through six successive stages.

- (a) **The first stage** involves the convergence of two air masses of contrasting physical properties and directions. Initially, the air mass (warm and cold) move parallel to each other and a stationary front is formed. This is called initial stage.
- (b) **The second stage** is also called as 'incipient stage', during which the warm and cold air masses penetrate into the territories of each other and thus a wave-like front is formed.
- (c) **Third stage:** This is the mature stage when the cyclone is fully developed and isobars become almost circular.
- (d) **Fourth stage:** Warm sector is narrowed in extent due to the advancement of cold front than warm front, as cold front comes nearer to warm front.
- (e) **Fifth stage:** Starts with the occlusion of cyclone when the advancing cold front finally overtakes the warm front and an occluded front is formed.
- (f) **Sixth stage:** Warm sector completely disappears, occluded front is eliminated and ultimately cyclone dies' out.

(II) Tropical Cyclones

(i) General Characteristics

Cyclones developed in the regions lying between the tropics of Capricorn and Cancer are called Tropical Cyclones which are not regular and uniform like extra tropical or temperate cyclones. There are numerous forms of these cyclones, which vary considerably in shape, size, velocity and weather conditions. The weather conditions of low latitudes mainly rainfall regimes are largely controlled by Tropical Cyclones.

- (a) Size of tropical cyclones varies considerably. On an average their diameters range between 80 km and 300 km.
- (b) Weak cyclones move at the speed of about 32 km per hour while hurricanes attain the velocity of 180 km per hour or more.
- (c) Tropical cyclones become more vigorous over the oceans but become weak and feeble while moving over land areas. This is why these cyclones affect only the coastal areas e.g. Tamil Nadu, Orissa and West Bengal coasts of India.
- (d) The centre of the cyclone is characterized by extremely low pressure.
- (e) Tropical cyclones are not characterized by temperature variations in their different parts because they do not have different fronts.
- (f) There are no different rainfall cells hence each part of the cyclones yields rainfall.
- (g) Tropical cyclones are not always mobile. Normally, they move from east to west under the influence of trade winds
- (h) Tropical cyclones are confined to a particular period of the year (summer season).

(ii) Types of Tropical Cyclones

Generally they are divided into 4 major types:

- (a) Tropical disturbances or easterly waves
- (b) Tropical depressions
- (c) Tropical storms
- (d) Hurricanes or typhoons

(iii) Origin of Tropical Cyclones

On an average, tropical cyclones are formed due to development of low pressure of thermal origin. They develop when the following requirements are fulfilled:

- (a) There should be continuous supply of abundant warm and moist air. Tropical cyclones originate over warm oceans having surface temperature of 27°C.
- (b) Higher value of Coriolis force is required for the origin of these cyclones.
- (c) They are associated with inter-tropical convergence (ITC), which extends from 50°-300N latitudes during summer season.
- (d) There should be anti-cyclonic circulation at the height of 9000 to 15000 m above the surface disturbance.

(iv) Distribution of Tropical Cyclones

There are 6 major regions of the tropical cyclones e.g. (1) West Indies, Gulf of Mexico, and Caribbean Sea. (2) Western North Pacific Ocean including Philippines, Islands, China Sea, and Japanese Islands. (3) Arabian Sea and Bay of Bengal. (4) Eastern Pacific coastal region off Mexico and Central America. (5) South Indian Ocean of Madagascar (Malagasi), and (6) Western South Pacific Ocean, in the region of Samoa and Fiji Island and the east and north coasts of Australia.

(v) Environmental Impact of Tropical Cyclones

Tropical cyclones are very severe disastrous natural hazards which inflict heavy loss to human lives and property in terms of destruction of buildings, transport systems, water and power supply systems, disruption of communication system, destruction of standing agricultural crops, domestic and wild animals, natural vegetation, private and public institutions etc. Through damages caused by high velocity winds, floods and storm surges.

ANTICYCLONES

General Characteristics

Surrounded by circular isobars anticyclone is such a wind system which has highest air pressure at the centre and lowest at the outer margin and winds blow from the centre outward in clockwise direction in the northern hemisphere and anticlockwise in the southern hemisphere fig.13. Thus, anticyclones are high-pressure systems and more common in the subtropical high pressure belts but are practically absent in the equatorial regions. Anticyclones were classified into (i) **warm anticyclones**, and (ii) **cold anticyclones** by Hanzilk in 1909.

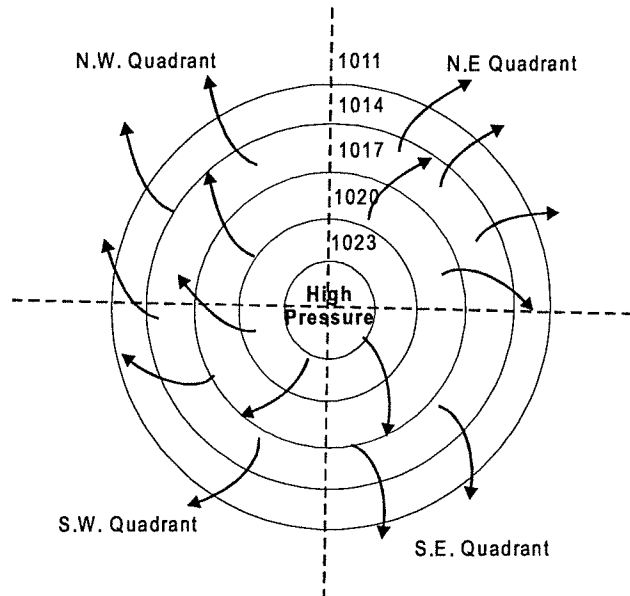


Figure 5.2: Generalized representation of air pressure and wind system in an anticyclone.

They are characterized by the following properties.

- (1) They are usually circular in shape. The difference of pressure between the centre and periphery of anticyclone ranges between 10-20 mb.
- (2) They are much larger in size and area than temperate cyclones.
- (3) Anticyclones follow cyclones. They move very sluggishly. The average velocity of anticyclones is 30-50 km per hour.
- (4) Winds descend from above at the centre and thus weather becomes clear and rain less because the descending winds cause atmospheric stability.
- (5) Temperature in anticyclones depends on weather, nature of air mass and humidity in the air.
- (6) Anticyclones do not have fronts.

1. Wind Systems and Temperature

Wind system is not fully developed in anticyclones because of weak pressure gradient. On an average, wind circulation is of divergent system wherein winds spread in all directions from high-pressure centre to low-pressure periphery. The winds are very much sluggish in the rear portion in comparison to the front portion. The centre is characterized by light breeze.

These arise due to the descent of either polar cold air mass or warm tropical air mass. Cold anticyclones are associated with extremely low temperature and they cause cold waves during winter season but when they come in summer season, weather becomes pleasant.

2. Shapes and Size

Anticyclones are generally of circular shape but are very large in size. They become so large in size that their diameters become 9,000 km.

3. Weather Conditions

Generally, anticyclones are rainless and sky is free of clouds because of the fact that descending air in the centre of anticyclone is warmed up at dry adiabatic rate due to subsidence. This causes rise in temperature, which reduces normal lapse rate of temperature, with the result the stability of air increases resulting into marked increase in the aridity of air. This is why anticyclones are indicative of dry weather.

4. Landslides

Among physiographic units, the two northern units of the Greater Himalayas (7500-8500m), and the Inner Himalayas (Trans-Himalayan zone), an intervening system of high plateau and valleys lying between the two great mountain ranges, are considered along with middle mountains, the traditional centres of population. The upper northern section of these middle mountains remains largely under upper montane forest (2900-4000 m), below which is the belt of intensive agriculture. Lithology is highly varied, including sedimentary, metamorphism, and granites. However, there are extensive areas of phyllites and schists; these are deeply weathered and the prevailing steep slopes render them highly susceptible to erosion and slope failure (mostly through landslides). Presently, according to gross yet reliable estimate, the landslides occupy about 1% of land surface in only five central districts of Himachal Pradesh. They have a total volume of more than $2.2 \times 10^6 \text{ m}^3$ and a mean age of 6.5 years. This helps to evaluate the denudation rate, which is about 12 mm/year (all erosive processes). Landslides have about 2.5-mm/year denudation rates. One of the main causes of landslides is road construction.

Suggestions

Various studies indicate that for each linear kilometer of mountain road, 10 small to medium landslides occur. Prior to the 1962 border war with China, the Himalayan section in India was in most parts accessible only on foot. The shock of the Chinese military presence, the three India-Pakistan wars of 1947, 1965, and 1971, the continued border tensions (especially along the Kashmir ceasefire line), and several other problems led to accelerated construction of up to 10,000 km of highways and connecting roads. The poor alignment and ill-considered design are causing a total soil loss of 0.199 t of sediment per linear meter of road per annum. Valdiya (1973) indicated that during the construction phase an average kilometer of road requires the removal of 40,000-80,000 m^3 of debris. These enormous volumes are dumped on the roadsides and damage ecologically fragile slopes by depriving them of natural vegetation and at times destroy the terraces.

