Sri Aurobindo College of Dentistry

Indore, Madhya Pradesh

INDIA

Module plan

- Topic : Fluorides in Dentistry
- Subject : Public Health Dentistry
- Target Group : Undergraduate Students
- Mode : PowerPoint Presentation
- Platform : Institutional LMS
- Presenter : Dr. Sandesh N

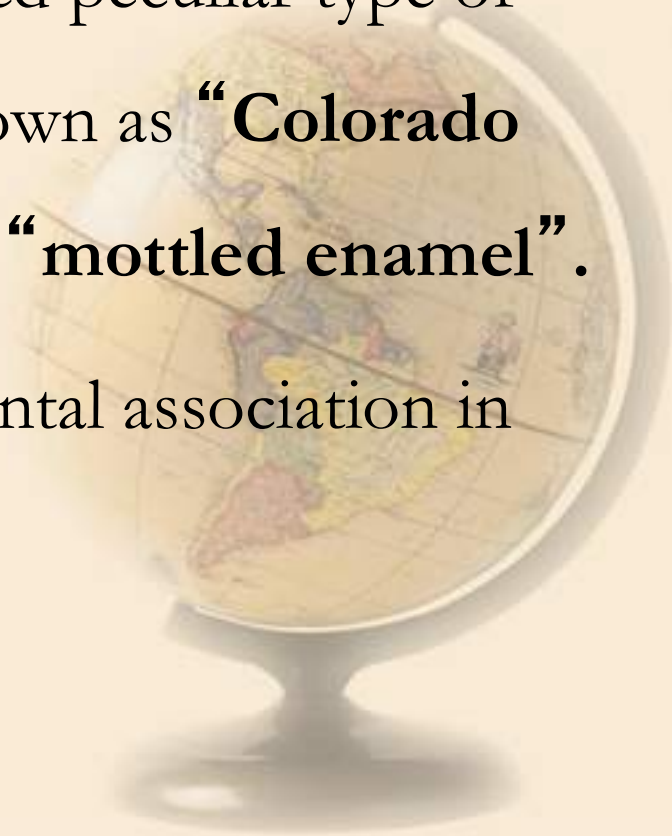
Learning objectives

- General Objective
  - Role of fluoride in oral health
- Specific Objective
  - History of fluoride
  - Metabolism of fluoride
  - Systemic fluoride
  - Topical fluoride

History of fluorides

- 26th June 1886 → Henri Moissan
- Dr Fredrick Mckay - 1901- noticed peculiar type of stains on his patients. Locally, known as **"Colorado stains"** and he called these stains **"mottled enamel".**

  1908 –presented a case in state dental association in Boulder

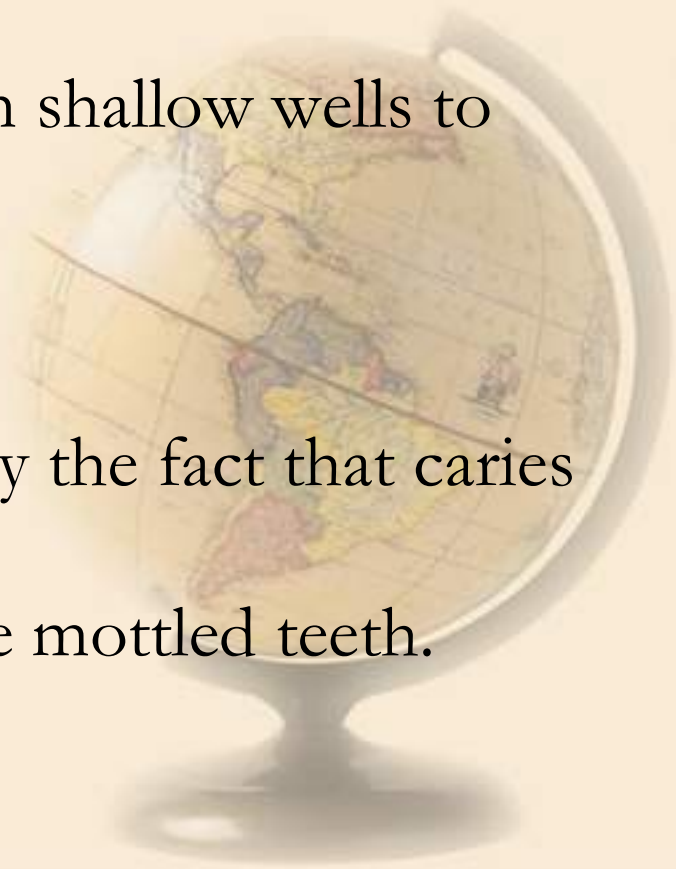


- **Sir** G.V.Black studied histologically these mottled teeth sent by McKay and found them to be hypocalcified.
- 1912 – Mckay found literature – JM Eager – on residents of Naples – Denti di Chiaie

1916 –Mckay and GV Black examined & reported that 85% of people were affected in colorado springs

Britton – water supply changed from shallow wells to Deep wells in 1898

- **Meanwhile,** McKay was struck by the fact that caries experience was not higher in these mottled teeth.



Cause of mottled teeth……?

McKay's observations

- occurrence of mottled enamel was localized in definite geographical areas, both in rich and poor areas.

- high proportion of children were affected; only who had been born and lived all their lives in these endemic areas.

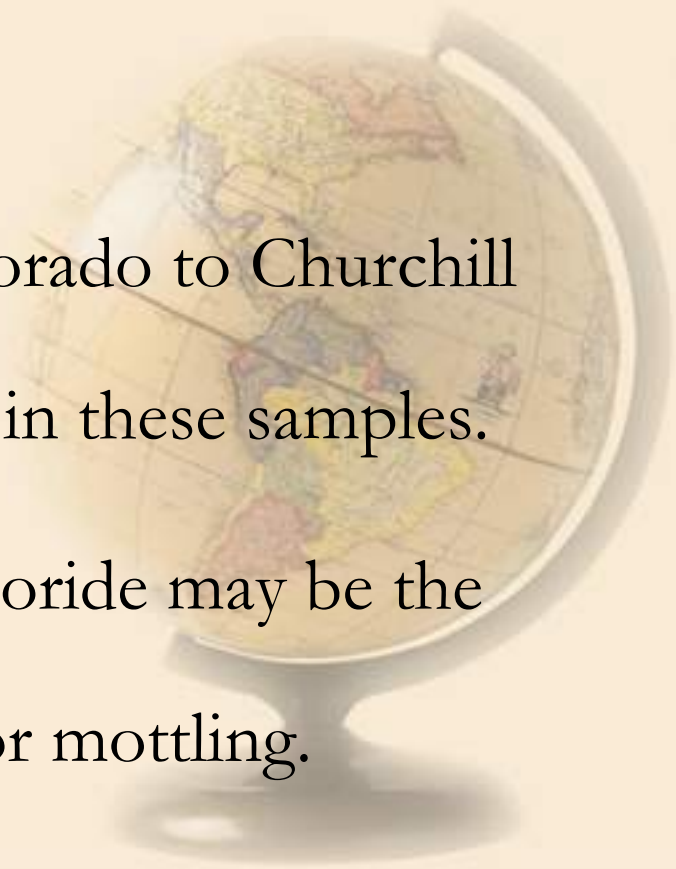
- 3 cities in Arkansas, where mottling occurred received water supply from one source, Fountain Creek.

- **These facts led him to believe that diet or environment was not the cause but something in the water supply might be responsible.**

1931—Mr. H V Churchill a chemist in Aluminum company (ALCOA) found excessive amount of fluoride in water samples from Bauxite ranging 13.7ppm.

Mckay sent water samples from Colorado to Churchill and found the fluoride to be high in these samples.

Thus an evidence was found that fluoride may be the mysterious element responsible for mottling.



SHOE LEATHER SURVEY

- Dr H Trendley Dean, in 1931carried out the famous Shoe Leather Survey which studied the relationship between Fluoride conc. in drinking water , mottled enamel and dental caries
- Surveyed 5824 children from 22 cities of 10 states of USA

- He concluded that water containing

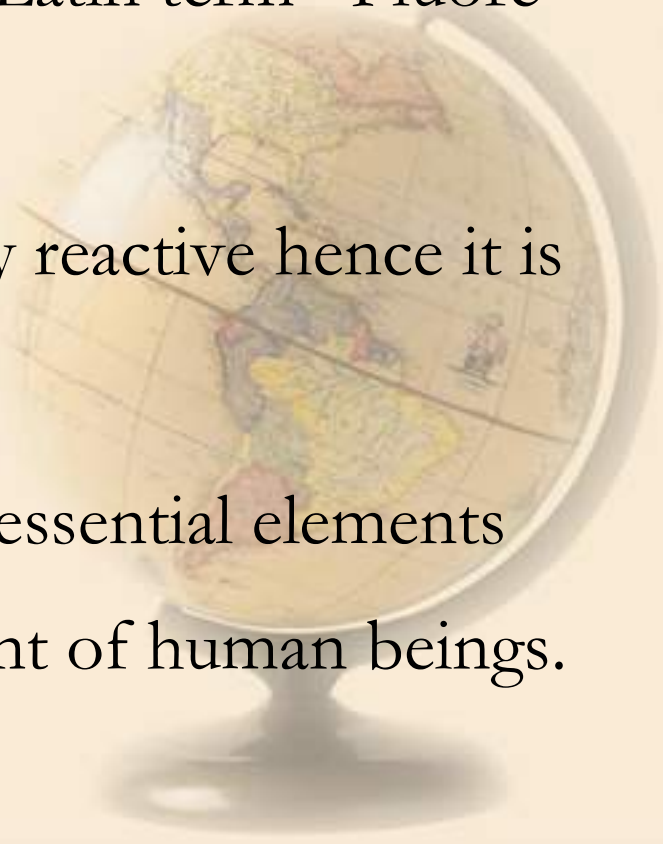
  > 1 ppm of Fluoride - mildest form of mottled enamel

  Higher the conc. - More severe the mottling

But an optimum level of fluoride upto 1ppm showed anticariogenic property without any mottling of teeth.

FLUORINE

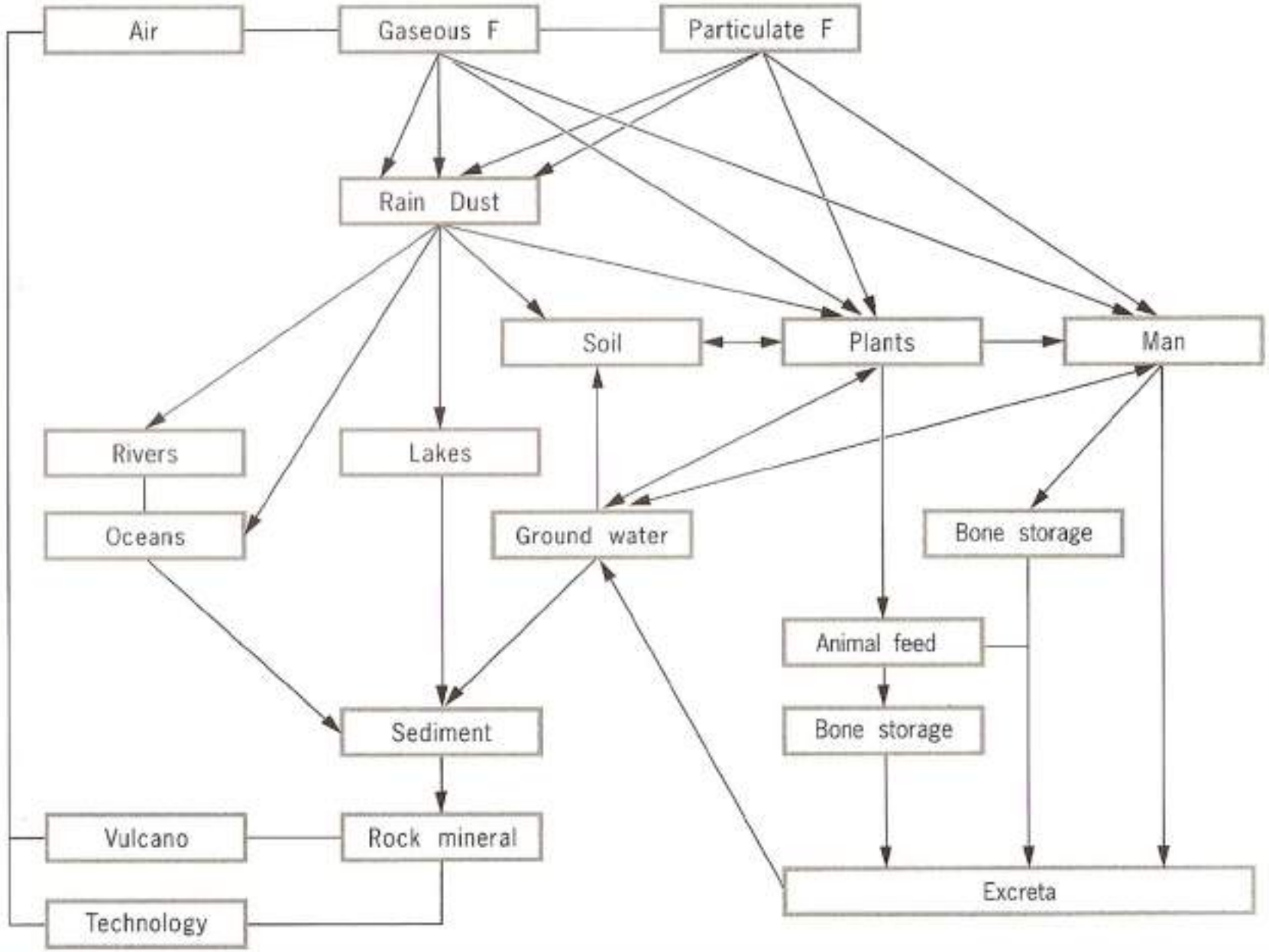
- Member of halogen with atomic weight 19 and atomic no 9
- Word fluorine is derived from the Latin term “Fluore” meaning “to flow”
- Most electronegative and extremely reactive hence it is rarely found in elemental state.
- One among the 14 physiologically essential elements for normal growth and development of human beings.



