CURRENT AFFAIRS PROGRAM
PRE CUM MAINS 2024
DEC 2023: BOOKLET-6

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1. GENERAL STUDIES – 3: S&T UPDATES

1) COMPUTER AND IT: WEB BROWSWERS – HOW DO THEY WORK

Why in news?

» How do web browser work? (Dec 2023: Source - TH)

Definition:

» A web browser is software that allows you to find and view websites on the Internet. They translate code into the dynamic webpage that forms the backbone of our online experience.

Different Browsers over the years:

» In 1990, the English Computer Scientist Tim Berners-Lee introduced the concept of World Wide Web and with it came the first web browser, also known as **WorldWideWeb**.

» The next watershed moment was **Mosaic browser in 1993**. It was developed by US National Centre for Supercomputing Application. It introduced the concept of **displaying images** alongside text. It revolutionized our interaction with the web and made internet visually engaging.

» **In 1994** came the **Netscape Navigator** and it became the most popular browser of its time. It brough features like bookmarks and user-friendly URL bar. It simplified the navigation and made the web more accessible.

» **Late 1990s** saw the period of the '**Browser Wars**'. Microsoft's **Internet Explorer (IE)** and Netscape Navigator were the primarily contenders. This competition led to a lot of innovation in various browsers. But, by 2,000 IE emerged as undisputed leader mostly on the back of the success of Windows operating system which generally shipped with IE as default browser which most of the people used. But this monopoly also led to stagnation and lack of innovation.

» **In 2004-05**, this monopoly was broken with the arrival of **Mozilla's Firefox.** Firefox was developed by a community of volunteers and was based on open-source principles. It introduced groundbreaking features like tabbed browsing, and pop-up blocking. It also allowed users to extend their personal browsers with add-ons.

» **In 2008**, Google launched **Chrome**, which swiftly gained in popularity for its speed and minimalist design. It also revitalized the browser market and encouraged innovation across the board.

» **Today**, the most popular browsers are Google Chrome, Firefox, Microsoft's Edge and Apple's Safari.

How do Browsers work?

Modern web browsers have multiple core components, each of which is a complex technology in itself.

A) REQUEST AND RESPONSE

- When you enter a website's address (in the form of Uniform Resource Locator (URL)) into your browser's address bar (or when you click a link), you set in motion **a sequence of digital communication**. The browser sends a request to a server, asking for the contents of the specific web browser you're interested in. This request travels through a network of servers, like

dispatching a letter through a series of post offices. Upon reaching the server, the request is received and processed.

- The server then formulates a response containing the information (or data) required to construct the web pages. This response embarks on its journey back to your browser, carrying the digital blueprint for the page you requested.

B) DECONSTRUCTING THE RESPONSE

- The response from the server is an amalgam of various files. Typically, these files have information encoded in three languages: **HTML, CSS, and JavaScript**. Each set of information plays a pivotal role in shaping the final presentation of the web page.
- **HTML (Hyper Text Markup Language)** provides the architectural blueprint of webpage. It defines structure of the webpage, outline elements like headings, paragraphs, images, and links. HTML is the foundation on which browser construct a visual layout.
- **CSS** (Cascading Style Sheets) imparts style and aesthetics to the HTML structure by controlling attributes like color schemes, fonts, spacing, and positioning. CSS ensures that webpages come with its unique identity.
- **JavaScript** is a dynamic engine, making webpages interactive and responsive. It allows interactive elements like pop-ups, forms, animations, and Realtime updates, creating an engaging user experience.

C) RENDERING

- With HTML, CSS and JavaScript in hand, a browser begins the process of rendering. This involves deciphering the HTML to understand the structural arrangement, applying CSS for stylistic finesse, and executive JS to infuse interactivity.
- The process is remarkably swift, assembling the final webpage and presenting it to user in a cohesive and visually appealing manner in much less than a second, depending on the amount of data.
- **Rendering engines** are in themselves a key piece of technology that enables screens to display graphics.

D) MANAGING DATA

- Browsers serve as adept custodians for your digital footprint, so they also implement instruments like **cookies** and **cache** to enhance your online experience.
- **Cookies** are small snippets of data stored on your computer by websites you visit. They retain information such as login status, site preference, and shopping cart content. This allows you to navigate seamlessly, without having to re-login to a site when you close and reopen it in a short span of time.
- **Cache** is a repository of frequently accessed files. When you revisit a webpage, the browser checks its cache to see if it already has a copy of the required files. If so, it retrieves them from the cache itself rather than re-downloading them from the server.