QUESTIONS

1. Write the definition of pollution in your own words and also explain the causes of pollution.
2. Explain the types of pollution. Write the precautions to minimize the pollutions (air, water, social, marine, noise).
3. What is social water management? Explain.
4. Explain the role of an individual in prevention of pollution and how it is possible?
5. How we can conduct the pollution case study in a particular area and also explain the disaster management?

Government

transverso

Blizzard Bag Assignment – American Government/Economics

After reading each presidential biography pick 3 significant things about each president and write a paragraph on each.

Ronald Reagan

- 1.
- 2.
- 3.

George H.W. Bush

- 1
- 2.
- 3.

Bill Clinton

- 1.
- 2.
- 3.

George W. Bush

- 1.
- 2.
- 3.

Barack Obama

- 1.
- 2.
- 3.

1981 - 1989 Ronald Reagan

After two troubled decades, Americans sought a president to restore confidence in themselves and the country - and Ronald Reagan delivered

The plot of the 1967 film *In Like Flint* involves an imposter replacing the president of the United States. Secret agent Derek Flint, played by James Coburn, uncovers the truth that a nefarious stand-in has been playing the part of the leader of the free world. "An actor? As president?" Flint gasps in astonished incredulity.

Barely 13 years later, the US voted for Ronald Reagan, a former Hollywood star and TV performer, as the 40th president of the country. It was an unlikely previous occupation for a resident of the White House, yet he proved to be an extraordinary leader.

Born in Tampico, Illinois in 1911, Ronald Wilson Reagan's immediate family consisted of alcoholic father John (known as Jack), older brother Neil, and nurturing, compassionate mother Nelle. She taught her boys not to blame their father as alcoholism was a disease. It impacted upon everyone, however, in that the Reagan family had to move frequently for Jack to find work. They finally settled in Dixon, Illinois in 1920, where Reagan's father sold shoes.

Following high school graduation, Jack's youngest enrolled in Eureka College, Illinois. He majored in economics and sociology, and while only average academically, he excelled in sport and drama. Tellingly perhaps, he was elected class president in his senior year.

Reagan first found work as a radio sports reporter in Davenport, Iowa, soon progressing to a similar post with larger station, WHO, in Des Moines. His

coverage of the Chicago Cubs baseball team proved popular in the state - and also kick-started his acting career.

In 1937, while following the Cubs to a training camp in California, the budding reporter also arranged to make a screen test at Warner Brothers studios. Tall, athletic, good-looking, and with an impressive speaking voice, Reagan landed a \$200 per week contract.

He appeared mostly in films regarded not as features but as B-movies. Frequently he played wholesome, easy-going 'good guy' characters who were, many have noted, rather like himself. In the relaxed, self-mocking manner that served him so well in his political career, Reagan later explained the studio 'didn't want the films good, they wanted them Thursday.'

Critics and himself regarded his best film as *King's Row*. Yet any hopes Reagan had of building on that 1942 release were curtailed by the war. A

US Army cavalry reserve since the 1930s, in the wake of Japan's attack on Pearl Harbor, Reagan was called to active service. Eyesight problems meant he wasn't suitable for combat duty but his talents were put to use in the military's first motion picture unit narrating training films and appearing in patriotic movies to aid the war effort. He had married actress Jane Wyman by then, too. Their first child, Maureen, was born in 1941, and a second, Michael, was adopted in 1945, but the marriage ended in divorce four years later.

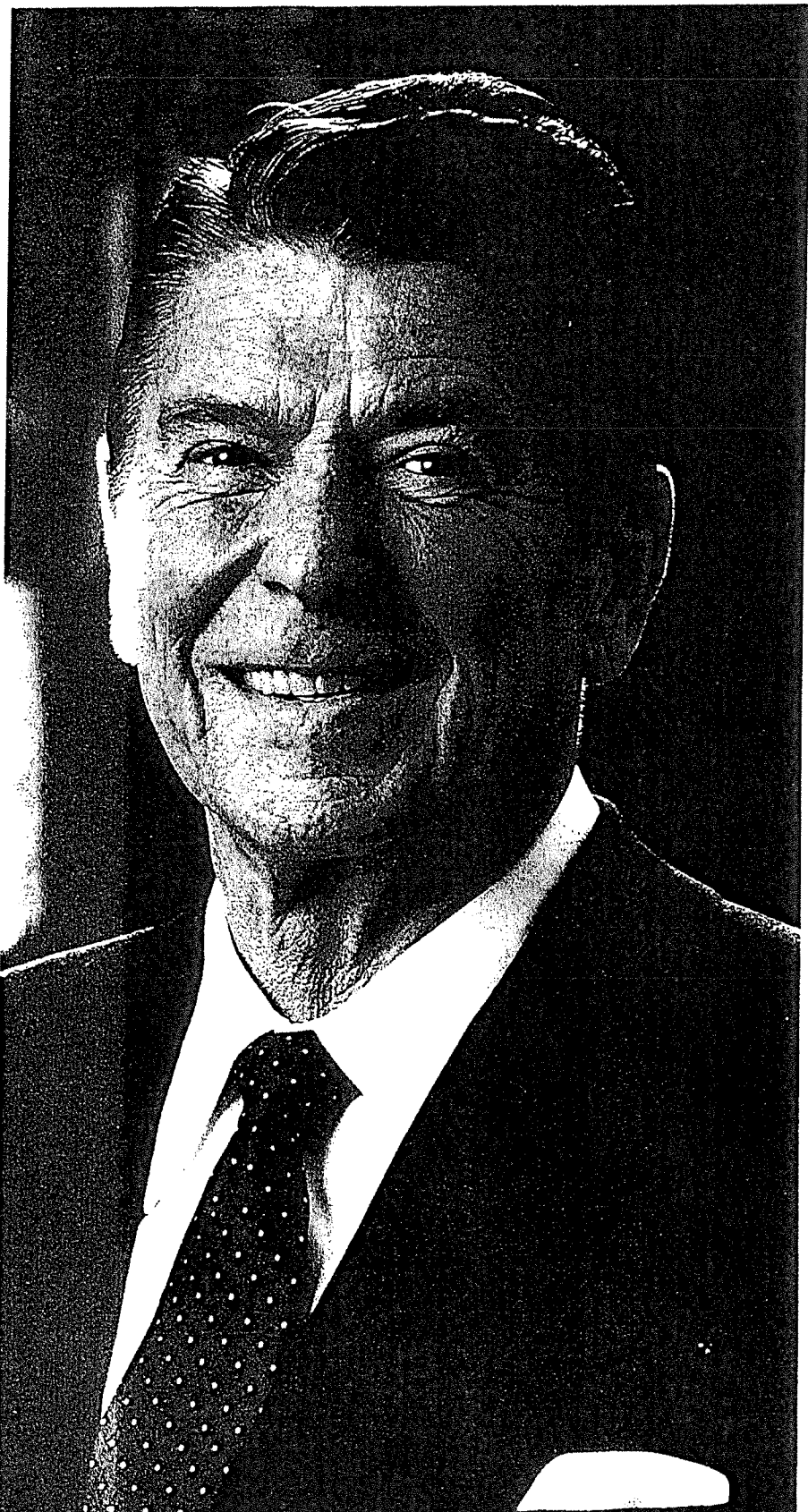
**Taking
office just 17
days before his 70th
birthday, Reagan
remains the oldest
man to become
US president**



RONALD REAGAN
Republican, 1911 - 2004

**Brief
Bio**

Raised in a poor family, Reagan followed a reasonably successful acting career which a stunningly successful political one. He was once a Democrat who later became an icon of Republican conservatism. Affable by nature, he nevertheless heightened the Cold War with provocative rhetoric before resigning arms reductions. Above all, he made a previously uncertain America feel good about itself again.



Ronald Reagan



Nancy and Ronald Reagan aboard a boat in California in 1964

Life in the time of Ronald Reagan

Cue VT

With the words, "Ladies and gentlemen, rock and roll," MTV was launched on 1 August 1981, kick-starting a revolution in the music industry. The first music video shown on the channel was "Video Killed The Radio Star", by British recording duo The Buggles.

Car wars

The DeLorean gull-winged sports car launched on the American market in the early 1980s - with the car industry in its biggest slump for decades. The company went bankrupt in 1982, though the car later featured as a time machine in the Back To The Future trilogy.

Armageddon almost by accident

The world came dangerously close to destruction in 1983. With Cold War tensions high, US and NATO forces began a wargame exercise called Able Archer '83. The Soviet Union, fearing a surprise attack might be instigated under such a premise, mobilised its nuclear forces and came close to launching.

Sport and politics

The Moscow Olympics in 1980 were boycotted by many countries including the United States. Four years later, the Soviet Union and others boycotted the Los Angeles Olympics. The Goodwill Games, introduced in 1986, attempted to break the cycle. Moscow hosted first, Seattle four years later, and there were three further tournaments.

Disaster in the skies

Space Shuttle Challenger began its tenth mission in January 1986. Among its seven astronauts was school teacher Christa McAuliffe, due to give lessons from space. Seconds into the mission, the Shuttle exploded, killing all on board. Reagan addressed the nation that evening to pay a moving tribute to the lost astronauts.