Source

- Minerals – Fluorspar (CaF_2), Cryolite (Na_3AlF_6),
  Fluorapatite ($Ca_{10}(PO_4)O_6$)

- Food – Dried Mackerel, Salmon fish
  Tea leaves , milk , meat
  Vegetables like cabbages,
  potato and lettuce
  Cereals like Jowar
  Fruits like banana

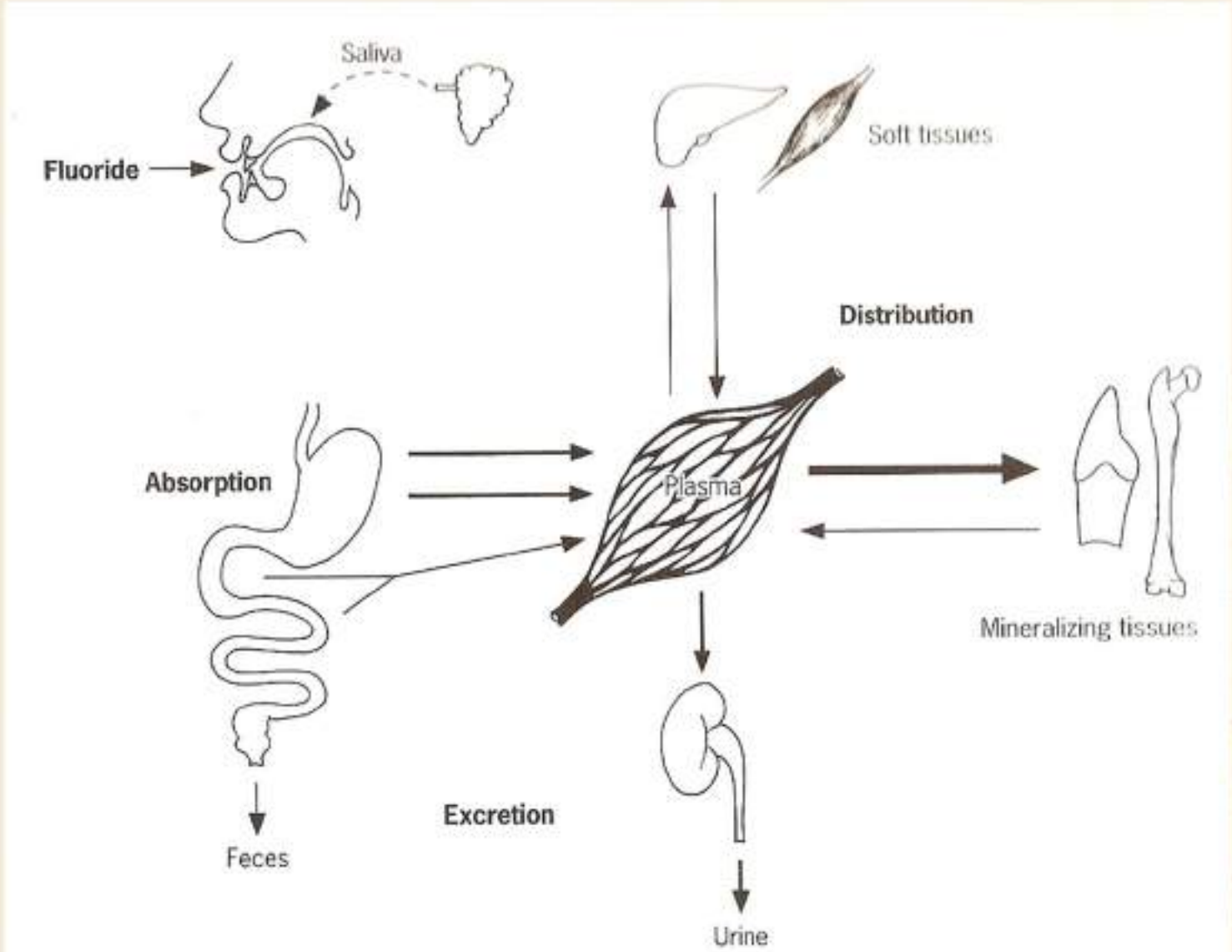

Air
Gaseous F
Particulate F
Rain Dust
Soil
Plants
Man
Rivers
Lakes
Oceans
Ground water
Bone storage
Animal feed
Bone storage
Sediment
Vulcano
Rock mineral
Technology
Excreta

Metabolism

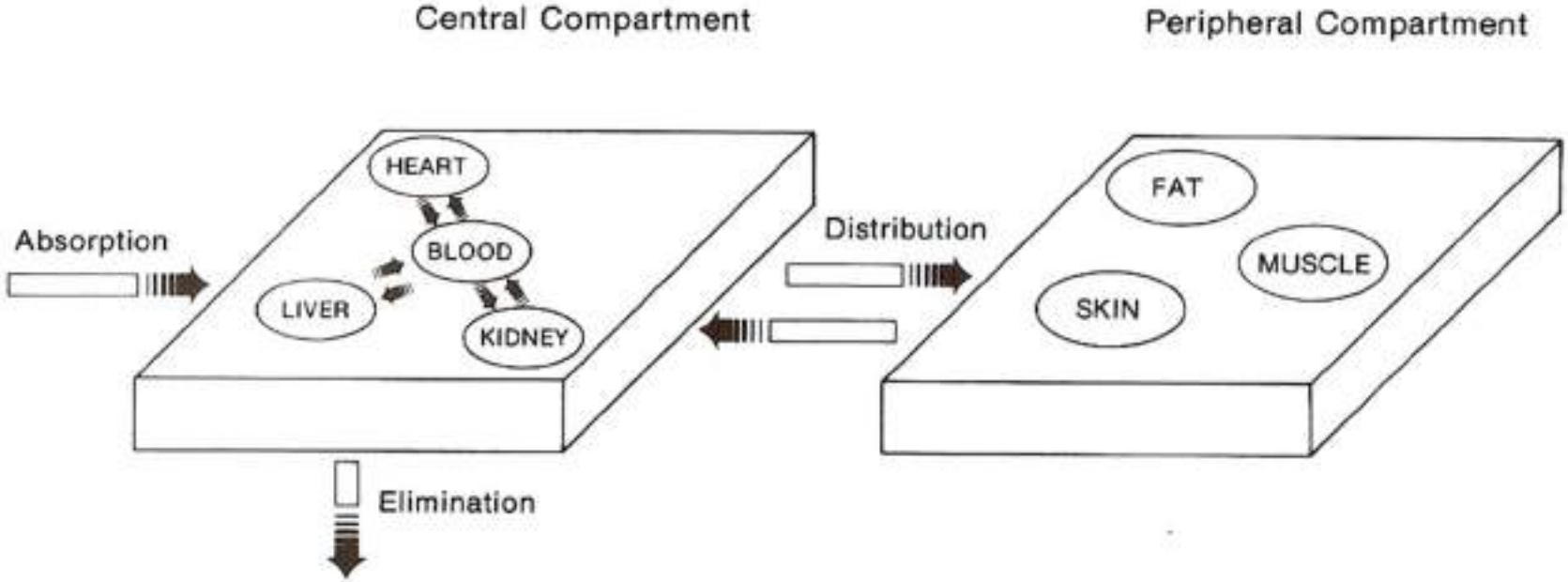
- Absorption – readily absorbed, mainly through stomach, lungs and rarely through skin.

- Excretion – urine, sweat, and faeces traces through milk, saliva, hair, tears

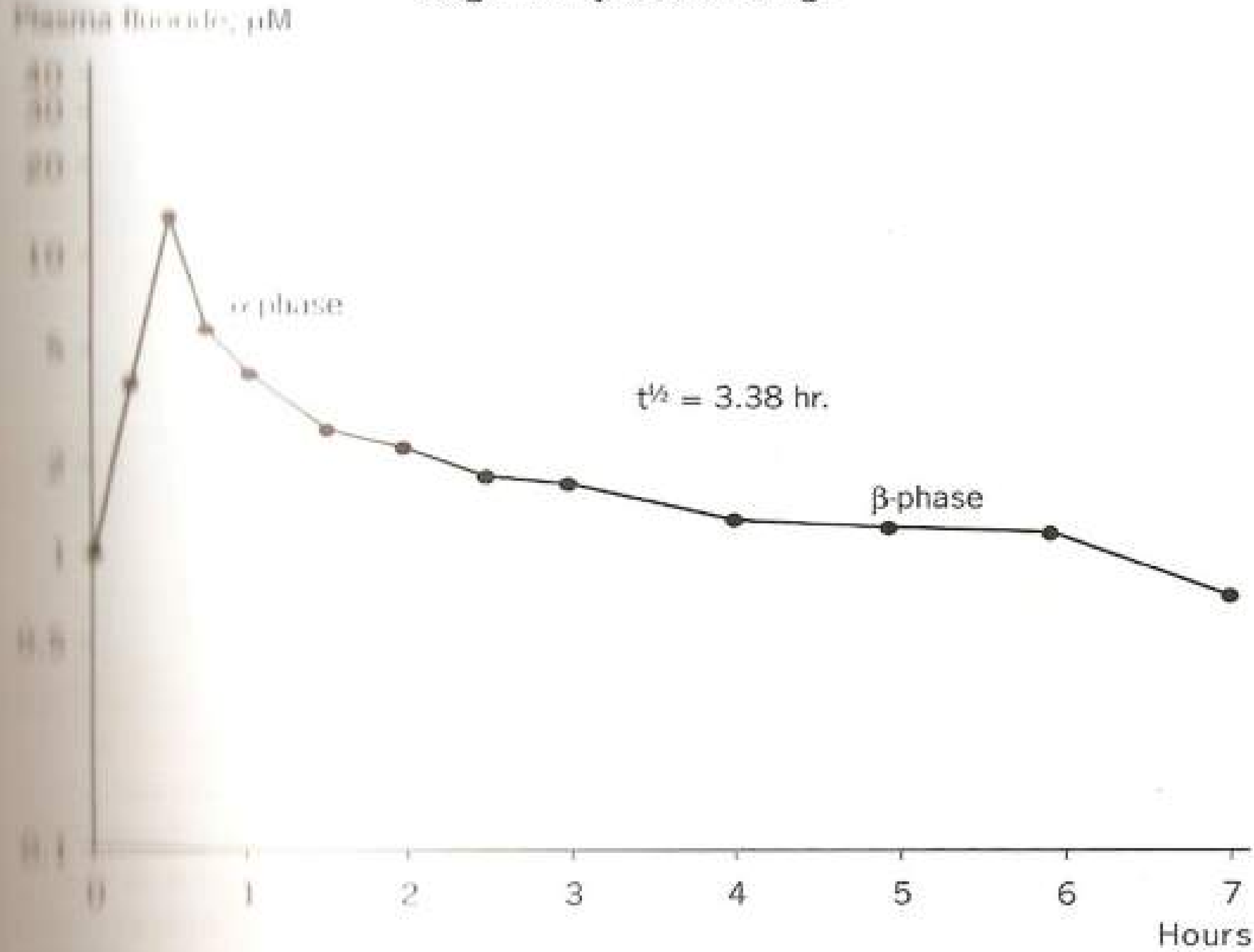
- Storage – Bone and Teeth



4-1. Schematic representation of fluoride metabolism.


