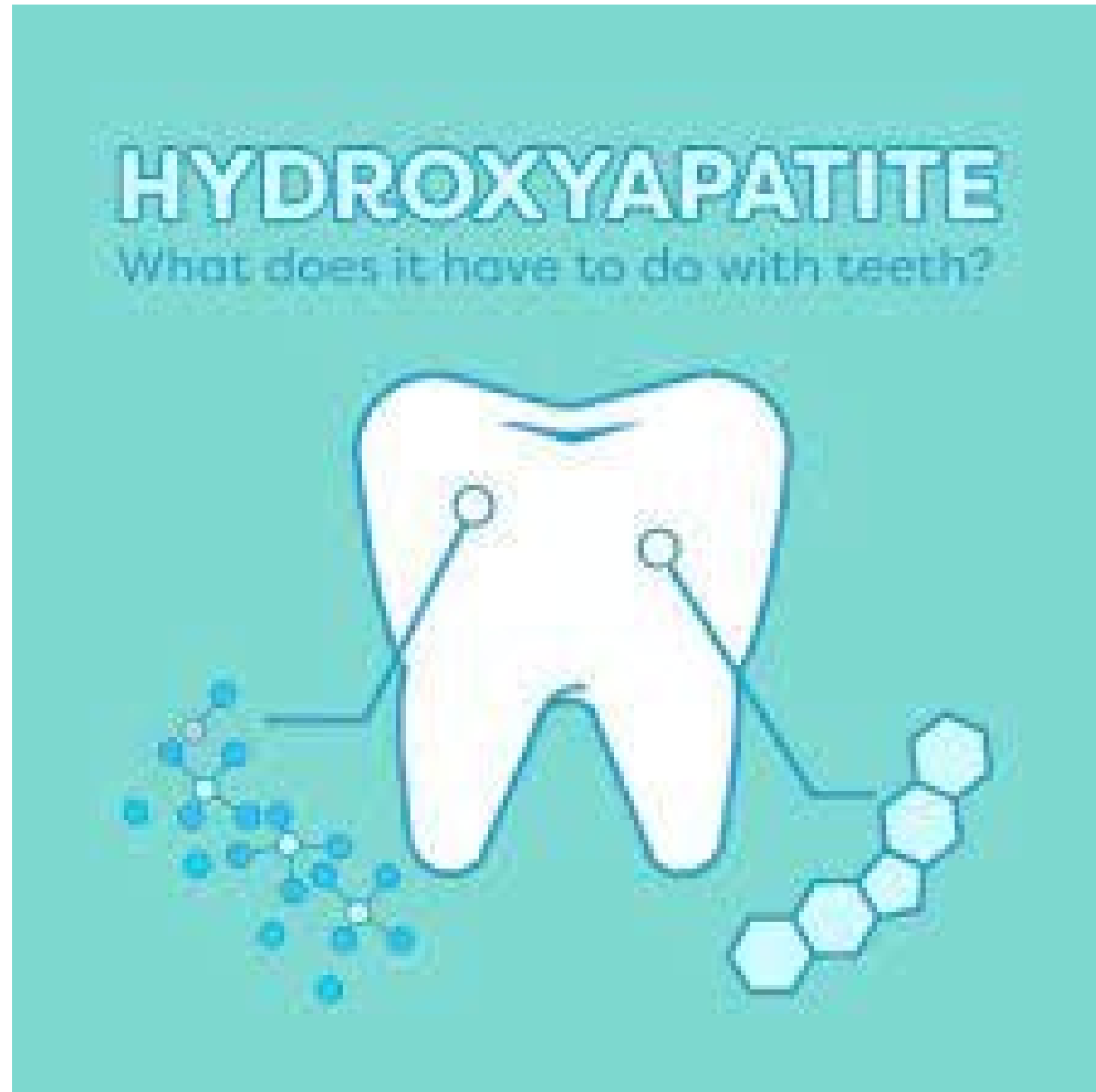


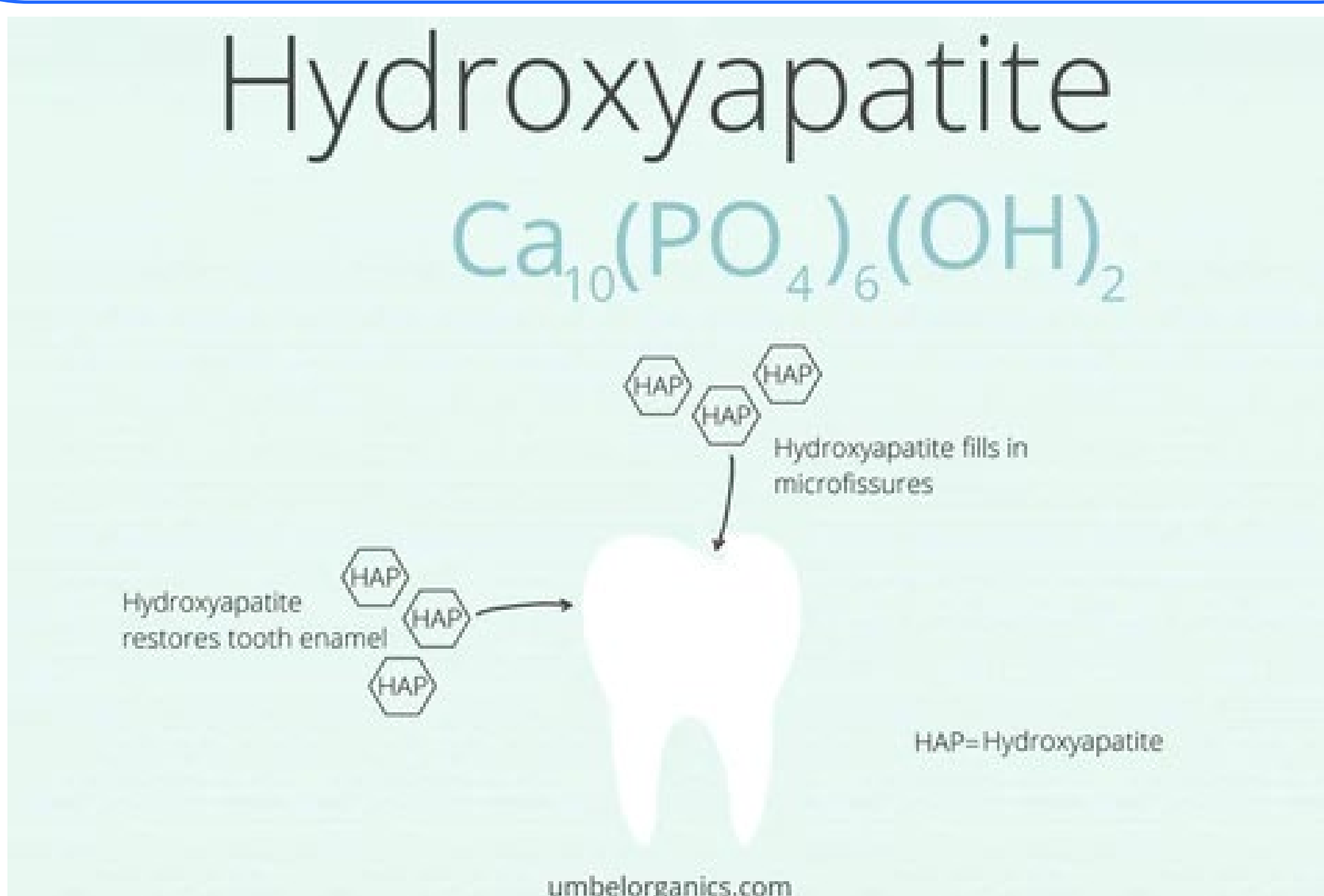
## What is Hydroxyapatite?

Hydroxyapatite, also identified as  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$  is an inorganic mineral mostly made up of calcium and phosphate. It has a very similar chemical structure to enamel in its natural form, the calcium makes up about 97% of tooth enamel and about 70% of dentin in teeth. Essentially, hydroxyapatite is the primary structural component of bone. This is why it is so effective in tooth remineralization (Roveri, 2022). Hydroxyapatite is naturally occurring and can safely restore and strengthen enamel. It is also biomimetic, which means the human body recognizes it as its own substance (Roveri, 2022). The oral care products that contain hydroxyapatite are often in the form of nanohydroxyapatite. The nanostructured hydroxyapatite particles very closely resemble the components of enamel minerals. Nanohydroxyapatite is hydroxyapatite with tiny particles that can penetrate enamel surfaces. This helps with tooth sensitivity due to its remineralization properties (Roveri, 2022). Many times the hydroxyapatite ingredient is used as a replacement for fluoride for patients who are allergic to or dislike fluoride.