Making nuclear weapons obsolete

Rather than trust that the volume of nuclear weapons of both superpowers would prevent war because of mutually assured destruction, Reagan seized on the notion of a Strategic Defence Initiative. He charged the scientific community with creating a system largely deployed in space to shoot down missiles launched at the United States. Research and development costs would be enormous, while such a system risked breaching existing weapons control treaties and instigating a new arms race. The economy of the Soviet Union, meanwhile, was in a parlous state, particularly after the price of its main export oil plummeted. Soviet leader Mikhail Gorbachev was introducing reforms promising greater freedom and sought negotiations with Reagan. The two leaders met four times.

The second summit in Iceland began with low expectations but progressed rapidly, Gorbachev eventually offering to eliminate all nuclear weapons within a decade if the Americans would confine SDI research to laboratories. Reagan, however, would not give up on SDI and such an historic agreement was never made, even though a later summit produced a treaty eliminating intermediate-range nuclear forces. Years later, with SDI as originally conceived proving difficult to achieve, defence systems were downgraded to earth-based theatre, not national, levels.



Reagan and Soviet Union leader Mikhail Gorbachev sign the Intermediate-Range Nuclear Forces Treaty in 1987

Reagan was first elected president of the Screen Actors Guild, the union for film and television performers, in 1947. He served as its leader for a further five years. They were turbulent times in the movie industry because of investigations by the House of Un-American Activities Committee into left-wing politics in Hollywood. Strongly anti-communist, Reagan fought other movie unions he felt were under communist influence, testified as a friendly witness to the HUAC, and was an FBI informant on suspected Hollywood leftist sympathisers. The blacklist of performers, writers and directors prevented from working for major studios because of their political views subsequently numbered more than 300.

During this period, Reagan's own politics were shifting. He had been a liberal, Democratic Roosevelt supporter but was becoming more conservative. Meeting actress Nancy Davis, who had views similar to her right-wing adoptive father, only accelerated the process. The pair married in 1952.

The movie offers were drying up, but in 1954 Reagan landed a TV job as presenter and occasional performer for General Electric Theatre, a drama series which became a staple of Sunday night viewing. Part of his role was to visit the sponsor company's plants, giving talks to its employees. Over the years, this exposure to 'business America' convinced the actor that big government hindered rather than helped enterprise, pushing him further towards the political right, while the talks helped hone his speech construction and delivery skills.

During his second term as governor of California, Reagan granted country singer Merle Haggard a full pardon from his past crimes



Reagan's acting career was a success, but few predicted he would eventually land the presidency

After campaigning with Democrats-for-Eisenhower to vote the Republican to the White House in 1952 and 1956, Reagan supported the Grand Old Party's Richard Nixon against John F. Kennedy, finally registering as a Republican in 1962. As such, he championed the party's 1964 conservative presidential candidate, Barry Goldwater. In the last week of the campaign, Reagan presented 'A Time for Choosing,' a 30-minute nationally televised address, considered to be one of the finest political endorsements ever made.

Although Goldwater lost, Reagan rocketed to pre-eminence on the Republican right.

The next move was to seek office himself. Against Democrat incumbent 'Pat' Brown, Reagan ran for governor of California in 1966. Brown tried discrediting his opponent as an inexperienced lightweight, but Reagan flipped the accusations, arguing he was an ordinary citizen fed up with

Defining moment A true soulmate 4 March 1952

After numerous film appearances, and a divorce, Reagan marries actress Nancy Davis. She claims her life only really begins after her marriage, which produces two children, Patricia and Ronald. The couple are devoted to each other, remaining deeply in love for the rest of their lives. Reagan's personal politics have begun to shift, in part through Nancy, in part due to his position as president of the Screen Actors Guild, and in part because of his exposure to the business world brought about by his role as presenter of TV's General Electric Theatre.



Timeline

- 1911**
Humble Beginnings
 Reagan is born in Tampico, Illinois. When the family settle in Dixon, his alcoholic father becomes a shoe salesman.
6 February 1911
- Hollywood Beckons**
 Reagan begins working as a radio sports reporter and is soon broadcasting on Chicago Cubs baseball games. Covering the team takes him to California, where he makes a successful screen test.
1932-1937
- New career**
 A nationwide TV appearance endorsing Republican presidential candidate Barry Goldwater brings in \$1 million worth of support. Goldwater loses, but Reagan's profile as a prominent politician is firmly established.
27 October 1964
- Time to govern**
 Reagan is elected governor of California, serving two terms. Untypically, he sanctions record tax increases to tackle a budget deficit and achieves some notable environmental success. Controversially uses the National Guard to quell student unrest.
1976
- Out of office**
 Reagan bids his time giving speeches and writing a weekly newspaper column before announcing he wishes to seek the Republican Party presidential nomination. He comfortably secures it.
13 November 1979
- The White House beckons**
 He is sworn in as the 40th president following a resounding election victory over Jimmy Carter. He advocates supply-side economic reform which quickly becomes known as 'Reagonomics'.
20 January 1981



Ronald Reagan

remote and inefficient state government. This appealed to voters, who also warmed to Reagan's affable personality. He won convincingly, securing a second term four years later.

A half-hearted tilt at the Republican presidential nomination failed in 1968. A more serious challenge to Gerald Ford - president after Nixon's resignation - followed eight years later. That failed too, but when Ford lost to Jimmy Carter, Reagan was the obvious choice to secure the GOP nomination in 1980. He resoundingly defeated President Carter, confidently asserting that he could rebuild the nation's economy and spirit - badly tarnished after Vietnam, the Watergate scandal, and the Iran hostage crisis - with sweeping tax cuts, increased defence spending, less government interference, and a balanced federal budget.

The American hostages in Iran were released the day Reagan was inaugurated, but that auspicious start was abruptly halted when John Hinckley Jr attempted to assassinate the new President in early 1981. With a bullet lodged in Reagan's body just millimetres from his heart, he was rushed to hospital. When Nancy arrived, her husband told her, "Honey, I forgot to duck." Just before undergoing surgery, he removed his oxygen mask, enquiring of the staff, "I hope you are all Republicans." Reagan's survival of the attack and his endearing quips made his popularity soar.

His language was hawkishly tough, however, when confronting the Soviet Union. Reagan dubbed it 'an evil empire', escalating the Cold War with his increased military spending. A further step came in 1983 when the president announced the country would develop the Strategic Defence Initiative. Labelled 'Star Wars' by critics, the system called for space-based technologies to intercept and destroy nuclear missiles launched at the United States.

Some contended this was a dangerous escalation of the arms race that would create a black hole in the military budget. In later years, however, others say pressures created by the SDI helped end the Cold War and pushed the Soviet Union into collapse, as its increasingly unstable economy was incapable of competing with such US military expansion.

With the economy booming again, a landslide second election victory was achieved in 1984. After Brezhnev, Andropov and Chernenko, a fourth Soviet leader, Mikhail Gorbachev, came to power during Reagan's presidency. Unlike the previous three, Gorbachev signalled he was prepared to negotiate with the US President, whose bellicose language began to soften during his second term. From a position of strength following military expansion, Reagan's discussions with Gorbachev on limiting the nuclear arsenal of both super powers bore fruit. Historic agreements on strategic arms reductions were signed, though some contend more could have been achieved had Reagan not been so steadfastly wedded to SDI.

While the economy continued expanding during Reagan's second term, there were increases to the budget deficit and the national debt, yet neither harmed his popularity. What did was the Iran-Contra Affair. American hostages were being held

in Lebanon by groups friendly to Iran. Despite a policy of not dealing with terrorists, between 1985 and 1986, arms were shipped to Iran in exchange for hostage releases and payments. Later, some of the payments were diverted to the Contras of Nicaragua who were fighting to overthrow the country's socialist government, even though such funding was outlawed by Congress. It remains unclear how

much the president knew about the Affair, but he did apologise to the nation for it, tarnishing his image. Nevertheless, on leaving office, Reagan had the highest presidential approval ratings since Roosevelt.

Five years after exiting the White House, Reagan was diagnosed with Alzheimer's disease. Despite periods in his last years in office when he appeared confused, with Nancy occasionally stepping forward to prompt his answers before the press, his doctors insisted he did not have the illness when serving.

The degenerative disease curtailed his public appearances in later life. He died aged 93 in 2004. Although the image of a rider-less horse following the carriage carrying his coffin, with Reagan's own riding boots reversed in the stirrups, seemed pure Hollywood for the former actor, it has been seen at state funerals for other former Presidents who were, like Ronald Reagan, venerated by the nation.

In his 1984 re-election, Reagan won more electoral college votes - 525 out of 538 - than any other president in history

"Reagan dubbed the Soviet Union an 'evil empire', escalating the Cold War"

Defining moment

Assassination attempt 30 March 1981

Leaving the Washington Hilton Hotel, the president and three others are hit by a hail of bullets fired by John Hinckley Jr. Reagan is rushed to hospital and undergoes emergency surgery. He survives, the first president to do so after being shot in an assassination attempt. His popularity skyrockets. Hinckley, obsessed with the actress Jodie Foster, sought to impress her by emulating a character from her film *Taxi Driver* who makes an assassination attempt. Charged with attempting to assassinate the president, Hinckley is found not guilty by reason of insanity and is confined to a psychiatric institution.