Central Compartment
Peripheral Compartment
HEART
BLOOD
LIVER
KIDNEY
FAT
MUSCLE
SKIN
Absorption
Distribution
Elimination

Singel I.V. injection of 3 mg F



Conc. in ppm Vs Effects

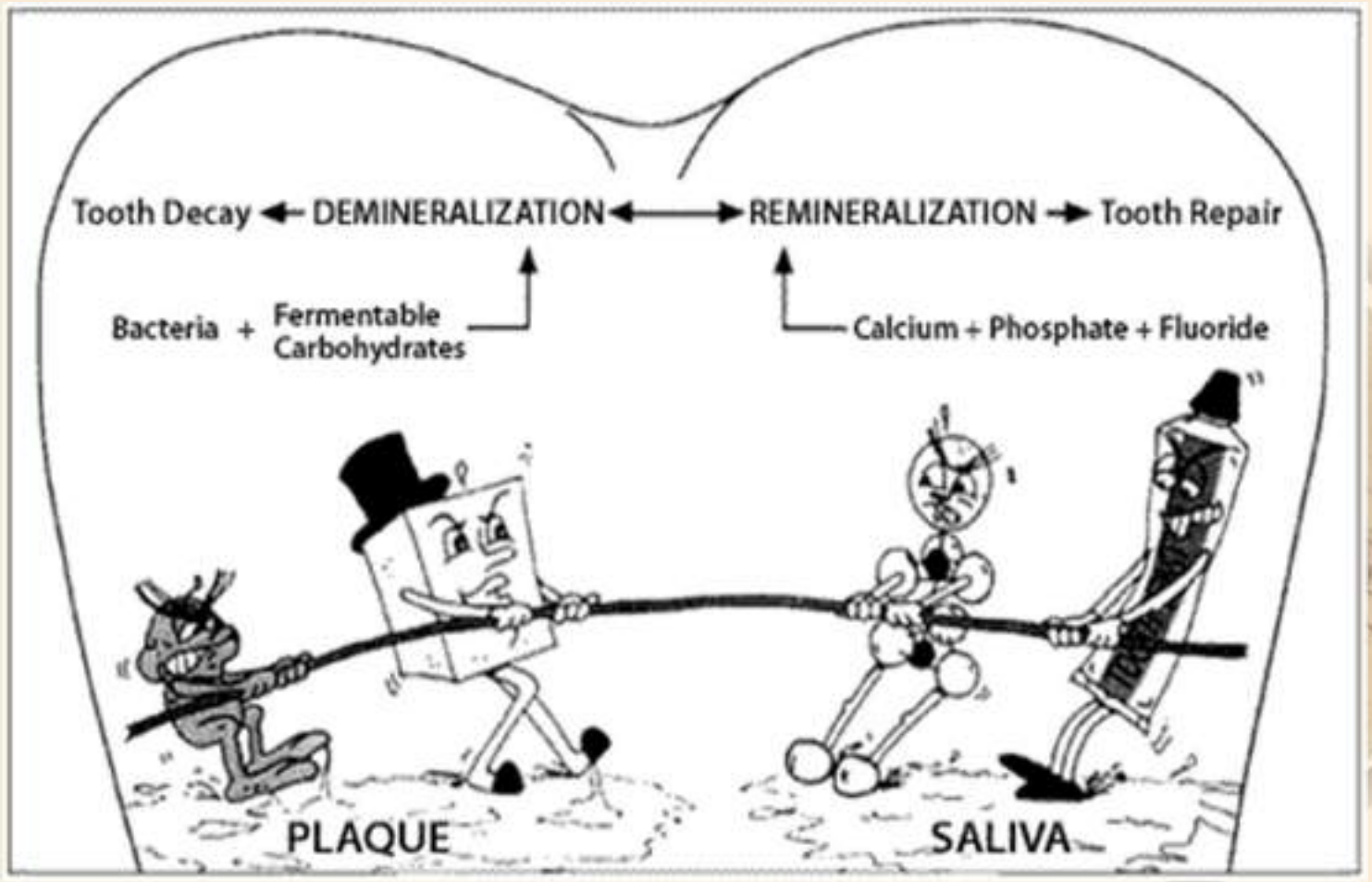
- What is ppm? - 1mg in 1ltr of water.

0.7 -1.2ppm	**Depending upon the temperature of the area**	**Prevents dental caries No dental/ skeletal fluorosis**
1.5 – 3.0 ppm	**Consumed over a period of 5 – 10 yrs or more**	**Dental fluorosis (milder form)**
4.0 – 8.0 ppm	**Consumed over a period of 15 – 20 yrs**	**Dental fluorosis (severe form) Skeletal fluorosis (milder form)**
> 8.0 ppm	**Consumed over a period of 5 – 10 yrs or more**	**Dental fluorosis (severe form) Skeletal fluorosis (severe form)**

Mechanism of action of Fluoride

- Replaces the missing hydroxyl ion and makes the enamel resistant for the acid dissolution – hydroxyapatite crystals
- Antibacterial action – reduces acid production by reducing enzyme enolase production
- Anti-adsorption properties – reduces plaque formation
- Alters the tooth morphology – widens the fissures & increases the intercuspal distance

Opposing factors at WAR….!

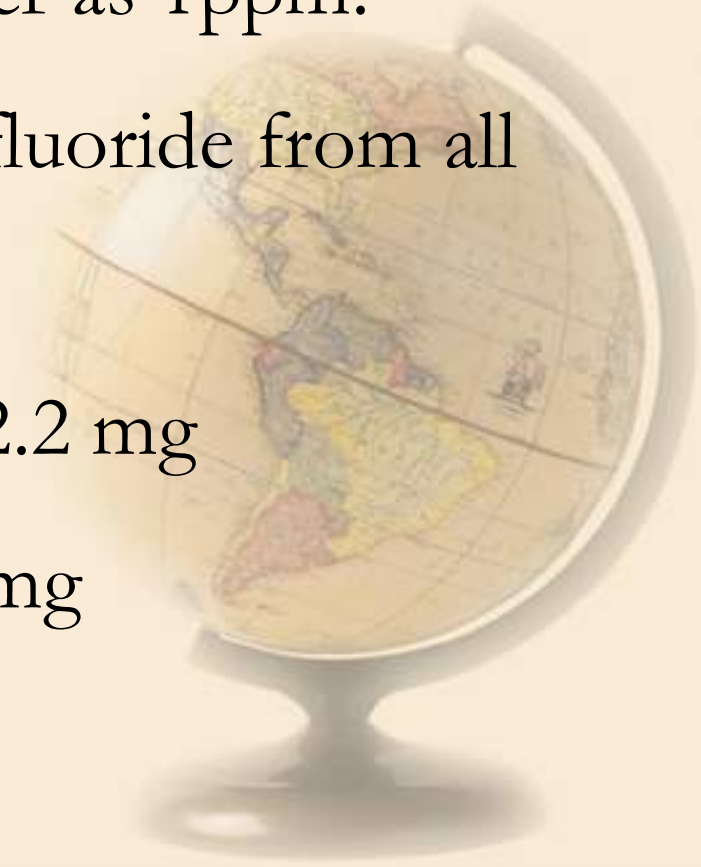


Safety aspects of fluoride in caries prevention

- W.H.O. 1963 recommended optimum levels of fluorides for drinking water as 1ppm.
- The average daily intake of fluoride from all sources for

adults ------- 2 – 2.2 mg

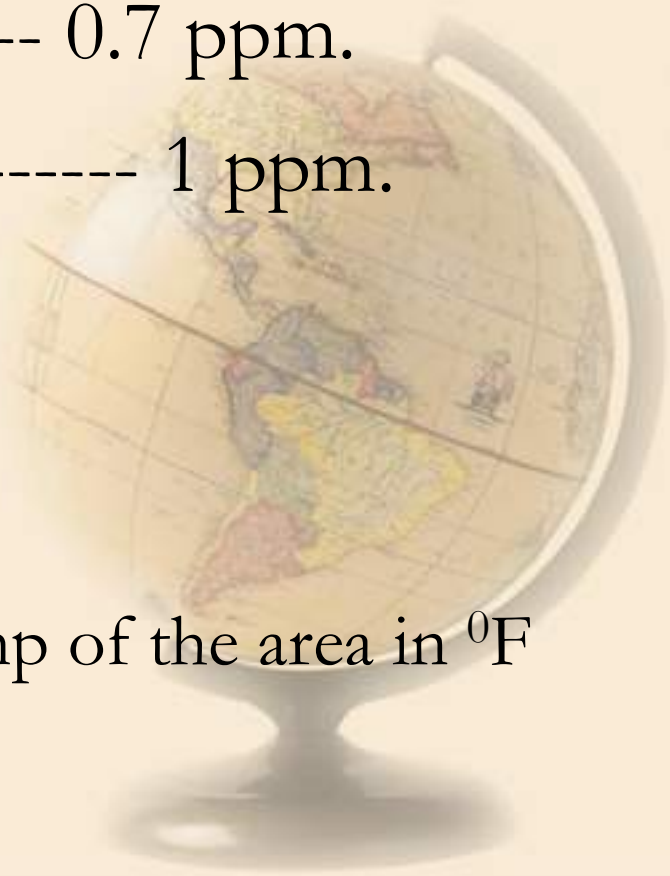
children ------- 1.2 mg



Optimum fluoride levels

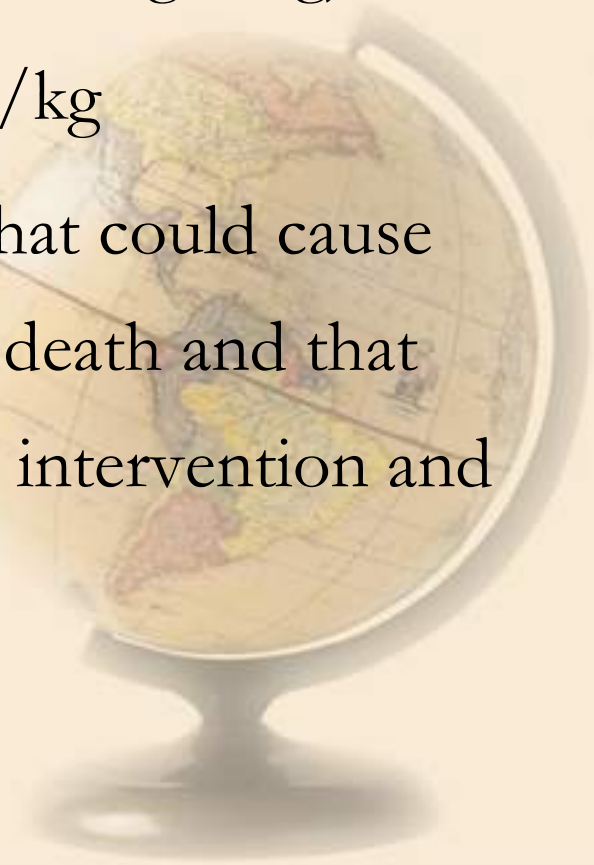
- In cold climate, recommended fluoride levels ----1.2 ppm
- In extremely hot climate, -------- 0.7 ppm.
- In moderate climate, ---------- 1 ppm.
- Galagan's formula
  - ppm F = 0.34 / E

Where E = -0.038 + 0.0062 X temp of the area in ^{0}F



Toxicity of fluoride

- Certainly lethal dose (CLD):70kgs → 5-10g(32-64mgF/kg)
- Possible toxic dose (PTD) : 5mgF/kg
- PTD is defined as "minimum dose that could cause toxic signs and symptoms, including death and that should trigger immediate therapeutic intervention and hospitalization"