## Advantages

In recent decades, hydroxyapatite has been used in oral care products as an alternative to fluoride due to its capability to remineralize enamel and dentin. Hydroxyapatite is known for its substantial biocompatibility and benefits involving preventative dentistry. Some preventive benefits include the prevention of caries, prevention of gingivitis and periodontitis, and prevention of dentinal hypersensitivity (Meyer, 2019). Studies show that hydroxyapatite has the ability to reduce the attachment of bacteria to enamel surfaces, similar to chlorhexidine oral care products. However, the use of hydroxyapatite does not involve the killing of the bacteria (Meyer, 2019). One study compared the use of a toothpaste containing 10% hydroxyapatite and a toothpaste containing amine fluoride. The experiment was tested on human primary teeth with and without carious lesions. The results showed that the hydroxyapatite toothpaste was just as effective in preventing demineralization in the sound teeth and in providing remineralization for the teeth with carious lesions (Amaechi, 2019). Another study examines the effectiveness of whitening in products that contain hydroxyapatite. It was proven that hydroxyapatite ingredients help to whiten tooth surfaces. There was a direct relationship between the amount of hydroxyapatite in the products and the effectiveness of whitening and brightening properties. Therefore, the more hydroxyapatite in the product, the whiter the enamel surfaces (Amaechi, 2019). Hydroxyapatite shows various benefits that are similar to fluoride.



## Disadvantages

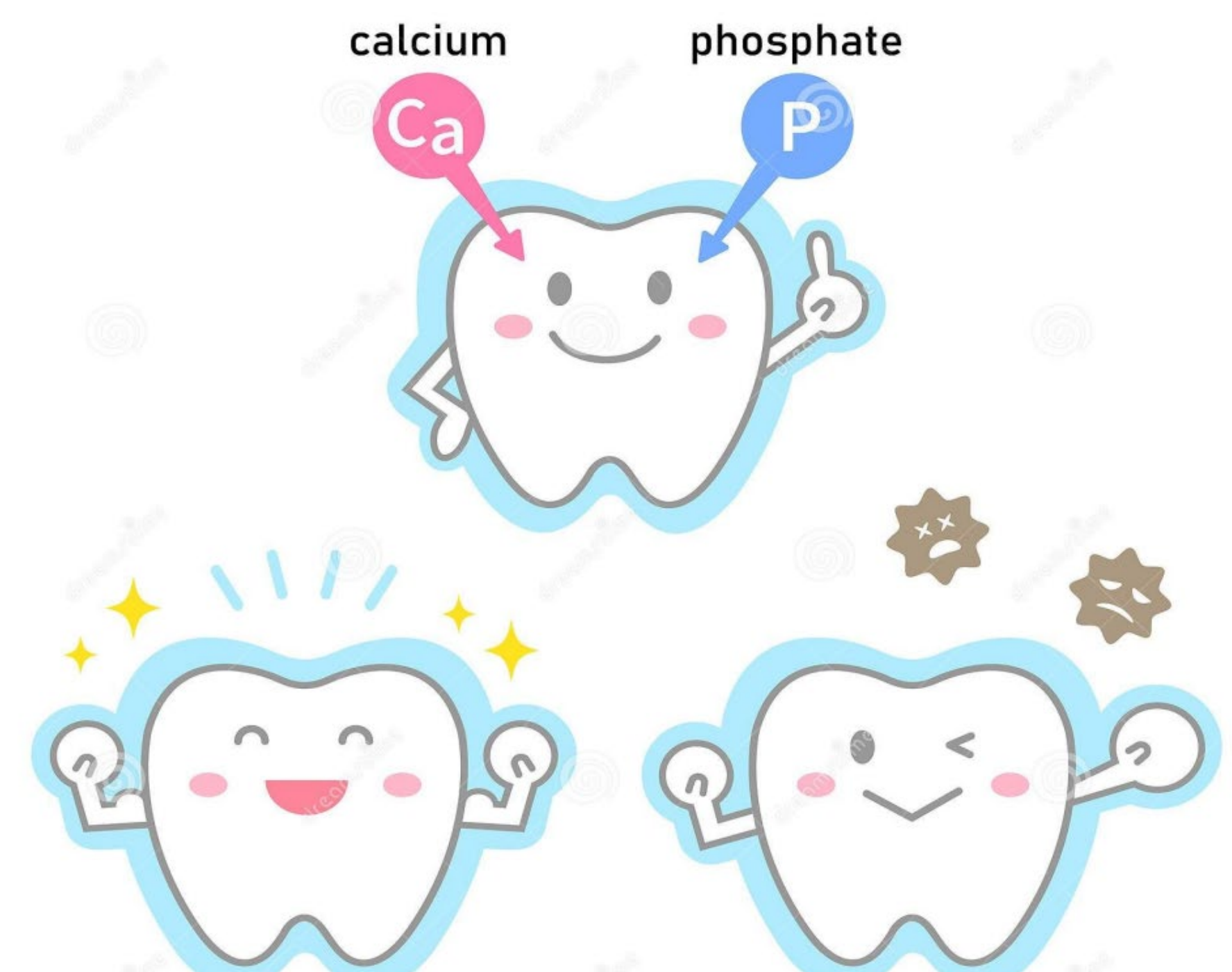
Hydroxyapatite has been known for its benefits in tooth remineralization within the recent decades. Unfortunately, hydroxyapatite-based oral care products are not as common as fluoride-based oral care products, so they are harder to obtain (Feroz, 2020). While hydroxyapatite has its advantages, it is not as readily available to consumers as fluoride products are. Almost every oral care product on the shelves contains fluoride, so that is what people are used to buying. Most consumers do not know to look for any other ingredients in their toothpastes. It is important as dental hygiene professionals to inform patients about the best ingredients and the best products for them.