Defining moment

Last day 20 January 1989

Reagan retires from the White House. Four successful summits with Soviet leader Gorbachev have paved the way for a peaceful resolution to the Cold War. Not all foreign policy ventures have been successful, though. The Iran-Contra Affair in particular has been shameful, even down to how much the president knew or didn't know about it. At home, there are mixed economic outcomes too. Inflation is down and under control and there has been extensive growth, yet the budget deficit has deepened while the national debt has soared. Without doubt, however, the president leaves office a popular and highly regarded figure.



Reagan delivers his famous speech in front of the Brandenburg Gate in Berlin, in which he appealed to Gorbachev to "tear down this wall"



● **Reach for the stars**
Reagan unveils his proposal for a Strategic Defence Initiative to protect the US from attack by nuclear missiles with space-based systems. Critics call it 'Star Wars' and claim it is unfeasible.
23 March 1983

● **Four more years**
After declaring it was "Morning again in America" during the campaign because of the resurgent economy, he secures a second term as president with the largest ever electoral college victory.
4 November 1984

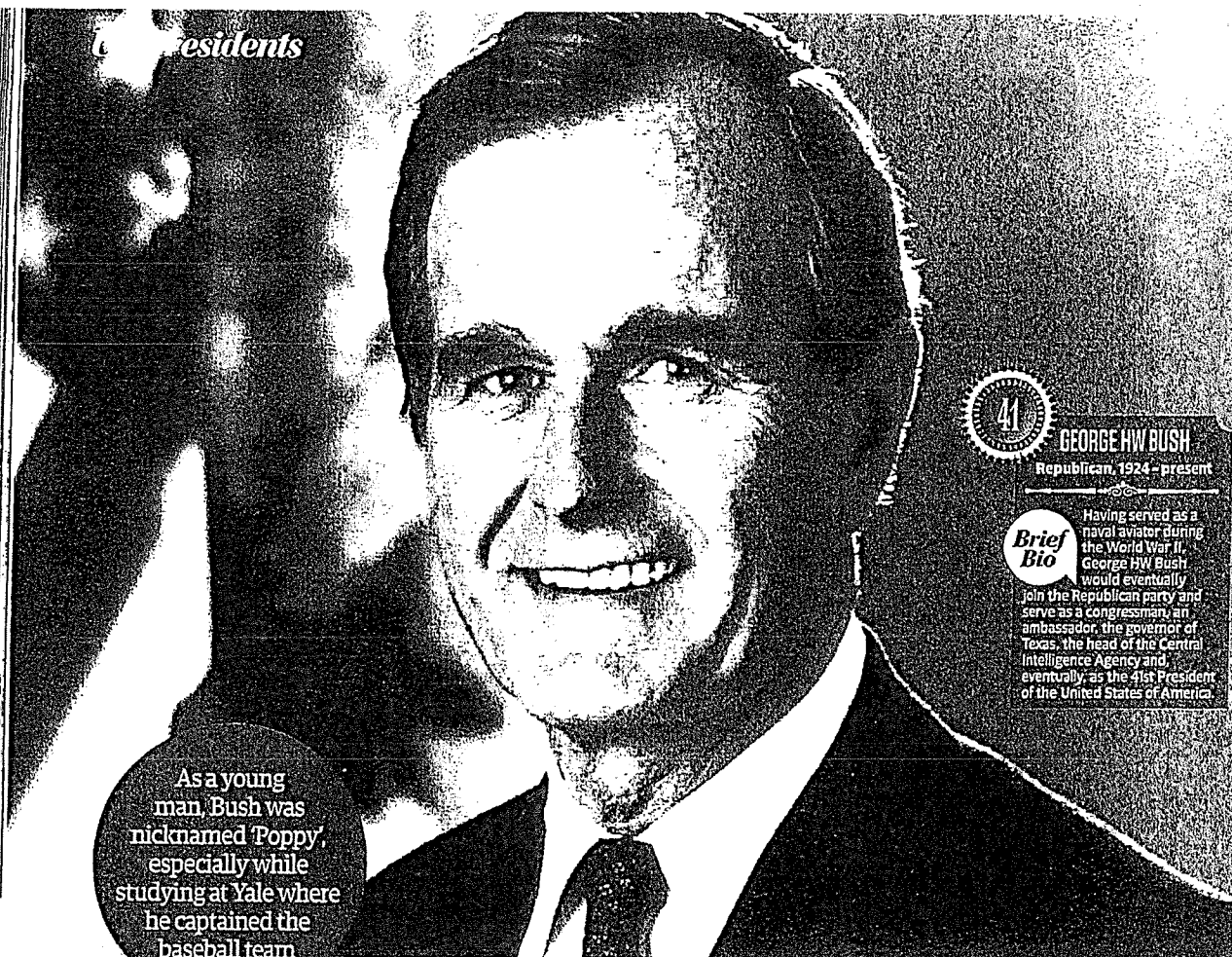
● **Iconic speech**
Reagan visits the Berlin Wall's Brandenburg Gate. Superpower summits have been productive but he challenges the Soviet Union to go further with reforms, urging, "Mr Gorbachev, tear down this wall!"
12 June 1987

● **No Sir!**
Reagan is awarded an honorary knighthood by Queen Elizabeth II. It is the highest honour Britain can bestow upon a foreign national, though he cannot be referred to as Sir.
14 June 1989

● **Incurable illness**
After appearing in public for the last time at Richard Nixon's funeral earlier in the year, Reagan discloses in an open letter to the American people that he has Alzheimer's disease.
5 November 1994

● **The curtain comes down**
At the age of 93, Reagan dies of pneumonia complicated by Alzheimer's at his Bel Air home in California.
5 June 2004

© Getty Images



GEORGE H.W. BUSH

Republican, 1924 - present

Brief Bio

Having served as a naval aviator during the World War II, George H.W. Bush would eventually join the Republican party and serve as a congressman, an ambassador, the governor of Texas, the head of the Central Intelligence Agency and, eventually, as the 41st President of the United States of America.

As a young man, Bush was nicknamed 'Poppy', especially while studying at Yale where he captained the baseball team

1989 - 1993

George H.W. Bush

The last living president to have served during WWII, George H.W. Bush is the elder statesman at the head of one of the US's most influential political families:

Born into a wealthy family on 12 June 1924, George Herbert Walker Bush was already a part of a legacy well versed in the minutia of military service and politics. His father, Prescott Bush, had served as a captain during World War I and had gone on to serve as a US senator. The second of five children, the young Bush attended the super-elite preparatory school Phillips Academy where he excelled both socially and academically, captaining varsity teams and holding a variety of leadership positions.

It was here, in 1941, that Bush met a young Barbara Pierce, the woman who would remain

at his side for decades to come. A year later, on his 18th birthday, Bush followed in his father's footsteps and joined the military, opting for the US Navy. He became the youngest ever naval aviator at the time, and flew a total of 58 combat missions during World War II.

After the war, Bush married his fiancée Barbara, graduated from Yale with a degree in economics and moved to Texas (with son, and future president, George Jr in tow) where he made his mark in oil refinery. However, his attention soon turned to politics. He became chairman of the Harris County Republican Party by 1963, but

failed in his attempts to gain a seat in the Senate on behalf of Texas. This knockback, and the one that followed the year after, didn't dissuade him and he eventually earned a seat in the House of Representatives in 1966.

His political career then began to bloom. His no-nonsense and direct demeanour, mixed with his family name, his experience as a war veteran and his influence as a former oil magnate made him a formidable force as he served as the US ambassador to the United Nations and headed up the Republican National Committee during President Nixon's Watergate scandal. His political ascendance even saw him assume the post of director of the CIA in 1976.

But by the end of the 1970s, Bush's attention had moved to the highest office of all: the presidency. His attempt to win the Republican nomination in 1980 wasn't to be, losing out to charismatic former Hollywood star Ronald Reagan, but his campaign made a big impact and Reagan selected him as vice president. The pairing proved successful and Bush served two full terms as vice president.

His own presidential campaign (1987-1988), took a far more proactive and aggressive tone than his previous effort, and his renewed vigour ultimately struck a chord - although Bush's victory wasn't a landslide, with the Republican taking 54.4% of the popular vote. Slim margin or not, Bush was in and he became the first serving vice president to be elected president since Martin Van Buren in 1836, and the first president to succeed someone from his own party since Herbert Hoover in 1929.

Sworn into office on 20 January 1989, Bush assumed the presidency at a time of dramatic change for the Western world, most notably the destabilisation of the Soviet Union. The Cold War that had silently raged for decades had petered out and Soviet states were finally transforming into democratic territories once more. In the face of such events, it's no surprise that Bush's administration would focus a great deal of its attention on foreign policy and the United States' relationship with the changing world.

Bush began a dialogue with liberal Soviet leader Mikhail Gorbachev, and between them Russo-American relations improved significantly. The two would form something of a political power couple on the global stage and the signing of the Soviet Arms Reduction Treaty in July 1991 typified this new strategy of cooperation.