Routes of administration of fluorides

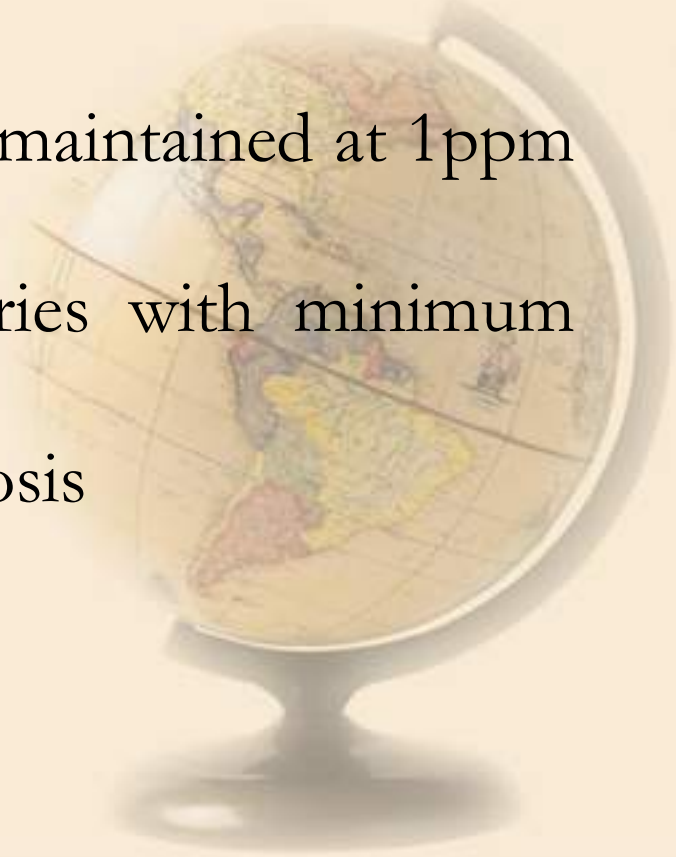
- **Systemic**
  - Water fluoridation
  - Salt fluoridation
  - Milk fluoridation
  - Fluoride tablets
  - Fluoride drops

Topical

- Sodium fluoride
- Stannous fluoride
- Acidulated phosphate fluoride
- Fluoride varnish
- Fluoride dentifrices
- Fluoride mouth rinses

Water fluoridation

- Upward adjustment of fluoride ion conc in public water supply in such a way that the conc of fluoride ion in water may be consistently maintained at 1ppm by weight to prevent dental caries with minimum possibility of causing dental fluorosis



Controlled water fluoridation studies

- *Jan 25 1945*

  Grands Rapid (Michigan) Vs Muskegon

  Arnold .et.al (1953) – caries in 6 yr children

  - (after 6 ½ y) GR = ½ Muskegon

- *May 2 1945*

  Newburg (Newyork) Vs Kingston

  Ast et al (1956)

  - (after 10y) – 23.5 – 13.9% ↓

- *June 1945*

  Brantford (Ontario –Canada) Vs Sarnia

  Stratford – auxiliary control (1.3ppm)

  Brown & Poplove 1965 (after 17y) – 55% reduction in Ontario compared to Sarnia but similar to Stratford

- *Jan 1946*

  Evanston (Illinois) Vs Oak park

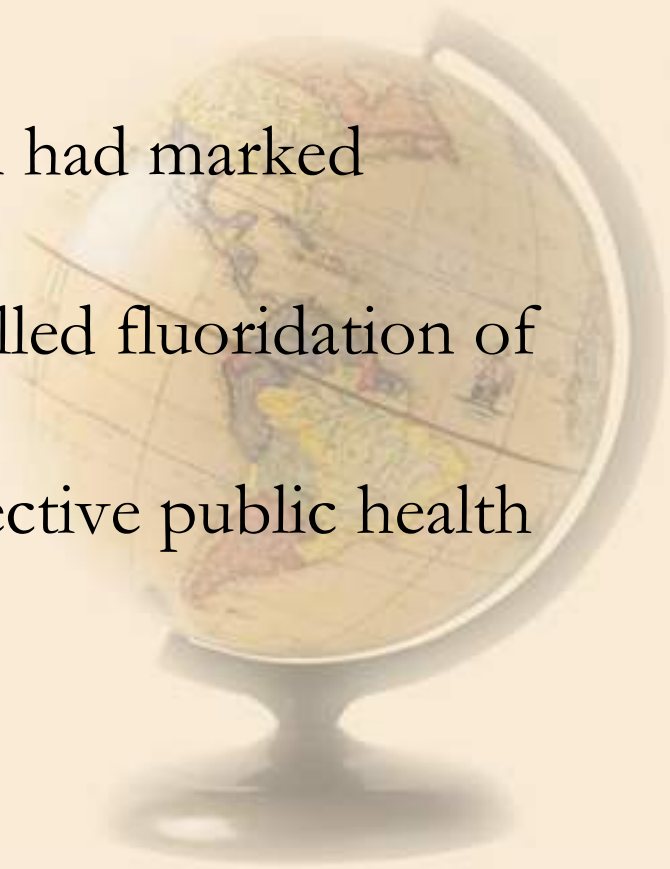
  after 14y – 49% reduction in caries was seen

- *March 1953*

  Tiel (Netherlands) Vs Culemburg

  after 13y – 58% reduction

- *In 1958* – WHO – 1st report – 1ppm had marked preventive effect on caries & controlled fluoridation of drinking water was a practical & effective public health measure



Method of estimation of fluoride concentration in drinking water

- Sample collection

  - 500ml from the source
  - If storing→2cc 6N HCl →2.0PH
  - Determined before 2-3 months

Methods

1. Fluoride electrode coupled with standard PH meter

   - typical calibration curve

   - by applying electrode potential difference equation

   - direct PPM reading

2. Scot sanchis method

   – Zirconium alizarine (colorless)

↓

ZrF6 + alizarine sulfuric acid (yellow)

Fluoride compounds used in water fluoridation

(a) Fluorspar – (mineral containing varying amount of CaF_2)

(b) Sodium fluoride

(c) Silicofluoride

(d) Sodium silicofluoride

(e) Hydrofluorosilicic acid

(f) Ammonium silicofluoride

Types of equipment for water fluoridation

- **Saturator system:-**
  - 4% saturated solution of NaF

Limitations –

- high hard water level
- need to clean the gravel bed used for filtration

recomm – Small towns (< 3.8 million ltrs /day)

- **<u>Dry feeder :-</u>**
  - NaF / silicofluoride powder

Limitations –

- obstruction of pipes
- compacting of F while stocked in humid atmosphere

Recomm – medium sized town (3.8-19 millions ltrs /day)

- **Solution feeder:-**
  - Hydrofluorosilicic acid using volumetric pump

Limitations –

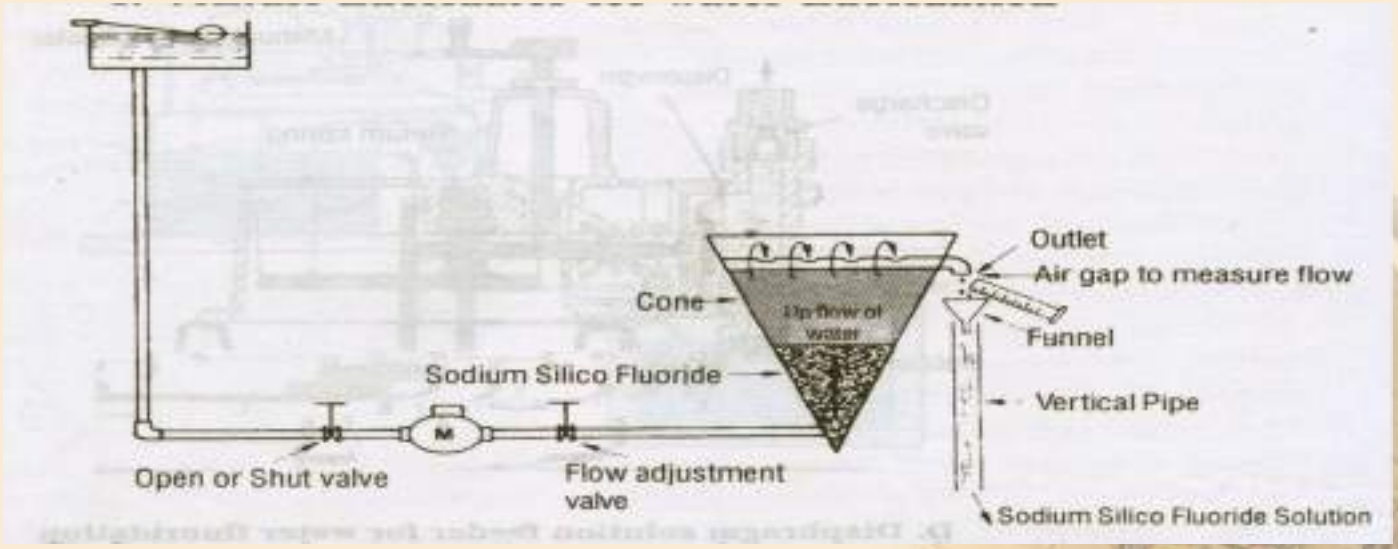
- equipment must be resistant to HF acid
- imprecision in determining the volume used for small quantities

Recomm – medium sized & large towns (>7.6 million ltrs/ day)

- **<u>Venturi fluoridation system</u> :-**
  - non electric system – J.N. Leo
  - activated by flow of water in main water lines
  - tank is made of plexiglass for visualization of chemical level
  - cost is 2/3 of the conventional equipment & easy to install

- **<u>Saturation – suspension cone</u>:-**

  Brazil – state of Rio Grande do sul



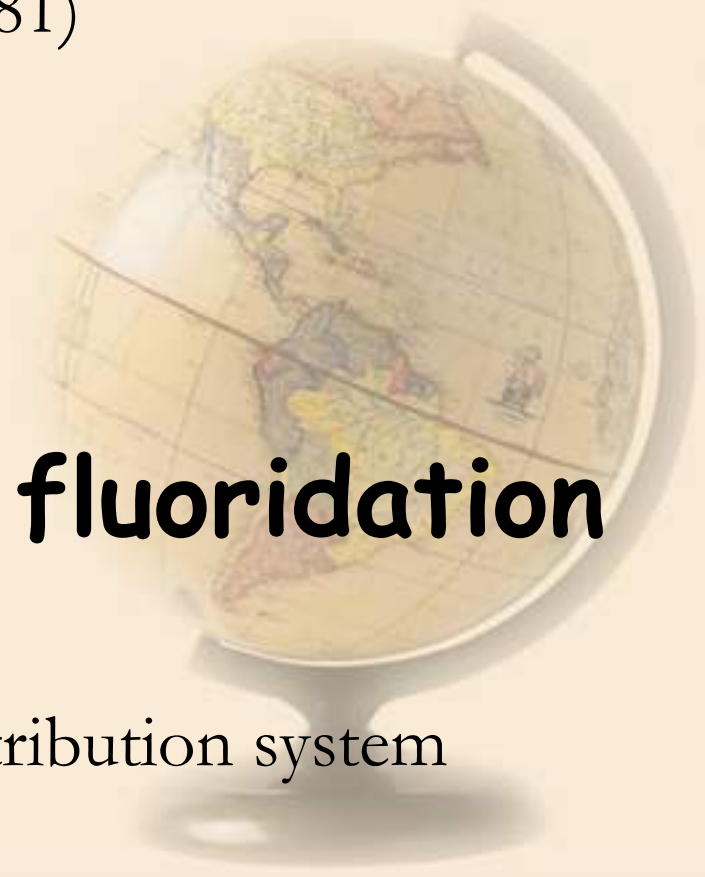
  – consists of upside down cone charged with a bag of sodium silicofluoride thro which a constant flow of water percolates
  – cone must of corrosion resistant material

Pre requisites for water fluoridation

- Presence of high caries in the community
- Fluoride level in drinking water – LOW
- Centralized water supply to the community
- Community acceptance or approval
- Installation and maintenance cost