## What is Fluoride?

Everyday minerals are added to and lost from a tooth's enamel layer through two different processes. Remineralization and demineralization, minerals are lost from a tooth's enamel layer when acids are formed from plaque bacteria and sugars in the mouth (Frisbee, 2021). Minerals such as Fluoride, Calcium, and Phosphate are remineralized by the foods, and water consumed to help prevent demineralization. The Fluoride ion (F) has been widely used topically in treatment of dental caries. Fluoride can be found in toothpaste, mouthrinses, and supplements. Fluoride may also be applied by a professional in the office in forms of gels, foams, or varnishes depending on the patient's personal needs. The time frame during which the primary and permanent teeth come in is certainly important for infants and children between the ages of 6 months and 16 years to be exposed to fluoride (Masterson, 2018). Dental caries is a preventable disease especially when monitored at a young age, the dental team can help prevent caries in children and young adults. Implying this role results in a significant lifelong gain in health. Preventive measures should be based on an individual's needs and for those at greater risk for dental caries. Assessment of caries risk involves patients previous decay experience, dietary habits, social habits, use of fluoride, and medical history (Morgan, 2018).

## Advantages

Fluoride intake benefits both children and adults in remineralizing the tooth enamel, preventing sensitivity, and tooth decay. The earlier children and younger adults are exposed to fluoride, the less likely they are to develop dental caries down the road (Idowu, 2019). Advantages of fluoride consist of protecting the enamel layer of the tooth, adding minerals back into the tooth after they have been demineralized, providing a natural preventative, and replenishing the calcium and phosphate ions that make your teeth harder and more protected. Fluoride is a naturally occurring substance found in oceans and groundwater. By using fluoridation, we are able to adjust the levels of fluoride in our drinking water to prevent tooth decay and cavities (Whelton, 2021).



## Disadvantages

Dental fluoride is the most effective method for dental caries prevention, and necessary for optimum oral health. However, not many focus on the toxic effects that play a role in dental fluoride. According to fluoride poisoning data collected by the American Association of Poison Control (AAPC), toothpaste ingestion remains the main source of toxicity followed by fluoride containing mouthwashes and supplements (Rizwan, 2017). This mainly occurs in children at younger ages not understanding the toxicity of swallowing toothpaste supplements. Dental fluorosis is one of the most sensitive and earliest indications of chronic fluoride toxicity. The mechanism of dental fluorosis is very complex and not fully understood. The excess amount of fluoride impedes normal enamel maturation and the dental enamel formed is hypomineralized with more surface and subsurface porosity (Rizwan, 2017). Not only do dental fluoride disadvantages play a role in the oral cavity however, it can affect your body's overall health. Dental fluoride toxicities can affect the Central nervous system, the kidneys, Gastrointestinal tract, and can cause fetal defects if not used properly. Since the level of safety for fluoride is low, any products containing high levels of fluoride should be monitored by dental professionals. Dental fluoride should only used based on a individuals specific needs to prevent toxins being injected into the body.

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