Another significant factor that defined Bush's time in office was the Gulf War. When the Iraqi military invaded Kuwait in January 1991, it thrust the world's oil resources into crisis. With infamous Iraqi leader Saddam Hussein now in control of these oil fields illegally, Bush and his administration had to act. Shortly after, Congress sanctioned the use of military force. Operations Desert Shield and Desert Storm saw US forces drive out the Iraqi occupation and liberate Kuwait. The liberation of Kuwait (and, of course, its precious oil reserves) sent Bush's approval ratings through the roof - but for all his successes in foreign policy, his domestic administration brought him no end of ridicule. The United States' economy was in recession, mainly due to sluggish job recovery across the nation, and while this economic downturn wasn't necessarily the fault of the Bush administration, it still left a significant proportion of the American population feeling vulnerable and disillusioned.

When Bush actively raised taxes (after, rather ironically, using the slogan, 'Read my lips: no new taxes,' as one of the tenets of his presidential campaign) in order to deal with the worsening budget deficit, his popularity ultimately plummeted. Even his successes overseas couldn't repair the damage and Bush lost his seat in the 1993 presidential elections to the popular Democrat Bill Clinton.

After serving a single term as president, Bush proudly watched his son George W Bush assume the presidency in 2000, while his other son Jeb became governor of Florida between 1999 and 2007. Now in his nineties and still going strong, the elder Bush continues his philanthropy, working with charities across the US to raise money for countless good causes.

As well as flying 58 combat missions, Bush was awarded three Air Medals and the Distinguished Flying Cross

George HW Bush



Bush's long list of political appointments, including being director of the CIA, made him a popular candidate for the presidency

Life in the time of George HW Bush

Somali strife

In the early 1990s African state Somalia descended into a devastating civil war, which plunged the country towards a humanitarian crisis. In April 1994, the United Nations attempted to aid the situation, but the mission failed. The war continued through Bush's administration and into Bill Clinton's.

Into the light

Bush established the Point Of Light Award, an affectionation of the Points Of Light movement, which aimed to promote the spirit of volunteerism in local communities. The award itself was created to recognise those that went above and beyond in the name of helping their fellow Americans. In 2013, the 5,000th award was granted.

Berlin united

In the same year Bush finally ascended to the office of the president, the world around his new administration was changing drastically. The crumbling of the Soviet Union saw East and West Berlin - divided for over three decades - united as one.

Soviet Union disbanded

In December 1991, the prime and first ministers of Russia, Ukraine and Belarus signed the Belavezha Accords which deemed the Soviet Union dissolved. A Commonwealth of Independent States (CIS) was established in its place.

Flood damage

Between April and October 1993, the United States suffered its worst recorded flooding in the history of the country. It occurred in the American Midwest along the Mississippi and Missouri rivers and caused a staggering \$75 billion in damages across agriculture, property and more.

The US invasion of Panama

During the 1980s, Panamanian leader Manuel Noriega (who had previously been openly pro-US) had been smuggling drugs from his nation into the US. When a democratic election ousted him from power he nullified the vote and reassumed control. In response, Bush sent 2,000 American troops into Panama (Operation Just Cause) to settle the growing unrest under Noriega's de facto government. The leader had been an issue for Reagan's administration, but the Republican president had been unable to find a solution. Under Bush's presidency, Noriega was removed from office and power was granted back to the rightful winner of the election, Guillermo Endara.



US President

In 1992, Clinton was accused of draft dodging during the Vietnam War

42

BILL CLINTON

Democrat, 1946 - present

Brief Bio

Bill Clinton's presidency came at a time of relative stability in United States history and his government oversaw a booming economy and progressive welfare reforms. Although the Democrat's time was nevertheless marked by scandal, particularly during his second term, he left with the highest end-of-office approval rating of any American president since World War II.

1993 - 2001

Bill Clinton

Calling himself 'The Comeback Kid', Bill Clinton's reign was tainted by scandal but it was impossible to keep him down

With the phrase, "It's the economy, stupid," ringing in the ears of the American electorate, Bill Clinton found himself the victor in the 1992 presidential campaign against President George HW Bush. The phrase hammered home the message that the economy was the most important electoral issue and, during Clinton's subsequent term, the United States' economy prospered. But it was to be just one of a number of things that would mark his eight roller-coaster years in office.

Bill Clinton was born William Jefferson Blythe in the tiny town of Hope, Arkansas, on 19 August 1946.

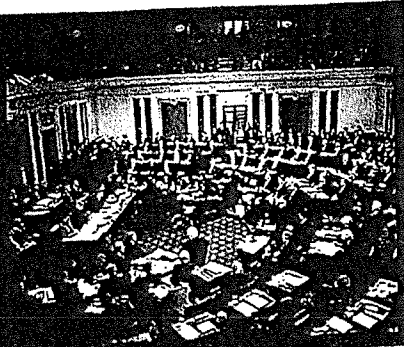
He was raised alone by his mother, Virginia Cassidy Blythe; his father had died in a car crash three months before Clinton was born. With his mother studying for a nursing degree in New Orleans, the young boy was raised by his grandparents Eldridge and Edith Cassidy. His mother married Roger Clinton in 1950 and although the used car salesman was a gambler and an alcoholic prone to violence, the future president nevertheless officially adopted his stepfather's surname at the age of 15.

During his formative years, Clinton had shown deep intelligence. He graduated from Georgetown University, won a Rhodes Scholarship to Oxford

Bill Clinton

The Lewinsky scandal

When former Arkansas state employee Paula Jones sued Clinton for sexual harassment, her lawyers went on to subpoena White House intern Monica Lewinsky, another woman with whom Clinton was suspected of having an affair. Clinton denied a sexual relationship twice in January 1998 saying, "I did not have sexual relations with that woman". But Lewinsky, who also initially said the accusations were false, testified before the Starr commission and admitted nine encounters. Clinton, meanwhile, denied the affair under oath. It led to an impeachment trial in the Senate in December 1998 but in February the following year he was found not guilty on the charges of perjury and obstruction of justice.



Clinton meets with President Jimmy Carter during his time as governor of Arkansas

Life in the time of Bill Clinton

A changing Europe

Although the Cold War was over, many European borders were being redrawn in the east, particularly due to the Yugoslav Wars, the Kosovo War and the Bosnian War. Many countries were also shifting away from the influence of the former Soviet Union. The political landscape was shifting and the United States' standing was strengthened.

Prosperous times in the US

The American economy was flourishing in the Nineties, experiencing the longest period of peacetime economic expansion in its history. The US had more than overcome the recession at the turn of the decade and the Welfare Reform Act also succeeded in reducing poverty from 1996.

Dawn of the Internet

Around 1995, the Internet really began to take off, three years after the first photo on the World Wide Web was published by its inventor, English scientist Tim Berners-Lee (he had also written the first web browser in 1990). The internet was proving to be revolutionary with email a popular form of communication.

Blair's rise to power

It is said that the progressive politics of Bill Clinton were mimicked by Tony Blair who became prime minister of the United Kingdom in 1997, following a landslide victory against the previously ruling Conservative Party. The UK and Ireland signed the Good Friday peace agreement in 1998.

Booming entertainment and high-profile cases

The 1990s saw the release of the first *Star Wars* prequel while animation moved up a notch with the debut of *Toy Story*. Punk rock flourished in California and nu metal became influential. Footballer and actor OJ Simpson fell from grace, accused of the double-murder of his ex-wife Nicole Brown Simpson and her friend Ronald Goldman.

Canada and Mexico which created a trade bloc and eliminated barriers to investment.

But reform of the US healthcare system had to be scrapped and it was a bitter blow. First lady Hillary Clinton had been put in charge of spearheading the proposal - unofficially nicknamed Hillarycare - and the president had hoped to see it through. He yearned for universal health care and made it part of his presidential campaign but strong opposition and red tape strangled it. Following that, the midterm elections in 1994 saw the Republican Party make a net gain of 54 seats in the House of Representatives and pick up eight seats in the Senate. The Republican Revolution saw the party win both houses of Congress.

It did not prevent Clinton from winning re-election in 1996. He became the first Democrat since Franklin D Roosevelt to win a second term, beating Republican Party nominee Bob Dole. Applauded for raising the national minimum wage, he clamped down on crime and became the first serving US president to visit Northern Ireland, telling his hosts the two countries were "partners for security, partners for prosperity, and most [importantly], partners for peace." Unemployment also fell to its lowest levels and the economy boomed. Yet further

trouble brewed in his personal life and his second term was marked by the scandal involving White House intern Monica Lewinsky. It led to the president's impeachment (and later acquittal), which blemished his reputation.

His final years of presidency saw a rise in his popularity with the signing of tax-relief plans, tax credits for children and college tuition, and the announcement of a \$70 billion budget surplus. But world tensions began to simmer and he oversaw a United States-led, two-month NATO bombardment of Serbia in support of the Albanians. He also warned in 1998 that Iraq was pursuing nuclear weapons, prompting four days of concentrated air attacks on Iraqi military installations. He may have taken office after the end of the Cold War but the United States' brief time of peace was coming to an end. Clinton left office on 20 January 2001.

Jazz fan Clinton began to play the saxophone aged nine and would play for 12 hours a day

University and studied law at Yale until 1973. But controversially, he was also questioned about his drug use at Oxford, responding infamously: "When I was in England, I experimented with marijuana a time or two, and didn't like it. I didn't inhale, and I didn't try it again." On the positive side, he met an ambitious, smart woman called Hillary Rodham at Yale and the couple married in 1975.