Cost of water fluoridation

- In Hong Kong – annual cost of lab equipments – 7000 $/yr
  - 11% of total cost of chemicals – $ 0.002 /person /yr
- In USA, Us public health service (1981)
  - US $ 0.35 /person /yr
- In India , Rs 0.25/person /yr



Limitation of water fluoridation

- Requires centralized pipe water distribution system

Legal aspects of water fluoridation in a community

- Mandatory laws :-
  - Requires a ministry of health or communities of certain size to fluoridate their public water
  - Enacted in Brazil, Bulgaria, Greece, Ireland & six states of USA and Washington DC
- Permissive or enabling legislation
  - Empowers the ministry of health or a local Govt to institute fluoridation
  - In Australia, German democ repb & Israel - health officials
  - In USA => state commissioner of public health
  - In Federal Republic of Germany => Federal Govt (under foods stuff & consumer goods law-1974)

School water fluoridation

- Alternate to community water fluoridation
- Recommended fluoride level in school water – 4.5 -6.3 ppm F
- Effectiveness – 40-50% reduction of DMFT at 5ppm F
- Heifetz et al (1983) => 47% reduction with 6.3ppm compared to a control group
- 1st investigation – 1954 in Virgin islands => not satisfactory

- 1965 – Horowitz et al => 22% less DMFT in fluoridated school compared to other school
- 3 major studies – in Mainland, USA

Pike county, Kentucky
Elk lake, Pennsylvania
} 1958 → Horowitz 1968
33% 35% ↓ after 8 yrs

Seagrove, North Carolina → 1968 → Heifetz et al in 1978
–none of them developed fluorosis
after exposing to 6.3ppm F for 8 yrs

Milk fluoridation

- Liquid (pasteurized or sterilized)
- Powder (containing variety of F agents)

- Compounds used – NaF, CaF, Disodium monofluorophosphate & Disodium silicofluoride
- Efficiency – moderate caries preventive 40-50% reduction with 5-15ppm F
- Reported that fluoridated milk keeps a permanently low level of ionized F with in the oral cavity promoting remineralization

Salt fluoridation

- Switzerland since 1955; Wespi (1961) – 1st to promote the use of table salt as vehicle of fluoride
- By 1967 – ¾ of domestic salts in Switzerland - 90mg F / kg salt
- Recently – raised to 200, 250 and 350 mg F /kg salt
- Toth – 39% reduction in deft in 6yrs old Hungarian children with 250mgF/kg salt for 8 yrs compared to control group (7% ↑)
- Columbia, Hungary, Mexico & Switzerland

- Advantages
  - Holds good in developing countries in India where centralized water supply is not present
  - Permits individuals to accept or reject it
  - Inexpensive
- Disadvantages
  - F salt consumption is lowest when need for fluoride is more (early years of life)
  - Current view is that salt → Hypertension

Fluoride supplements

Tablets
Lozenges
Drops

→ NaF
→ APF

Tablets – available in dose of –

NaF →
- 2.2mg(1mgF)
- 1.1mg(0.5mgF)
- 0.55mg(0.25mgF)

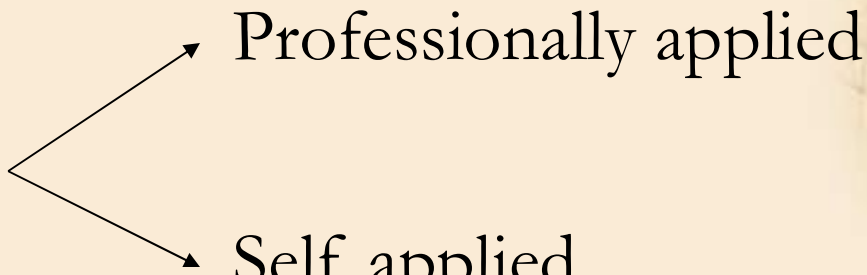
Drops – 10 drops => 1mg F

Dosage acc to F conc of drinking water (Am acd of Peadrt)

Age	< 0.3	0.3-0.7	>0.7
Birth – 2yrs	0.25	0	0
2-3yrs	0.5	0.25	0
3-14yrs	1.0	0.5	0

Topical fluorides

- Are delivery systems which provide fluoride for local chemical reaction to exposed surfaces of erupted dentition



Professionally applied

Self applied

Professionally applied Topical Fluorides

- Bibby in 1942 – repeated application of sodium & potassium fluoride reduces caries

NaF
APF
SnF2

-Aqueous solution
-Gel
-Prophylaxis paste
-Dental varnish

Comparison of Topical Fluoride agents

	NaF	SnF2	APF
Percent F	2%	8%	1.23%
ppm F	9,200	19,500	12,300
Frequency of application	4 weekly intervals at 3,7,11,&13yrs	1or 2/yr	1 or 2/yr
Taste	Bland	Disagreeable	Acidic
Stability	Stable	Unstable	Stable in plastic container
Tooth pigmentation	No	Yes	No
Gingival irritation	No	Occasional transient	No
Average effectiveness	29%	30%	28%

- Methods of application of topical F
  - Paint on technique
  - Tray technique
- Technique of topical F application

1) **Knutson's technique :-**

After prophylaxis → Thoroughly wetted with soln → Allowed to dry for 3-4 min → Three further applications With one week intervals

Recommended ages – 3,7,11 &13yrs

2) Muhler's single application technique

Through prophylaxis Including stripping of inter proximal surfaces → Teeth isolated & dried with Air

Kept moist with soln for 4min → Repeat application every 6 months

3) Mercer & Muhler technique

Same as Muhler's method except that teeth is kept moist for 30 sec instead of 4min

4) Dubbing & Muhler technique

Prophylaxis with SnF2 paste
(10 sec for each surface)
(unwaxed floss - interproximally)

+

4 min application of
standard Fluoride soln

5) Englader technique

-Soln or gel is applied in special maxillary & mandibular mouth pieces made of PVC

- Application time – 3min ; 3 times a week in schools

6) Szwejda – Knutson multiple chair technique

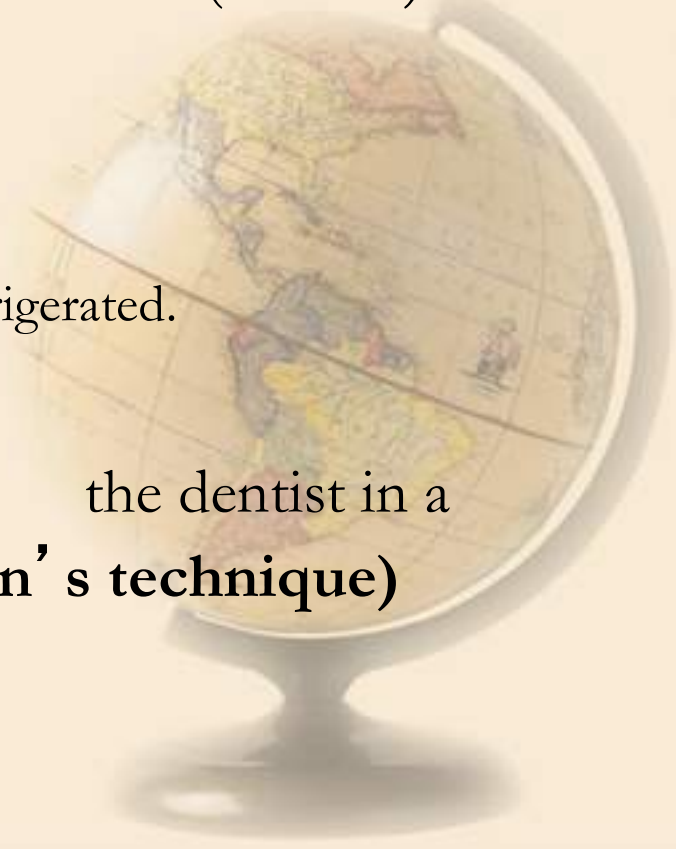
Same as Knutson's method , bit time taken per child is greatly reduced by using several chairs

NaF -

Method of preparation

- Available both in powder and liquid form. The compound recommended for use is 2% solution
- Dissolving 20grms NaF powder in one litre (1000ml) distilled water in a plastic bottle

- **Advantages –**
  1) Acceptable taste.
  2) Stable if stored in plastic container and refrigerated.
- **Diadvantages**
- Procedure requires FOUR visits to the dentist in a relatively short period of time **(Knutson's technique)**



- **Mechanism of action of NaF:**

  Sodium fluoride combines with hydroxy appatite to from calcium fluoride

  ↓

  chocking off

  ↓

  calcium fluoride then in turn reacts with hydroxy appatite crystals to form fluoridated hydroxy apatite

SnF2 -

- **Method of preparation**
  - Not stable – becomes cloudy – Tin hydroxide
  - Muhler et al - recommended fresh soln of SnF2 be prepared for each pt
  - 0.8 grms (1 capsule) dissolved in 10ml distilled water in plastic container
- **Advantages**

1) Procedure frequency complies with 6 months recall appointment schedule

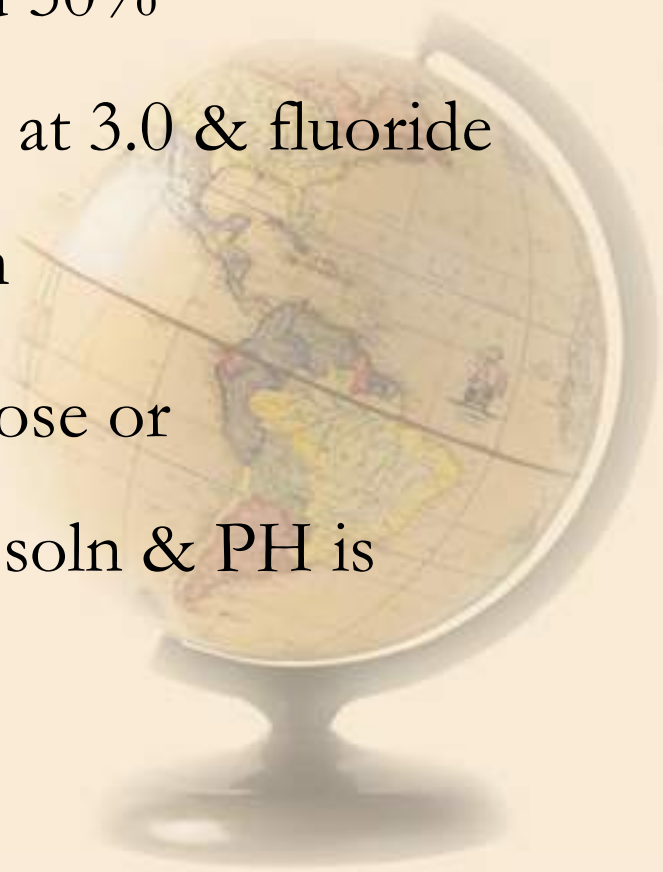
- **Disadvantages**
  - Bitter metallic taste
  - Need to be freshly prepared for each application.
  - Not stable in solution
  - May cause reversible tissue irritations
  - Staining at margins of restorations
- **Mechanism of action of SnF_2:**
  - Four compound are formed
    - Tin hydroxy phosphate
    - Stannous trifluorophosphate
    - Calcium trifluorostanate
    - Calcium flouride

APF -

- **APF** – 1960 – Brudevold (at Forsyth dental center)

  – Dissolving 20 grms of NaF in 1 ltrs of 0.1M Phosphoric acid & to this is added 50% hydrofluoric acid to adjust the PH at 3.0 & fluoride conc to 1.23% => Brudevold soln

  – Gel – gelling agent – methyl cellulose or hydroxyethyl cellulose is added to soln & PH is adjusted b/n 4-5



- **Advantages of APF**

1) Acceptable taste
2) Stable if stored in Plastic container
3) Procedure frequency complies with 6 months recall appointment schedule

- **Disadvantages of APF**

– Increased chair time and use of suction
– Acidic – sour / bitter in taste
– Cannot be stored in glass container
– Repeated or prolonged exposure may lead to loss of material from porcelain and composite restorations.