E) SECURITY

- Web browsers use an array of security measures to protect your data as they fly between your computer to various servers, via the internet, and even when they're stored on your computer. They

do this by using **encryption protocols**, such as **HTTPS**, to create secure tunnels for data exchange shielding the information from prying eyes.

- Browsers also use warning systems to alert you about potentially malicious websites, preventing inadvertent exposure to threats.

Future of Internet Browsers:

- As technology hurtles forward, web browsers evolve in tandem. They are embracing new technologies like **Web Assembly**, a format that enables near-native performance within the browser environment.
- Support for VR and AR experience is also on the horizon, promising immersive online interactions.
- Privacy features are being bolstered, providing users a greater control over their digital footprint.

Conclusion:

- **Web browsers** are the unsung heroes of our digital endeavors, translating code into the dynamic web pages that from the backbone of our online experiences.

2) HEALTH: GENERIC MEDICINES

- **Why in news recently?**
  - » On Aug, 2023, the National Medical Council (NMC) directed all doctors to prescribe only generic names and not brand names which led to protest. Following the Indian Medical Association's protest, the NMC has withdrawn the order on 'generic prescribing' since Aug 23, 2023.
    - **Why the protest?**
      - Doctors trust certain brands
      - The control over which brands to take will go to chemist shops.
- **Example Questions**
  - » "Generic medicines can play a key role in making India's health sector affordable". Discuss. [15 marks, 200 words]
- **What is a generic drug?**
  - » Generic drug is a **low cost version of pharmaceutical drug** that is equivalent to a brand-name product in dosage, strength, route of administration, quality, performance and intended use.
  - » They usually enter market after patent protection of the original drug expires.
- **Note:** Broadly Medicines can be of three types:
  - » **Branded**: These are still on patent
  - » **Branded Generic**: Off-Patent and Generic, but nonetheless produced by a reputed company, with a brand.
  - » **Generic**: Off-Patent, and unbranded.
- **Government's attempt in promoting generic drugs**
  - » National Medical Council (NMC) has directed all doctors to prescribe generic names and not branded names.

    - » But this order was withdrawn after protest from Indian Medical Association.
  - » Making it mandatory for all chemists to display generic medicines prominently
  - » **Pradhan Mantri Bhartiya Janaushadhi Pariyojna (PMBJP)** was launched by Department of Pharmaceuticals, Ministry of Chemical and Fertilizers, Government of India as a direct market intervention scheme in 2008.
    - » As of Jan 2023, **9,000 Jan Aushadhi Kendras** are functional across the country.
      - The government has set up a target to increase the number of Jan Aushadhi Kendras to 10,000 by March 2024.
        - It offers 1759 medicines, and 280 surgical devices covering all major therapeutic groups.

- **Advantages**
  1. **Affordable healthcare:** Generic medicines are cheaper as it doesn't include manufacturer's marketing cost, cost spent on prescribing doctors etc.
  2. **Breaks the doctor-pharma nexus:** The existing nexus leads to prescription of only the brand of companies which gives some kick-backs to doctors.
     - » **Reduce unnecessary prescription:** This is resorted to by doctor if pharma companies are paying them
  3. **Promotes domestic pharma companies** as India is a world leader in generic drug manufacturing.
  4. **Difficult for quacks to function** as non-qualified people may find it difficult to know generic names

- **Limitations**
  1. **Quality concerns**
     - » Concerns about lack of uniformity in the quality of generic versions.
     - » Studies have shown that many generic versions don't work.
     - » Doctors trust and prefer well-established brands.
  2. **Erode doctor-patient relationship**
     - » As by prescribing generic drugs, doctor refuse to take responsibility for clinical outcomes.
  3. **Low profit margins for retailers**
     - » Retails pharmacists, in turn, have little incentive in stocking and selling low price generic medicines since they have lower profit margins.
  4. **Shortage**
     - » Though, there are more than 9,000 Jan Aushadhi Kendras, the reach of traditional medical stores is very high and they primarily deal in non-generic versions.
  5. **Difficult for common person to understand**, especially the multiple salt names in a FDC.
  6. **May discourage big pharma companies to launch their new medicines in India**

- **Way forward**
  - » **Improved Quality** through improved regulation of pharma sector.
    - Human Resource issues like shortage of drug quality inspectors has to be tackled in a fast track manner.
  - » **Increasing Production and Availability**: Increasing the penetration of Jan Aushadhi Kendras.
  - » **Allow pharmacist to substitute for alternative:** Laws for enabling substitution of generic and branded equivalents by pharmacists need to be introduced.
  - » **Prohibit Branding for out of patent drugs**

» **Increased awareness** on generics needed among consumers, pharmacists
» **Short names for generic FDCs** (officially approved trade names) will also ensure that doctors don't write out the generic names of their multiple constituents.
» **Improving government health facilities** would contribute to more coverage of government hospitals in overall health coverage and government hospitals can promote generic better.