By the time the couple had a daughter, Chelsea, in 1980, the Democratic Party member had already served two years - from 3 January 1977 to 9 January 1979 - as the 50th attorney general of Arkansas. He had only just begun his first of two split terms as the 40th and 42nd governor of Arkansas too, the second of which ended on 12 December 1992.

But Clinton was destined for greater things and his reputation was growing. He followed a progressive brand of politics, which was part and parcel of a New Democrat, centrist faction ideology that had emerged following George HW Bush's victory in 1988. He firmly believed in the need to improve the quality of public education. In 1992, he had won his party's nomination, running for president on a promise of welfare reform, a tax cut for the middle classes and an expansion of the Earned Income Tax Credit for the working poor.

His campaign was marred by claims of an affair by nightclub singer Gennifer Flowers yet with Clinton and his running mate Al Gore successfully in the White House, public attention turned firmly to politics. Clinton focused his work on economic reforms that would drag the US out of the recession that had blighted Bush's later years.

There were some positive standout moments including the so-called 'Don't ask, don't tell' law in 1993 which replaced an outright ban on gay people serving in the military and prohibited discrimination. That same year, Israel's prime minister Yitzhak Rabin shook hands with the Palestine Liberation Organisation's Yasser Arafat following the signing of the Oslo Accords. An agreement was also ratified in 1994 by the US,

2001 - 2009

George W Bush

Bush's time in office was marked by the terrorist attacks on the United States which led to the global War on Terror

It is video footage which has been seen many times over and yet it still manages to stay in the minds of those who view it. On the day Al-Qaeda terrorists flew two hijacked aeroplanes into the World Trade Center in New York, the White House chief of staff, Andrew Card, was filmed whispering into the ear of George W Bush in front of schoolchildren. That day also saw another plane blasted into the Pentagon and control of United Airlines Flight 93 seized - both were acts by Al-Qaeda - only for Flight 93 to crash in a field in Pennsylvania after its brave passengers attempted to overcome the terrorists.

The president listened intently for the few seconds it took for the message to be delivered, his face barely flickering as the news cameras focused upon him. He was reading a book to schoolchildren in Florida and, after the news was delivered, he continued to read for a few more minutes, stood up, apologised and left. But for those brief moments, he was a picture of calm on an otherwise hectic and uncertain day.

September 11 is the day which would define the 43rd president's time in office. He had only been leader for eight months when 9/11 - as it became known - happened in 2001, and he barely had the opportunity to make his mark. But from that moment on, he led the global War on Terror. He positioned himself as the head of the coalition of the willing - a group of allied countries uniting

against terrorism - and he formed the Department of Homeland Security. The US was plunged into two long military campaigns in Afghanistan and Iraq, which split the opinion of its citizens. There was no denying Bush's impact.

Bush was born on 6 July 1946 in New Haven, Connecticut, the son of Barbara Bush and the future President George HW Bush, who made his fortune in oil. It was a relatively happy childhood albeit tinged with great sadness following the death of his younger

sister, Pauline, of leukaemia aged just three. Bush was seven at the time and it was an event which dominated and shaped his early years as he battled to come to terms with his grief. A report in the *Washington Post* in 1999 said that Bush repeatedly questioned why no one had told him she had been dying. It was an event which defined him, ensuring his life would be driven by chance and humour.

This was evident during his time reading history at Yale University. He was a member of the privileged Skull and Bones society and he spent more time socialising and drinking than studying. "To the C students, I say, 'You too can be president of the United States,'" he quipped in 2001 at Yale's 300th commencement. Even so, he was - literally - a high flier after graduation: until 1972, he served as an F-102 fighter pilot in the Texas Air National Guard during the Vietnam War. He went on to receive a Master of Business Administration from Harvard Business School in 1975.

Bush and wife Laura were instrumental in setting up PEPFAR, which helps save the lives of HIV and AIDS sufferers in Africa



GEORGE W BUSH

Republican, 1946 - present

Brief Bio

George W Bush was the son of another president - George HW Bush and his earlier life had alternated between forays in politics and business. After becoming governor of Texas, he was elected as the 43rd president, only to bear the brunt of the terrorist atrocities of September 11 in 2001, which went on to define both of the terms he eventually served.



George W Bush



An infant George W Bush is held lovingly by his parents, future president George HW Bush and his wife Barbara circa 1947

Life in the time of George W Bush

The War on Terror

September 11 changed everything for the first decade of the 21st century. Al-Qaeda terrorists would strike in Madrid, London and Mumbai, while Iraq and Afghanistan dominated political thinking. There were mass protests against war, rising fears of further attacks and concern over Iran's nuclear ambitions.

Religious awareness rises

The world became less ignorant of other religions and began to learn and understand more about Islam, in particular. Meanwhile, Pope John Paul II died on 2 April 2005. Two years earlier, he had sent Cardinal Pio Laghi to meet Bush, asking him to reconsider invading Iraq. He wouldn't.

The rise of Apple

More people began to invest in technology, in part, because of the phoenix-like revival of Apple spearheaded by founder Steve Jobs who had returned to the company in 1997. The iPod was released in 2001 and revolutionised the way that people bought and listened to music and the iPhone in 2007 ushered in the smartphone era.

Slower air travel

Concorde was retired in 2003 following its only crash in 2000. It was also a victim of the terrorist attacks of September 11 which had caused a general downturn in air travel numbers, and it heralded the end of supersonic transport and fast travel between the United States and Europe.

Superheroes dominate Hollywood films

With wars, climate change worries and disasters such as Hurricane Katrina, the world needed superheroes, it seemed. The box office was awash with *X-Men*, *Fantastic Four*, *Iron Man*, *Watchmen*, *Batman* and *Spider-Man* movies, and fantasy films such as *The Lord of the Rings* were also popular.



Bush was only the second president after John Quincy Adams to be the son of a president

His success, experience and responsibilities did not curb his fondness for alcohol, though. In 1976, he was caught drink-driving and arrested. He continued drinking for another ten years, only giving up alcohol in 1986, just two years before he became a paid campaign advisor on his father's successful presidential bid. During that time he had married Laura Welch, joined the United Methodist Church, run a failed campaign for the House of Representatives from Texas' 19th congressional district against Kent Hance, created Arbusto Energy which became Bush Exploration and fathered two children: twin daughters Barbara and Jenna.

In 1994, two years after being campaign advisor for his father's failed re-election campaign, Bush

won governorship of Texas and served two terms. It led to him becoming the Republican presidential nominee for the 2000 elections. This had put him up against Al Gore, vice president of the United States under President Bill Clinton.

The election was mired in controversy as scores of voters said they had accidentally voted for the wrong candidate because the ballot was not entirely clear. A recount was triggered in Florida where Bush's victory of margin was just 537. Disappointed voters had rows over hand recounts and punch card ballots where so-called 'chads' were hanging from the papers and were not registering votes. In the end, Bush was declared the winner

even though Gore had won the popular vote by 48.4 per cent to Bush's 47.9 per cent.

When Bush was seeking election, he had promised to overhaul Medicare, Social Security and public education. He wanted to put to bed the Clinton-esque scandals of the last office and he rode a wave of principled policies. Newspapers spoke of his desire to cut taxes and help the poor with health insurance tax credits. He wanted investment in the military too.

In his first term Bush achieved tax cuts, and he made strides in the education sector but on September 11 everything would change.

Bush's priorities needed to shift in line with the expectations he laid out on the evening of that day.

Having been fully briefed on the terrorist attacks and their likely motivation, Bush's attention fixed on foreign rather than domestic policy. Analysts believed the United States could become an isolationist country but instead the US went all-out, seeking retribution. 'The search is underway for

those who were behind these evil acts,' he told the nation as Osama Bin Laden quickly became identified as the enemy's leader and targets started to be identified.

Bush had, after all, said that 'we will make no distinction between the terrorists who committed these acts and those who harbour them' and so the army and air force were sent to bombard Afghanistan and drive out the ruling Taliban. In 2003, attention switched to Saddam Hussein, the president of Iraq and a man who Bush's father had fought in the Gulf War between 2 August 1990 and 28 February 1991. Hussein



Defining moment - Bush graduates from Yale University 1968

Bush arrives at Yale in 1964, at the same time his father is in the running for the Texas United States Senate election against Democrat Ralph Yarborough. He studies history but it is not known what his grades were, quite possibly because he was not viewed as an exceptional student, rather someone who liked to drink, party and have fun. On one occasion he is arrested for disorderly conduct for taking a Christmas wreath from a shop door but the charges are dropped. On 1 January 1967, a notice in the Houston Chronicle says Bush is engaged to Cathryn Lee Wolfman. The wedding is later called off.

Defining moment - Bush elected governor of Texas 1994

Bush defeats the popular incumbent Ann Richards and governs Texas for five years, having won a second term in 1998 - the first Texas governor to have done so. He proves to be popular, winning 68.6 per cent of the vote the second time around. Bush improves public schools, cuts taxes and encourages growth in business, but there is condemnation from human rights activists throughout his time in charge. By the time he leaves office, he has presided over 152 executions - more than any other governor in the state's history at that time.