- Mechanism of action of APF
  - Dehydration and shrinkage of apatite crystals
  - Formation of DCPD (Dicalcium phosphate Dihydrate)
  - DCPD is later converted into flourapatite.
  - The thickness of flourapatite formation will be more because of shrinkage

Fluoride varnishes

1) Duraphat :

- 1st Fluoride varnish in Germany
- Viscous yellow material containing 22600ppmF as NaF in a neutral colophonium base (NaF varnish containing 2.26% F in organic lacquer)

2) Fluorprotector

Clear polyurethane based product containing 7000 ppm F from an organic compound difluorosilane (silane fluoride with 0.7% F in a polyurethane based lacquer)

3) Carex

Contains lower fluoride conc than Duraphat (1.8% F)

Effectiveness :- Duraphat → Permanent → 30-40%

Primary → 7-44%

Fluorprotector → 1-7%

Carex → equivalent to Duraphat

Recommended application – Biannually

Technique

Oral prophylaxis

↓

Teeth are dried but not isolated with cotton rolls

↓

0.3-0.5 ml (6.9-11.5 mgF)

↓

Application is done on lower arch & then on upper arch

↓

Asked to keep mouth open for 4 min

↓

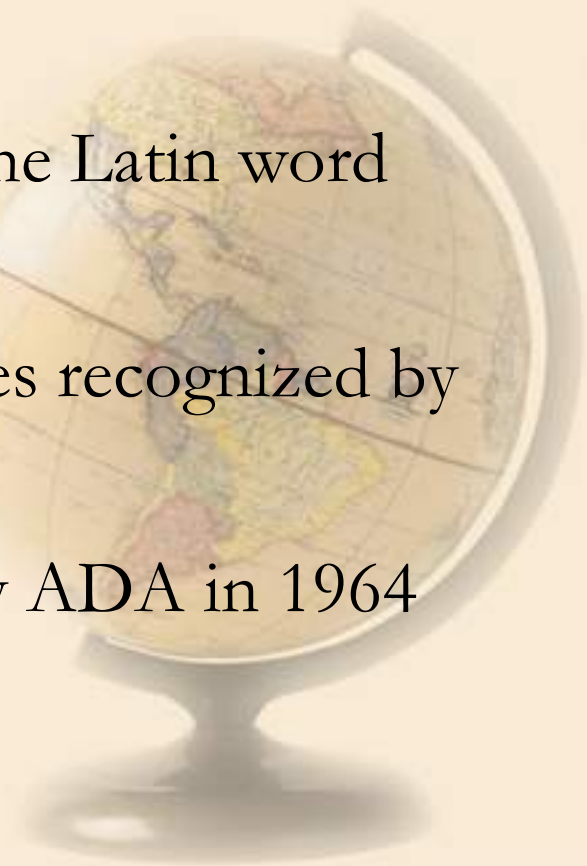
Pt asked not to eat or drink for 1hr & not to eat hard food till next day

Self applied topical F

- Dentifrices
- Gels
- Mouth rinses

F Dentifrices –

- The term 'dentifrice' derived from the Latin word 'dens' = tooth ; 'fricare' = to rub
- 1955 – SnF2 dentifrices – 1st dentifrices recognized by food & drug administration (FDA)
- 1st fluoride dentifrices was accepted by ADA in 1964



- Types of fluoride dentifrices
  1) NaF dentifrices
  2) SnF2 dentifrices
  3) Monofluorophosphate dentifrices
  4) Amine fluoride dentifrices
  5) Hexafluoro zirconate dentifrices

- Monofluorophosphate dentifrices
  - 1981 – most widely used agent in the world
  - Produced during 1940's in the research laboratories of Ozark Mahoning company in Tulsa, Okalahoma
  - Composed of one atom of phosphorus, 3 atoms of O2 & 1 atom of F
- Recommendation for F dentifrices use

Below 4 yrs	F toothpaste is not recommended
4-6 yrs	Brushing once daily with F paste & twice with out F paste
6-10 yrs	Brushing twice daily with F paste & once with out F paste
Above 10 yrs	Brushing twice daily with F paste

- **Fluoride mouth rinses**
  - Bibby et al in 1946
  - In mid 1960's – scandinavial researches – showed that biweekly rinse for 1 min with 0.2% NaF (1900 ppmF) was effective in reducing caries
  - Furthermore – daily – 0.05% NaF (230 ppmF) – gave – more caries protection
  - Effectiveness – 20-50% reduction

- Composition & usage

Source	F%	F ppm	Recommended usage
NaF	0.2	900	Weekly
NaF	0.02	100	Twice daily
NaF	0.05	225	Daily
APF	0.02	200	Daily
SnF2	0.1	243	Daily

Fluoride Dentifrices containing Anticalculus agent

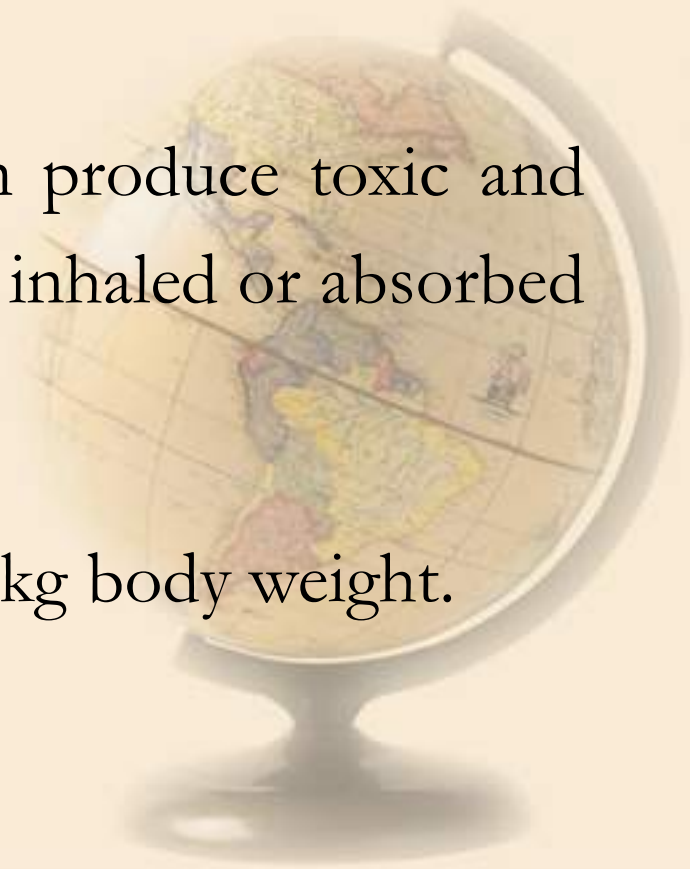
-Pyrophosphates – prevents calcification of calculus by interfering with calcium & phosphate precipitation from saliva

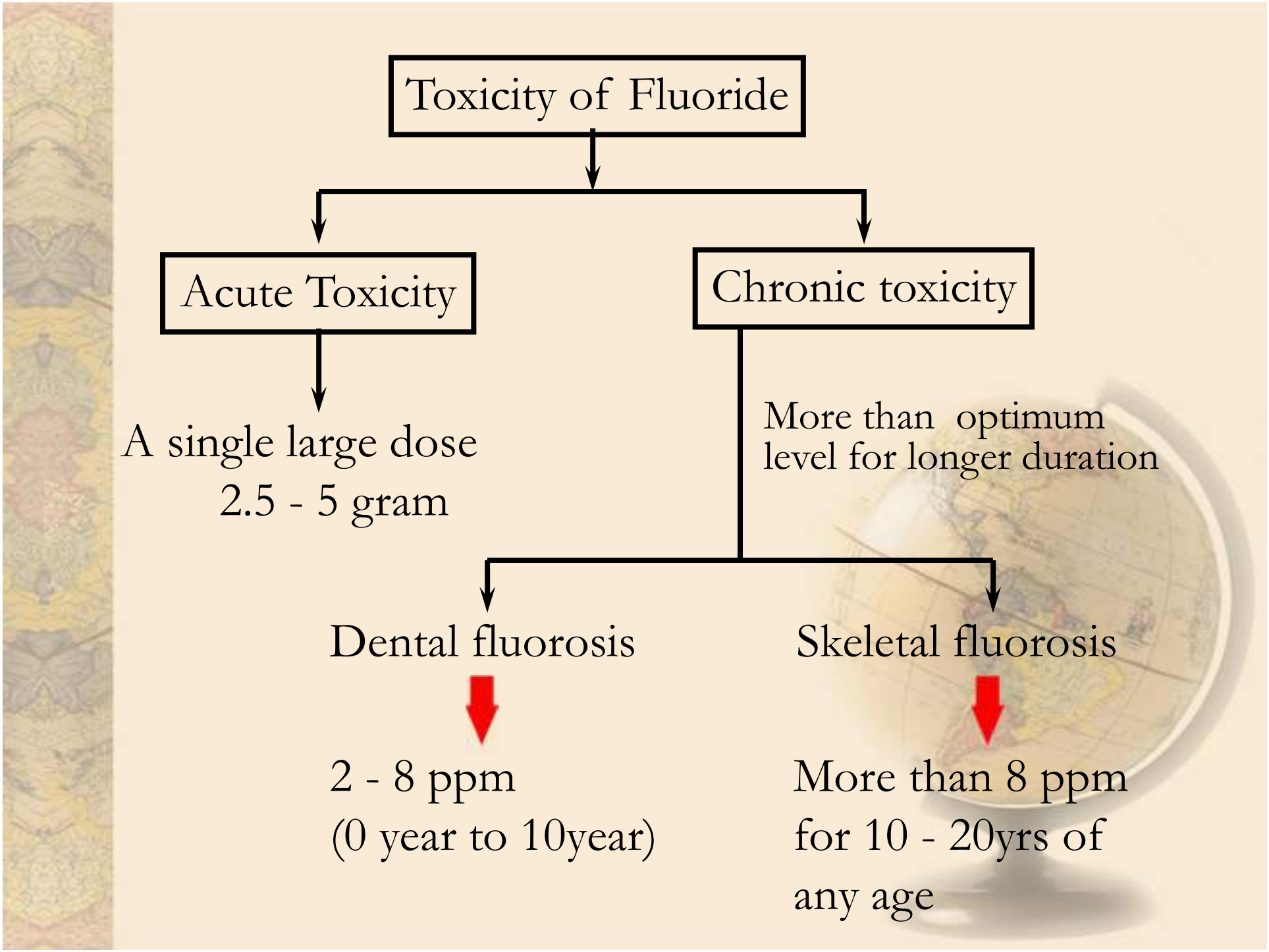
Toxicity of Fluorides

Fluorides are extensively used in the practice of Dentistry to reduce the incidence of Dental caries.

Used in excessive quantities, F. can produce toxic and even lethal outcome when ingested, inhaled or absorbed in to the body.

Probable toxic dose (PTD) is 5mg/kg body weight.




Toxicity of Fluoride
Acute Toxicity
Chronic toxicity
A single large dose
2.5 - 5 gram
More than optimum
level for longer duration
Dental fluorosis
Skeletal fluorosis
2 - 8 ppm
(0 year to 10year)
More than 8 ppm
for 10 - 20yrs of
any age

Symptoms of Fluoride Toxicity

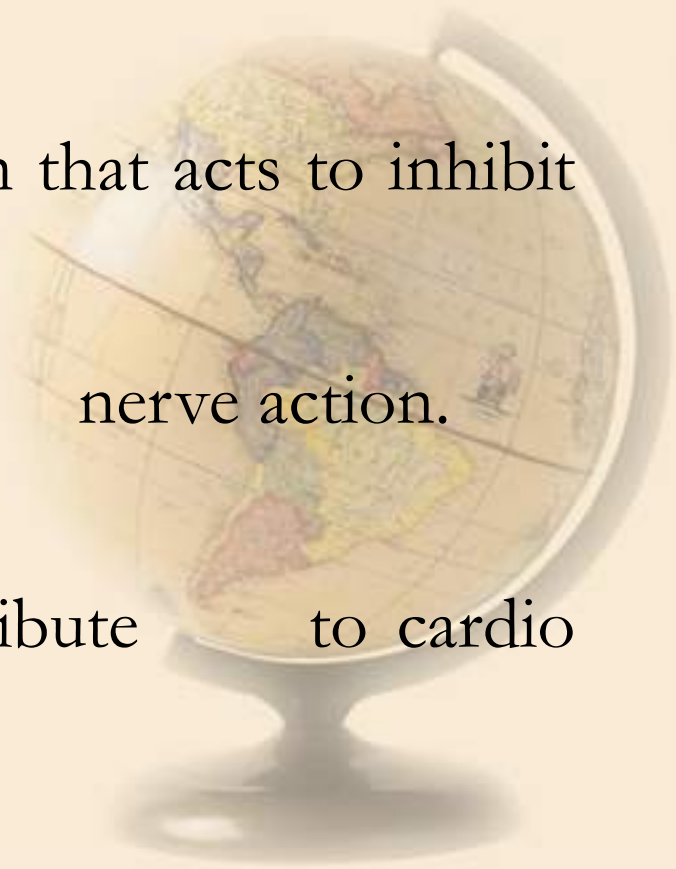
Fluoride acts in Four general ways

1) When F. Salts contact with moist skin or mucous membrane, Hydrofluoric acid forms cause chemical burn.

