
IODINE

Presentation by
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Element 53

- Greek---'iodes'---meaning violet
 - Group 17/VII of the periodic table---halogen
 - Atomic weight is 126.9045 grams
 - Melting point is 113.7 °C
 - Boiling point is 184.4 °C
 - Bernard Courtois discovered iodine in 1811
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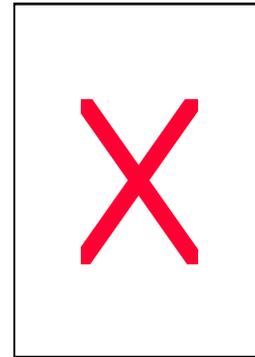
Where does it exist in nature?

- Iodide ions in brines
- An impurity in Chile saltpeter
- Main natural source of iodine is kelp

2000 kg seaweed = 1 kg iodine

Other Facts

- Elemental iodine is produced by oxidation with chlorine
- It produces a variety of colors in organic solvents
- Starch is a common indicator
- Be careful with handling!



Uses of Iodine

- Silver iodide is used in photography
 - Disinfectant for external wounds
 - Essential trace element
 - Iodine is used by the thyroid gland
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The Thyroid

- Largest endocrine gland in the body
 - Synthesizes and stores thyroid hormones: thyroxine (T_4) and 3,5,3'-triiodothyronine (T_3)
 - Located in the neck
 - 2 lobes connected by a narrow isthmus
 - Composed of functional units called follicles
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The Thyroid 2

[http://www.betterhealth.vic.gov.au/bhcv2/bhc
articles.nsf/Pictures/Thyroid_gland_explained
?OpenDocument](http://www.betterhealth.vic.gov.au/bhcv2/bhc/articles.nsf/Pictures/Thyroid_gland_explained?OpenDocument)

Iodine and the Thyroid Gland

- Normal adult thyroid weighs 20-25g and contains 8-10 mg of iodine
 - Iodine contributes to 65% of T₄ molecular size and 59% of T₃ molecular size
 - Iodine provides the raw material for hormone synthesis
 - Most ingested iodine is reduced in the gastrointestinal tract and absorbed almost completely
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Iodine and the Thyroid Gland 2

- Iodate → iodide → completely absorbed
 - Thyroid selectively concentrates iodide in amts. required for adequate hormone synthesis
 - Most of the remaining iodine excreted in urine
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Iodine and the Thyroid Gland 3

Iodine in the thyroid gland

+

complex series of
reactions

= thyroid hormones

Iodine and the Thyroid Gland 4

- Deiodinase helps to recycle iodine within the thyroid gland
 - Thyroid-stimulating hormone (TSH) is the major regulator of thyroid function
 - Pituitary secretes TSH in response to concentrations of thyroid hormone
 - Elevated serum TSH concentration indicates primary hypothyroidism
 - Decrease in TSH concentration reflects hyperthyroidism
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What happens when you don't consume enough iodine?

Iodine Deficiency Disorders

Iodine deficiency disorders: Malformations

- Fetus: abortion, perinatal death, infant death, neurological cretinism, severe mental deficiency, deaf-mutism, spastic deplegia, squint, myxedeatous cretinism, growth-stunting, severe mental deficiency, psychomotor deficiency
- Neonate: goiter, hypothyroidism
- Child and adolescent: hypothyroidism, mental deficiency, low physical development
- Adult: goiter, mechanical compression of adjacent organs in the neck, endocrine disorders (hyperthyroidism/hypothyroidism), neoplasia (benign tumors/cancer), mental deficiency

Source: *Essentials of Medical Geology*, pg. 190, Table X

Iodine Deficiency Disorders (I.D.D.): Statistics

- In 1990, the U.N. and W.H.O. estimated that about 1 billion people are at risk for I.D.D.
 - 211 million with goiter
 - 5.1 with cretinism
 - Mean IQ loss of 13.5 points in the population living in severely iodine deficient areas
 - Iodine deficiency is the greatest cause of preventable brain damage in childhood
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Historical Advances

- Chinese were treating goiter with powdered seaweed and sea urchins several thousand years ago
 - BCE: Greeks used burst sponge to treat goiter
 - 1811: discovery of iodine by adding concentrated H_2SO_4 to a seaweed of the type that was used to treat goiter
 - 1819: Fyfe identified iodine in sponge
 - 1820: Coindet treated goiter with iodine
 - 1854: Chatin suggested low iodine in soil, water, and food caused goiter
 - 1896: Baumann showed that the thyroid is rich in iodine; Halsted showed that maternal thyroid removal caused fetal thyroid hyperplasia in dogs
 - 1908: McCarrison characterizes endemic cretinism
 - 1909: Marine shows that maternal iodine deficiency caused goiter in the fetus (dog)
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Historical Advances, con't

- 1915: Kendall discovers thyroxin
- 1917: Smith shows that maternal iodine deficiency caused “cretinism” (swine)
- 1921: Marine shows that goiter can be prevented by iodide
- 1927: Harrington synthesizes thyroxin
- 1941: Mackenzie shows that sulfanilguanidine inhibits iodide concentration by thyroid (rat)
- 1943: Mackenzie shows that aminobenzene and thiourea inhibit iodine concentration by thyroid (rat); Mackenzie reveals hyperplasia of pituitary gland in hypothyroid state (rat)

Source: *Essentials of Medical Geology*, pg 190, Table IX

What causes I.D.D.?