Timeline

1945

- **George W Bush is born**
Bush is born in New Haven, Connecticut and is the first child of Barbara and George HW Bush. His parents would later give him three younger brothers - Jeb, Neil and Marvin - and two sisters - Dorothy and Robin.
6 July 1946

- **The Bush family relocate to West Texas**
Bush's father decides to move the family to West Texas in order to pursue a new career in the oil industry. This is where the young Bush grows up, later attending The Kinkaid School in Houston.
1948

- **Death of his sister**
Just a few weeks after the birth of Barbara Bush's second son, Jeb, daughter Pauline Robinson Bush - nicknamed Robin - is diagnosed with leukaemia and dies six months later. The young George is understandably devastated.
11 October 1953

- **Bush marries Laura Welch in Texas**
Less than a year after meeting, Bush, who is now 31, marries Laura Welch, aged 33, at the First United Methodist Church in Midland, Texas. They go on to have twin daughters called Barbara and Jenna.
5 November 1977

- **Bush enters politics**
Bush runs for the House of Representatives from Texas' 19th congressional district but loses. He decides to pursue a business career in oil and becomes highly successful. He also buys the Texas Rangers.
1978

- **Bush wins the presidential election**
After one of the most controversial elections ever, Bush becomes the 43rd president of the United States and he resigns as governor of Texas. He is inaugurated on 20 January 2001.
2000

George W Bush

"Bush's slow response to Katrina rankled with the American people"

was identified as supporting terrorist groups and he was captured in December 2003.

Key to Bush's efforts to remove Hussein from power and cause change in Iraq was a litany of supposed evidence that Iraq was actively pursuing nuclear weapons. He was claimed to have a stash of chemicals earmarked for warfare and was said to be a threat to world peace. The words 'weapons of mass destruction', or WMD, became widely used but searches in Iraq found nothing at the time of invasion and no caches have ever been discovered since. The whole affair was ultimately highly embarrassing and controversial.

Bush was accused of misleading the American people, an allegation he has strenuously denied. He also risked becoming tarnished by a war that seemingly had no end point in sight. Some sections of the US and the press often held him to ridicule and he was the victim of hoaxes falsely claiming him to have the lowest IQ of any US president over the preceding 50 years. 'Bushisms' became a term given to his frequent verbal slip-ups. 'Our enemies are innovative and resourceful, and so are we,' he said in August 2004. 'They never stop thinking about new ways to harm our country and our people, and neither do we.' That year, though, he ran for re-election and won, defeating the Democratic Party's challenger, John Kerry with 50.7 per cent of the popular vote and a margin of 286 to 252 electoral votes.

Certain policies - while controversial around the world - did not seem to affect him. Bush's

administration had approved the Guantanamo Bay detention camp in 2002 which held 779 men and boys in harsh conditions. At that time, Bush had the highest approval rating of any president during a mid-term congressional since Dwight D Eisenhower. His second term saw his popularity dip, though. His standing deteriorated in 2005 when Hurricane Katrina struck the Gulf Coast in the summer, killing more than 1,000 people and causing \$100 billion of damage.

Bush was on vacation in the 1,600-acre Prairie Chapel Ranch in Crawford, Texas, and he did not immediately cut it short. Bush's slow response to Katrina rankled with the American people as news reports continued to show the extreme devastation. Even when he did end his holiday two days earlier than intended, he did not visit the area straight away. It was widely seen as the event which caused the United States to lose confidence in him. His approval rating dropped to 40 per cent in 2006.

By 2008 it had dropped further, to an astonishing 22 per cent according to one poll. By this time the United States was suffering a financial crisis that was also engulfing the world. The Economic Stimulus Act of 2008 sought to stimulate the economy but the global recession was in full force. Amid growing discontentment, Bush had come to the end of his second term but there was no appetite for four more years of Republican policies. It paved the way for a Democratic Party victory as Barack Obama defeated John McCain to spark a new era in American history.



Bush oversaw the construction of a brand new stadium in Arlington

Bush the sports fan

Bush was a keen sportsman and he played rugby union during his high school and Yale years. Having learned in 1988 that the Texas Rangers were being put up for sale, he headed a group the following April which invested \$89 million and took a controlling stake in the franchise.

Under Bush's watch - and in conjunction with the city of Arlington - a new stadium was built for the team costing \$193 million. It was financed through a half-cent sales tax increase for Arlington residents. The move boosted attendances, pushing them beyond two million for the first time in franchise history.

Bush continued to buy more shares and he eventually took his personal financial investment to \$606,302. But attorney Glenn Sodd sued the Rangers on behalf of two families whose property had been seized for stadium parking space. They argued that they had received only a fraction of its value.

The new Ballpark eventually opened in 1994 and achieved average crowds of 40,374 but when Bush was elected governor, he decided to step down as managing general partner. In 1998, the franchise was eventually sold to Tom Hicks for \$250 million, a sum which netted Bush a cool \$14.9 million. Bush remains a huge fan of the Texas Rangers and he is often seen at the games.

Defining moment

Terrorists strike the United States 11 September 2001

No timeline of George W Bush could be complete without mention of September 11 since it would go on to define his entire presidency and overshadow everything else he achieved. Bush is informed of the multiple terrorist attacks on US soil while he is reading *The Pet Goat* to children at the Emma E Booker School in Sarasota, Florida. He gives a short press conference at 9.30am that morning before he is moved to a secure location on board Air Force One. He returns to the White House and begins work on a more long-term response.



● **Education reform introduced**
Bush pushed through the No Child Left Behind Act which introduced the standardised testing of children to close the achievement gap between the advantaged and disadvantaged.
2002

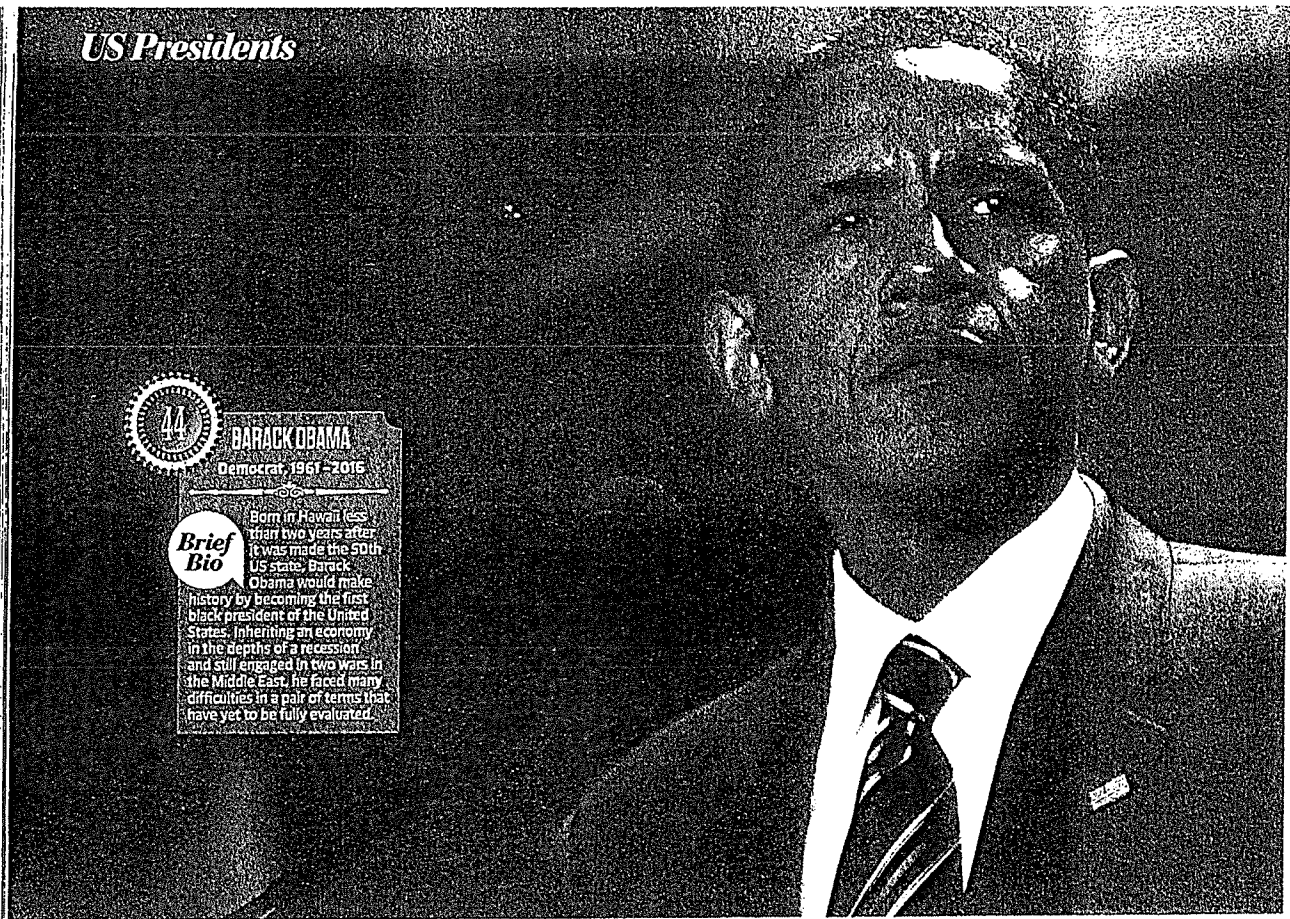
● **A busy year**
As well as declaring war on Iraq - ensuring that it joined Afghanistan in being part of the War on Terror, Bush brings in laws encouraging business growth, better health systems and he also signs the HIV/AIDS act.
2003