2) It is generally protoplasmic poison that acts to inhibit enzyme system.

3) It binds calcium that is needed for nerve action.

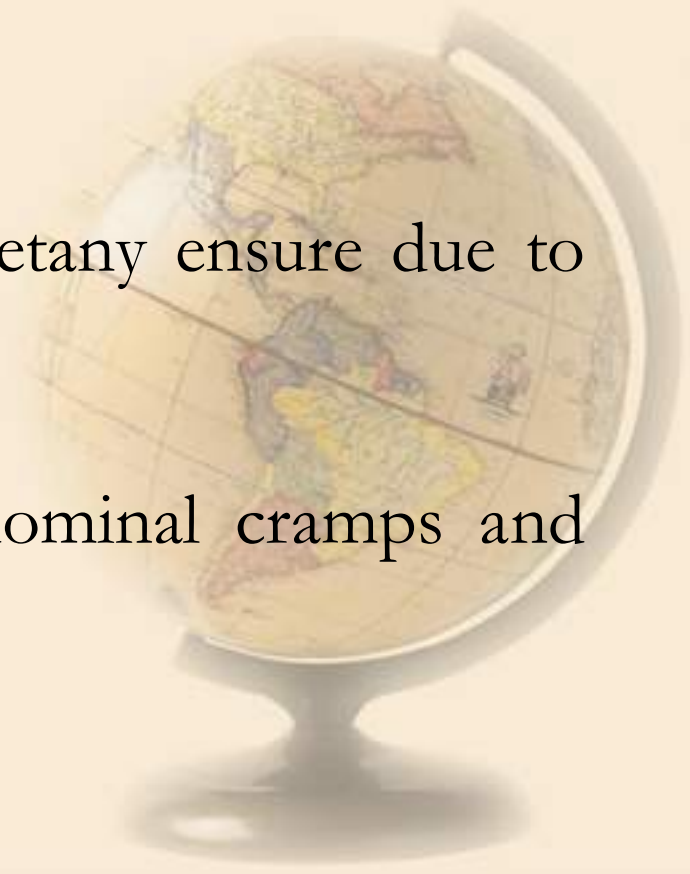
4) A hyperkalemia occurs that contribute to cardio toxicity.



Following ingestion of Fluoride, nausea and vomiting can occur. It is due to Production of Hydrofluoric acid in the acid environment of stomach, causes irritation of the stomach wall.

Local or general signs of muscle tetany ensure due to the drop of blood calcium.

This can be accompanied by abdominal cramps and pain.



Finally, hypocalcemia and hyperkalemia intensity results in either coma, convulsions or cardiac arrhythmia's.

Treatment of F. Toxicity

Immediate treatment – aimed at reducing amount of F- available for absorption from GI tract – induce vomiting

↓

Protection of stomach by binding F with orally Administration of 1% calcium chloride or calcium gluconate / Milk.

↓

Transport to the hospital at earliest possible time

↓

Fluid replacement to maintain urinary flow rate.

↓

Maintenance of blood calcium level with I.V. Calcium.

FLUOROSIS

A non-reversible, incurable disease weakening skeletal structures caused by high level of fluorides in water.

- skeletal fluorosis
- Dental fluorosis

Skeletal Fluorosis

- A water fluoride level over 8ppm
- Characterized by
  - Increased x-ray density of trabecular bone (spine, pelvis)
  - Increased thickness of long bone cortices due to endosteal and periosteal apposition
- In more advanced cases
  - Calcification of ligaments → Ankylosing spondylitis

Skeletal Fluorosis..

- Other effects are-
  - Gastric complaints
  - Osteo sclerosis
  - Exostosis of long bones, vertebrae, jaw bones, & other flat bones.

Misdiagnosed as Rheumatoid or Osteo Arthritis

Skeletal Fluorosis..

Early cases— vague pain in small joints, knee and joints of spine

Later cases--- stiffness of spine & limitation of movement

Advanced cases---KYPHOSIS— difficulty in walking partly due to stiffness & partly due to neurological lesions

Dental Fluorosis

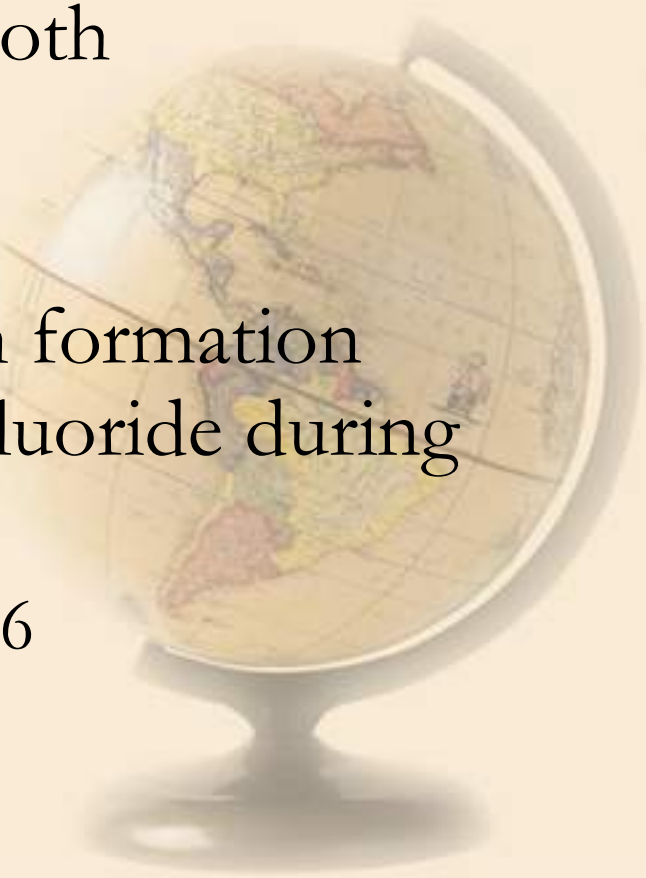
- *Definitions*

1. Hypo-mineralization of tooth enamel or dentin by the long continued ingestion of excessive amounts of fluorides during tooth development

   -Dean 1934

2. A specific disturbance of tooth formation caused by excessive intake of fluoride during formation period of dentition

   - Murray 1986



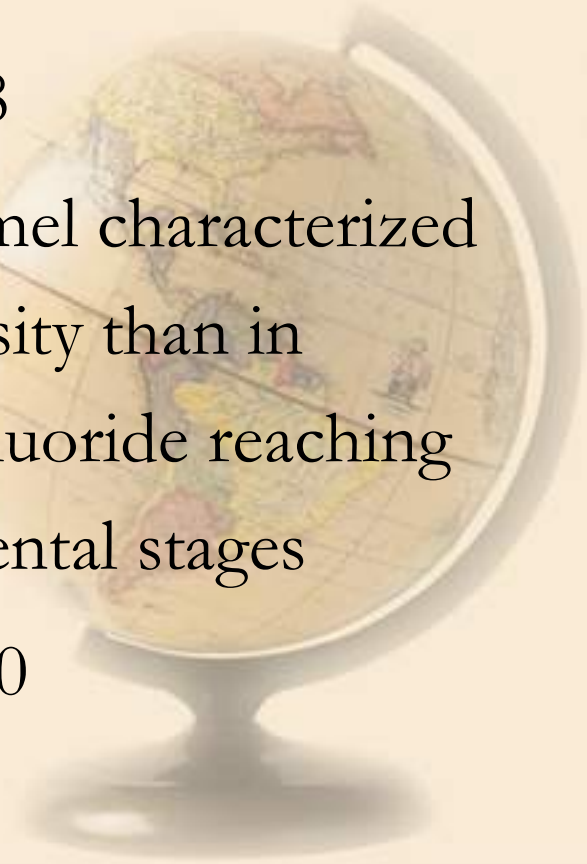
Dental Fluorosis..

3. Disturbance in tooth enamel formation caused by fluoride being present in tissue fluid over a prolonged period during tooth development

   -fejerskov 1988

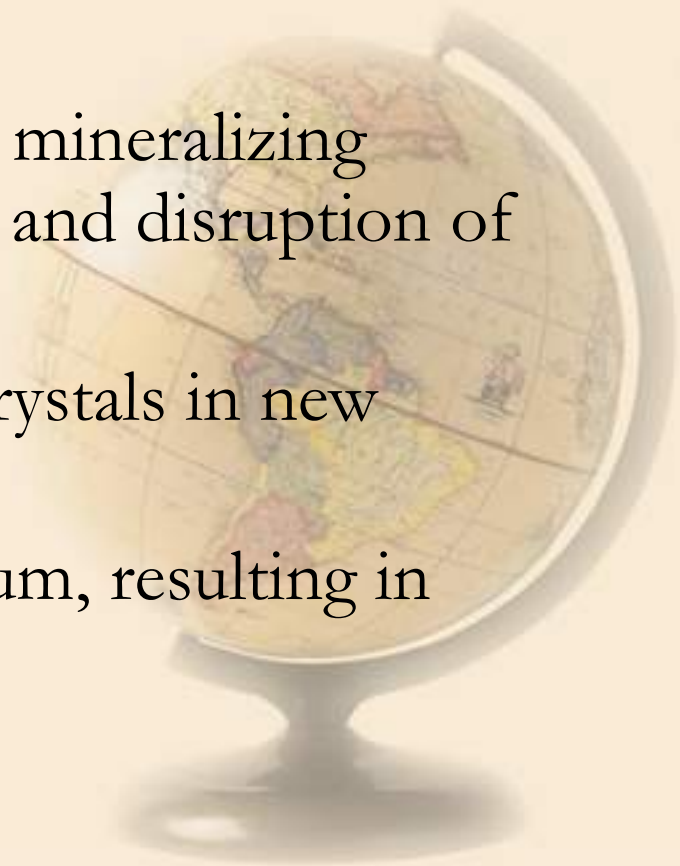
4. Permanent hypo mineralization of enamel characterized by greater surface and subsurface porosity than in normal enamel, resulting from excess fluoride reaching the developing tooth during developmental stages

   - fejerskov 1990



Possible mechanism of dental fluorosis

- Inhibit Protein synthesis and reduce secretory enamel (↓ sed amino acid uptake)
- In Mineralization:
  - Irreversibly affects the existing mineralizing matrix, (more rapid deposition and disruption of crystal growth)
  - Interferes with deposition of crystals in new matrix
  - reduce the available ionic calcium, resulting in reduced proteolytic activity



- Interferes Protein removal from the matrix
  - Amelogenin is hydrolyzed and removed from the matrix
  - A dose dependent delay in hydrolysis and removal of amelogenin is caused by fluorides

↓

delay growth of enamel crystals

↓

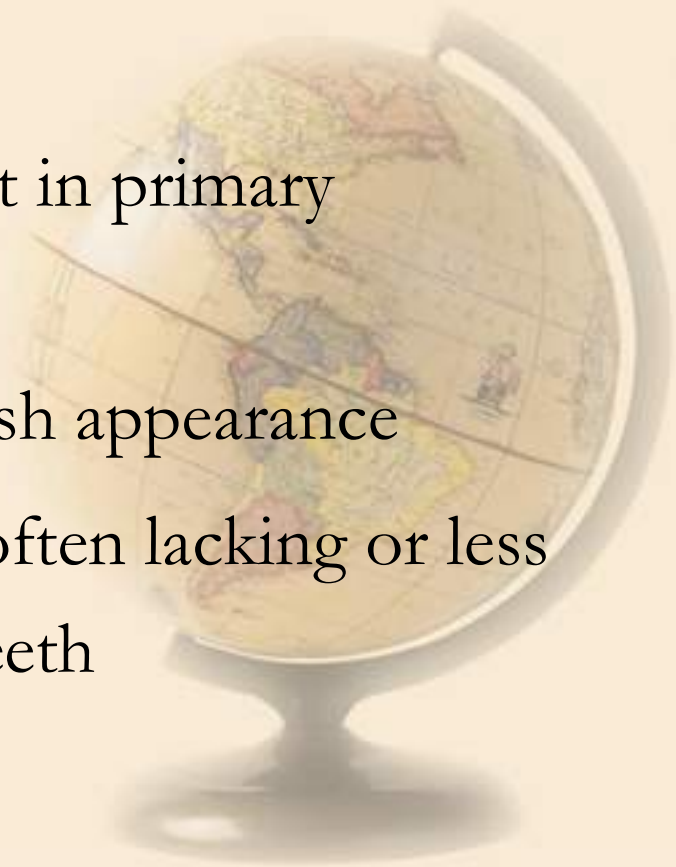
tooth erupts with incompletely mineralized enamel