- Not enough iodine intake
 - Cause: low iodine concentration in soil
 - Goiter: thyroid gland becomes enlarged in an attempt to be more efficient
 - Brain damage: iodine deficiency impairs certain aspects of lipid metabolism in the developing mammalian brain
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Case Study: Iodine Deficiency and England in the 20th Century

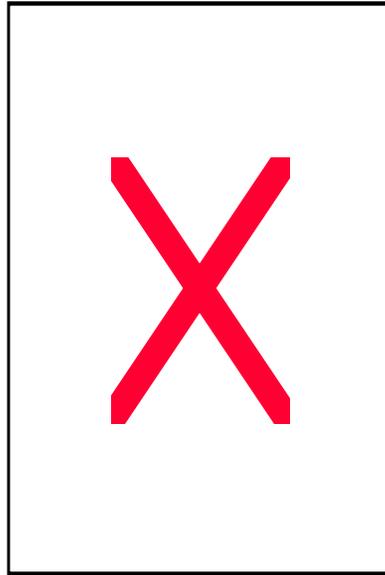
- 1920s British research: iodine supplementation reveals improved livestock reproductive performance
 - Rise of the iodine content in milk
 - Government policies of increased consumption of milk
 - Endogenous infant mortality rates decrease as iodine intake increases
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Case Study: Maring of New Guinea

- Georgeda Buchbinder, Department of Anthropology, Queens College
 - Endemic goiter and endemic cretinism a by-product of culture contact
 - Substitution of non-iodized trade salt for locally manufactured salt that was high in iodine
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Evidence from Research in Geochemistry

- Geographically defined---high mountain ranges, rain shadow areas, and central continental regions
 - Little iodine in the secondary environment is derived from weathering of the lithosphere
 - Iodine concentration decreases as you move inland
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How do you know if you have I.D.D.?

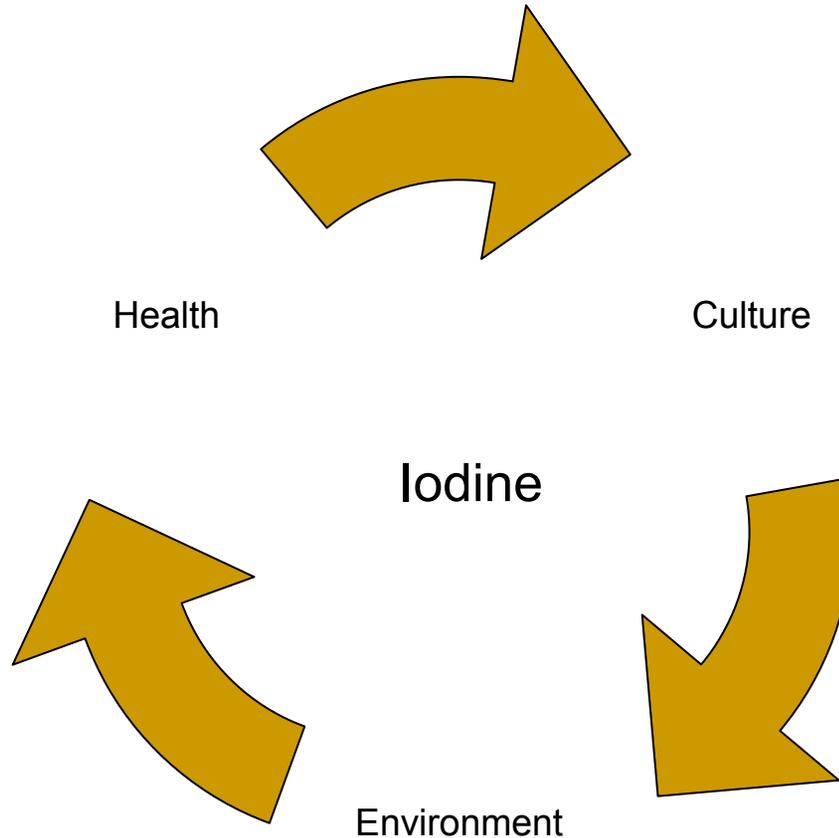
More Research Methods: Clinical Assessment of Iodine Status

- Goiter and cretinism
 - Chemical methods
 - Potentiometry
 - Neutron Activation Analysis
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Normal Clinical Values of Iodine for Healthy Adults

- Urinary > 1000 $\mu\text{g/L}$
 - Serum T_4 60-100 $\mu\text{g/L}$
 - Serum TSH 1-50 $\mu\text{g/L}$
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What does this all mean?



Preventative Measures

- Iodine supplements
 - Iodized oil
 - Food fortified with iodine
 - Iodized salt
 - World Health Organization, UNICEF
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Summary and Conclusion

- Iodine and its chemical properties
 - Iodine and the Thyroid Gland
 - Iodine Deficiency Disorders
 - Prevention
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References

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