● **Bush is inaugurated again**
Having beaten senator John F Kerry in the presidential race of 2004, Bush assumes a second term, but the destruction in New Orleans brought about by Hurricane Katrina severely dents his popularity ratings and leaves him with a public relations mountain to climb.
2005

● **Sealing the borders**
The Secure Fence Act of 2006 was signed in a bid to halt the rise of illegal entry, drug trafficking and security threats in the United States. A fence 700 miles long was built on the Mexico-US border to boost security.
26 October 2006

● **More activity in Iraq**
Further US troops are committed to Iraq in order to secure Baghdad and the adjacent Al Anbar province. Former Iraq president Saddam Hussein was finally executed by the United States the year before.
2007

● **Second term ends**
Bush draws his second term of office to a close and Democrat Barack Obama is elected the 44th president of the United States. Bush publishes his memoirs in 2010 and he becomes a grandparent for the first time in 2013.
26 October 2008



BARACK OBAMA

Democrat, 1961–2016

Brief Bio

Born in Hawaii less than two years after it was made the 50th US state, Barack Obama would make history by becoming the first black president of the United States. Inheriting an economy in the depths of a recession and still engaged in two wars in the Middle East, he faced many difficulties in a pair of terms that have yet to be fully evaluated.

2009 – 2017

Barack Obama

Barack Obama's inauguration generated unprecedented excitement and clamour. He largely delivered on his promises to restore the country's shattered reputation abroad and resurrect it from the doldrums of the Great Recession

On 20 January 2009, downtown Washington DC was swamped with millions of supporters, generating the largest inauguration crowds since Lyndon Johnson's re-election in 1965. The man they had come to see: President Barack Obama. Elected to the nation's highest office at the tender age of 47, his only political experience consisting of one term in the Senate, Obama was a sensation.

Obama's upbringing was atypical, yet emblematic of the American dream that came to underscore his political story. Born in Honolulu to a mother from Kansas and a father from Kenya, he lived in Indonesia and Hawaii, splitting time between his mother and grandparents. He was unsettled

as a teen, and admitted to smoking marijuana and experimenting with cocaine to fit in. He was rigorously home-schooled for much of his childhood by his mother, and he credited this occasionally stern upbringing with instilling in him the values that would allow him to succeed. He gained national attention in 1991 when he was elected the first black president of the Harvard Law Review. He also began writing a book on race relations that would become his bestselling memoir, *Dreams From My Father*. Obama began teaching at the University of Chicago Law School, lecturing on constitutional law, and working as a community organiser. During his political career, he would often return to the measured, patient tones that he honed teaching law.

Barack Obama

Later political opponents mocked Obama's days as a community organiser and point to his associations with unsavoury characters that he cultivated, but his work with black churches in Chicago helped bolster his image as a man of the people, rather than an elite and disconnected Ivy League scholar.

During his candidacy for the Illinois Senate, Obama gained notoriety with his bitter opposition to Bush's invasion of Iraq. At the 2004 Democratic National Convention, he electrified his party with the keynote speech, rising from obscurity to a genuine party leader. Despite a fruitful first term as Senator, Obama was a political neophyte, so few expected him to pose a serious challenge to Hillary Clinton in the lead up to the 2008 presidential election. However, Obama's accessible, tech-savvy campaign harnessed an engaged new cadre of young voters and small fundraisers. He was an excellent orator, charismatic, and rode a wave of adulation and excitement to the White House, defeating John McCain in a landslide victory.

The country was in a bad state, suffering from the wounds inflicted by a runaway Wall Street, and dealing with the worst recession since the Great Depression. Obama embraced a radical spending plan, rejecting the austerity that many European nations opted for. His stimulus plan was his most lasting and resounding success, as the country recovered quickly from the recession and unemployment decreased steadily over his two terms.

When Obama was inaugurated, the US was also embroiled in two unpopular wars in Iraq and Afghanistan. He had promised to end both wars, and when he was re-elected in 2012, he campaigned on his successes in the Middle East, having ostensibly ended the Iraq War in 2011. However, as tensions boiled over in Syria and Iraq, Obama sent troops back in – and he never did withdraw troops from Afghanistan altogether.

His presidency was characterised throughout by battles with a stubborn Congress – the Democrats had a majority in both Houses in his first term, but that didn't last. He failed to follow through on his campaign pledge to close the notorious Guantanamo Bay detention facility when Congress refused to cooperate, but supporters will wonder if he could have done more. His lingering

achievement was his Affordable Care Act, dubbed ObamaCare, which, although neutered somewhat in Congress, was a genuine and lasting effort to make basic healthcare available to all Americans. His efforts at working with Republicans on landmark legislation foundered, and he repeatedly faced the threat of government shutdowns from an increasingly fractious Republican House critical of his excessive spending. In the wake of the Sandy Hook school shooting, Obama reiterated his desire to pass gun-control legislation, but was again thwarted.

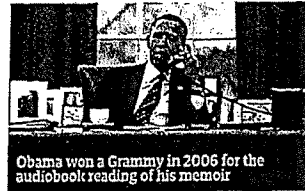
Obama will be remembered for his deep commitment to progressive ideals. He repealed the 'Don't ask, don't tell' policy, allowing openly gay men and women to serve in the military. And in 2015, a Supreme Court featuring two of his appointed justices made same-sex marriage federally legal. He considered himself an arbitrator of racial disputes, and often intervened in police matters (notably issuing statements on the killings of Michael Brown and Trayvon Martin), yet towards the end of his second term it became clear that racial tensions in the US were worse than ever before.

Obama's two terms featured notable foreign policy successes, the highlights being the rapprochement with Cuba, the killing of Osama Bin Laden, and the successful negotiations with Iran over its nuclear program. However, those were overshadowed by his failure to deal with ISIS, his sluggish action in Syria, an inability to control the security environment in Iraq, a bombing campaign in Libya that left it a failed state, frosty relations with Israel, the debacle in Benghazi, backtracking on a warning to Bashar al-Assad over chemical weapons use, and repeated humiliation at the hands of Vladimir Putin and Russia. Critics will find similarities in the foreign policy of Obama and his predecessor, as he continued Bush's extra-judicial drone strikes in dozens of countries, and stepped up a mass surveillance plan through the National Security Agency. Obama swept in on a platform of hope, and to his credit delivered on many domestic items, salvaged the economy, and did much to restore the United States' reputation abroad, yet he failed to realise many of his promises and was widely seen as indecisive when it mattered most.

Obama worked in Baskin Robbins as a teenager and as a result can't stand ice cream

The Affordable Care Act

Obama's most lasting achievement was healthcare reform, which he pushed through in 2010 with the Patient Protection and Affordable Care Acts. Despite serious opposition from the right-wing Tea Party movement and virtually every Republican in Congress, the act carried and was reaffirmed by the Supreme Court in 2012. Despite a slow roll-out of government-sponsored healthcare plans, and subsequent opposition by state governors, the Act has made affordable healthcare available to working-class Americans, and granted the consumer protection from predatory insurance company practices.



Obama won a Grammy in 2006 for the audiobook reading of his memoir

Life in the time of Barack Obama

The Great Recession

A sub-prime mortgage crisis, a shady default swaps market, and the bundling of exotic financial instruments combined with deregulation of Wall Street in the 1990s and 2000s led to a total collapse of the financial system and the housing market in 2007. Obama creditably resurrected the car industry, regulated the banks, and restored the economy over his two terms.

The Iraq War 'ends'

In early 2009, Obama announced that he would end the Iraq War within 18 months. The US public was upset with the fraudulent entry into the war and the subsequent failure of nation-building. Obama kept his word. However, when the Islamic State shrugged off the American-trained and American-supported Iraqi army, captured Mosul and carried out ethnic cleansing campaigns in 2014, thousands of US troops re-entered Iraq.

Osama meets his watery grave

In May 2011, CIA intelligence revealed that Osama Bin Laden was living in Abbottabad, Pakistan. Obama rejected a plan to bomb the compound, opting instead for a raid by Navy Seals. The raid was successful, and Bin Laden was shot and buried at sea. Though he was no longer actively involved in Al-Qaeda, the raid was considered a strategic and moral victory for the US and bolstered Obama's popularity.

Spying among friends

When Edward Snowden revealed the NSA's overreach in collecting data, the US faced a stern backlash abroad. German Chancellor Angela Merkel was particularly enraged that US intelligence was listening to her mobile phone calls. The NSA agreed to stop the overzealous collection of data but Obama's popularity dipped.

A thin red line

When Syrian dictator Bashar al-Assad used sarin gas, a chemical weapon outlawed by the Geneva Convention, to murder thousands of innocent civilians in Damascus, Obama faced a conundrum. He had called the use of such weapons a red line not to be crossed, at the threat of immediate military reprisal. Yet Obama backed down from his threat and Putin mediated the situation instead, humiliating him.