Distribution of fluorosis in permanent dentition

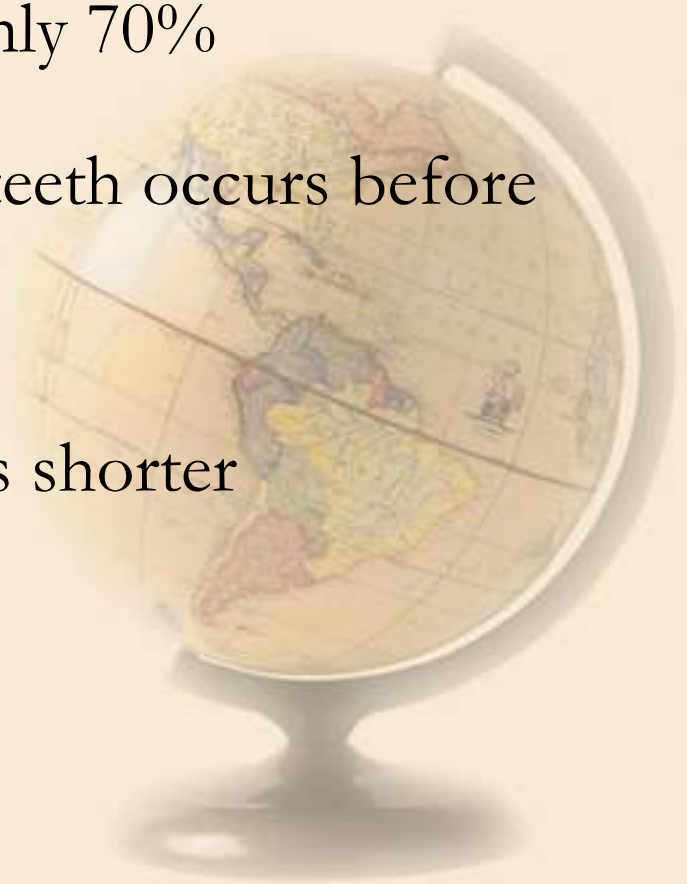
- Posterior teeth are more affected than anterior in both maxilla and mandible
- Fluorosis occurs symmetrically within the arch
- Premolar>2nd molar>max incisor>canine>1st molar> mandibular incisors

Distribution of fluorosis in primary dentition

- Exhibit less fluorosis than their permanent successors, but distribution within the dentition follows similar pattern
- Assessment of fluorosis is difficult in primary dentition bcoz:
  - Thinner enamel-→ more whitish appearance
  - Incremental lines of retzius is often lacking or less pronounced than permanent teeth



- Reasons for less appearance of fluorosis in primary dentition:
  - Placenta as selective barrier ---Only 70%
  - Most of calcification of primary teeth occurs before birth
  - Duration of enamel maturation is shorter
  - Thinner enamel



Post eruptive changes in dental fluorosis

- Changes are determined by degree of subsurface porosity
- Pitting occurs shortly after eruption depending on initial hypo-mineralization
- Very susceptible to enhanced attrition

- the severity of fluorosis :-

(i) Fluoride concentration in drinking water,

(ii) Period of exposure,

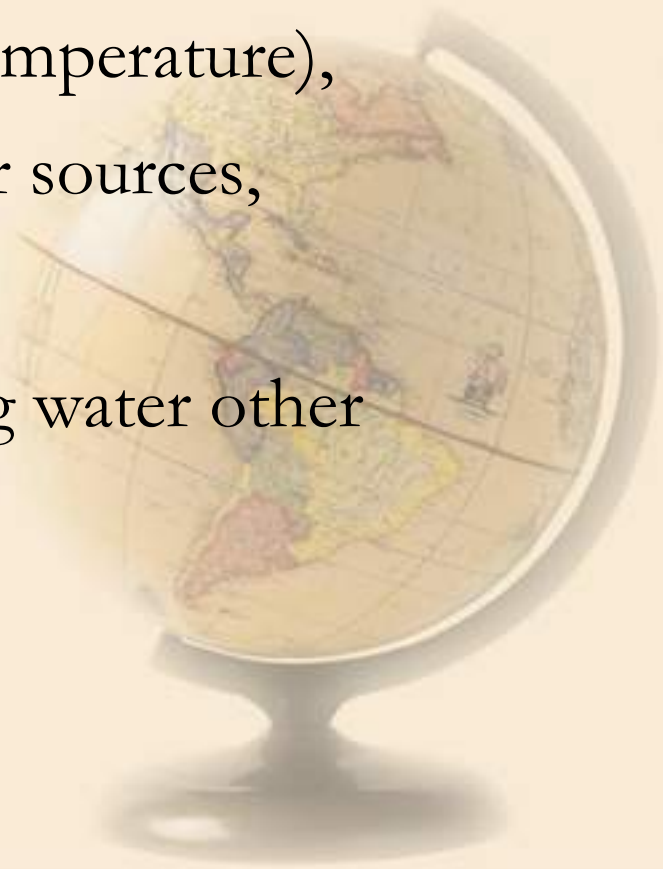
(iii) Climatic factors (for example Temperature),

(iv) Fluoride ingestion through other sources,

(v) Nutritional status,

(vi) Chemical constituent of drinking water other than fluoride, and

(vii) Occupation.



Classification systems of fluorosis

- Dean's index:
  - Trendly H. Dean in 1934
  - Initially this index categorized dental fluorosis on a seven point ordinal scale :-

Normal, questionable, very mild, mild, moderate, moderately severe, severe

  - In 1939 Dean combined moderately severe and severe as only severe and thus modified it into 6 point scale

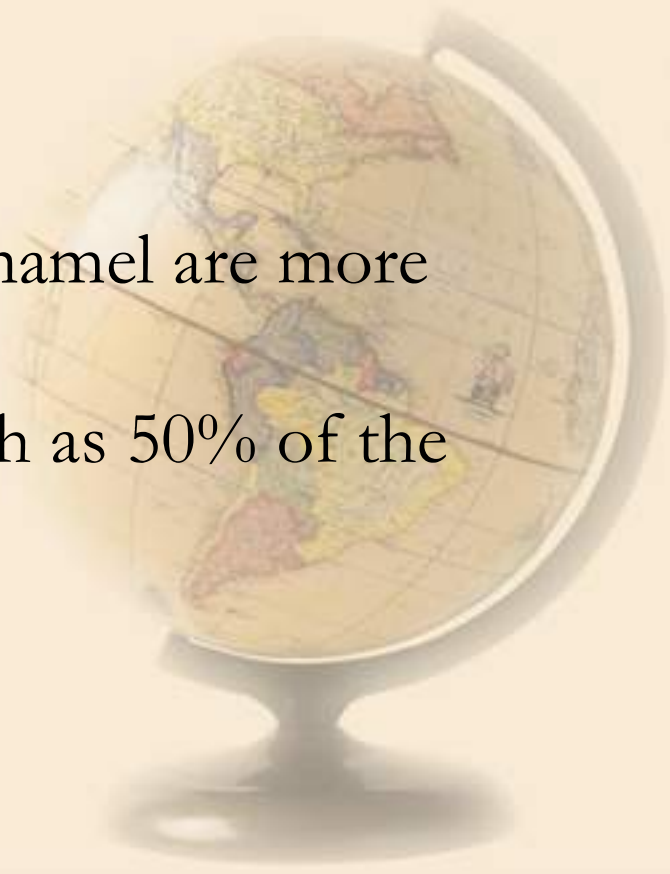
Criteria of scoring:-

0 – Normal – enamel represents usual translucent semivitriform, surface is smooth, glossy & pale creamy white color

1 – Questionable – slight aberrations from the translucency ranging from white flecks to occasional white spots

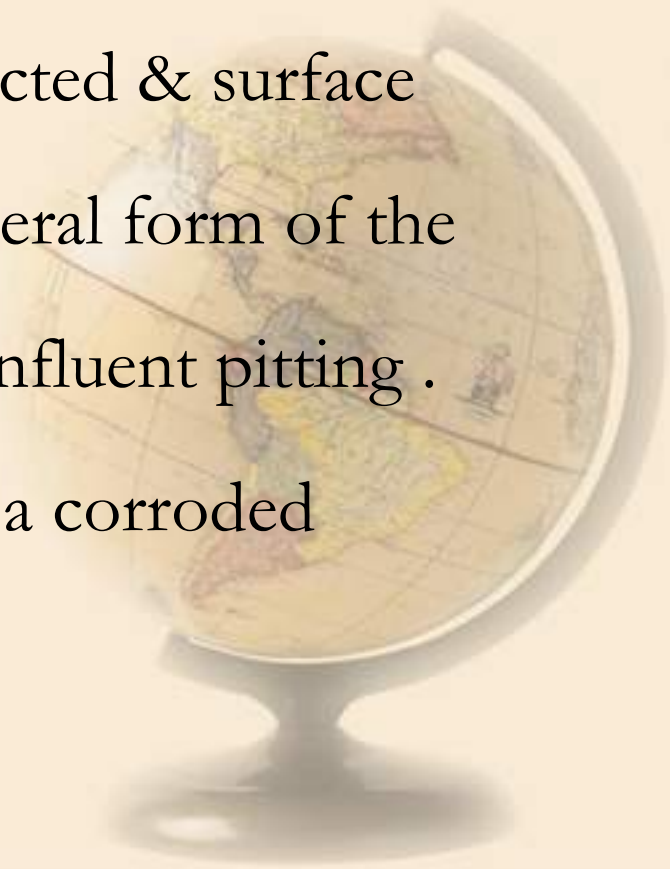
2 – Very Mild – small opaque paper white area scattered irregularly over the tooth showing no more than 1-2mm of white opacity

3 – Mild – white opaque areas in the enamel are more extensive but do not involve as much as 50% of the tooth



4 – Moderate – all enamel surface are affected & surfaces subjected to attrition show marked wear, brown stains are frequently a disfiguring feature

5 – Severe – all enamel surface are affected & surface hypoplasia is so marked that the general form of the tooth may be altered . discrete or confluent pitting . Brown stains are widespread & give a corroded appearance



- **Community fluorosis index:-**

Trendly H Dean

In 1935 – criteria

clinical appearance	*numerical weight*
Normal	0
Questionable	0.5
Very mild	1
Mild	2
Moderate	3
Severe	4

In 1942 – Community index of dental fluorosis

$$Fci = \frac{\text{sum of (no. of individuals x statistical wt)}}{\text{no. of individuals examined}}$$

In 1946 – Public Health significance of CFI score

0.0 – 0.4 – Negative

0.4 – 0.5 – Borderline

o.5 – 1.0 – Slight

1.0 – 2.0 – Medium

2.0 – 3.0 – Marked

3.0 – 4.0 – Very marked

Differential diagnosis

characteristics	Dental fluorosis	Enamel opacities
Area affected	all surfaces, often enhanced on or near tips of cusps or incisal edges	Usually centered in smooth surface of limited extent
Lesion shape	Line shading in pencil sketch which follow incremental lines OR cloudy appearance OR snow capping at cusp tips	Round or oval
Demarcation	Diffuse distribution of varying intensity	Clearly differentiated
Color	Paper white ,frosted appearance, stain at time of eruption	Creamy yellow to dark reddish orange at the time of eruption
Teeth affected	Always homologous teeth. Premolars & 2nd molars mostly affected	Labial surface of single tooth, mostly incisors