- **Conclusion**
  » Overall, generic prescribing is a good move in the right direction and will have several positive ramifications for healthcare in India. However, like everything, successful implementation would require a series of enabling steps at different levels from production to prescription and from Quantity to Quality.

A) PRELIMS SCHEMES: PRADHAN MANTRI JAN AUSHADHI YOJANA (PMJAY)

- **Intro:**
  » **Pradhan Mantri Bhartiya Janaushadhi Pariyojna (PMBJP)** was launched by Department of Pharmaceuticals, Ministry of Chemical and Fertilizers, Government of India as a direct market intervention scheme in 2008.

- It aims to make quality generic medicines available to all at affordable prices through Jan Aushadhi Stores (JAS) opened in each district of the states.
  » First Jan Aushadhi Store (JAS) was opened at Amritsar Civil Hospital in 2008.
- Other key focus of the scheme is to create awareness and demand for generic medicine

- **Incentives given:**
  » The scheme provides an excellent opportunity of self-employment with suitable and regular earnings.
  » An incentive of **Rs 5,00,000** is provided to the Jan Aushadhi Kendras as financial assistance and one time additional incentive of Rs 1 lakh (as reimbursement for IT and infra expenditure) is provided to Jan Aushadhi Kendra opened in **North-Eastern India**, Himalayan state, island territories, and backward areas identified by NITI Aayog as aspirational districts or if opened by women entrepreneurship, Ex-Serviceman, Divyangs, SCs and STs.

- As of Jan 2023, **9,000 Jan Aushadhi Kendras** are functional across the country.
  » The government has set up a target to increase the number of Jan Aushadhi Kendras to 10,000 by March 2024.
    - It offers 1759 medicines, and 280 surgical devices covering all major therapeutic groups.

3) HEALTH: NEGLECTED TROPICAL DISEASES (NTD)

- **WHO Definition:**
  » NTDs are a diverse group of **20 conditions** that are **mainly prevalent in tropical areas**, where they mostly affect i**mpoverished communities** and disproportionately affect women and Children.
    - The epidemiology of NTDs is complex and often related to environmental conditions.

- They are caused by variety of **pathogens** - viruses, bacteria, protozoa, and parasitic worms (helminths).

- **Which are the diseases included in NTDs**:
  - » Buruli Ulcer, Chagas Disease, Dengue & Chikungunya, dracunculiasis (Guinea-worm disease), echinococcosis, foodborne trematodiases, human African trypanosomiasis (sleeping sickness), leishmaniasis, leprosy (Hansen's disease), lymphatic filariasis, mycetoma, chromoblastomycosis and other deep mycoses, onchocerciasis (river blindness), podoconiosis, rabies, scabies, and other ectoparasitoses, schistosomiasis, soil-transmitted helminthiases, snakebite envenoming, taeniasis/cysticercosis, trachoma, and yaws and other endemic treponematoses.

- **Note:**
  - » '**Noma**' is the latest addition to WHO's list of neglected tropical diseases (Dec 2023)

- These diseases are **contrasted with the "big three" infectious diseases** (HIV/AIDS, tuberculosis, and malaria), which generally receive greater treatment and research funding.

- **Jan 30**: World **NTD Day**
  - » In May 2021, the delegates at the 74th World Health Assembly unanimously adopted a proposal to declared Jan 30 as 'World NTD Day.

- **WHO's new roadmap for 2021-2030 calls for three strategic shifts to end NTDs:**
  - » From measuring process to measuring impact.
  - » From disease-specific planning and programming to collaborative work across sectors.
  - » From externally driven agendas reliant to programmes that are country-owned and country-financed

A) NOMA DISEASE

It is a severe gangrenous disease of the mouth and face. It primarily affects young children (between the ages of 2 years to 6 years) in regions of extreme poverty.

It starts as an inflammation of gums, which, if not treated early, spreads quickly to destroy facial tissues and bones.

Cause: Evidence indicate that NOMA is caused by bacteria found in the mouth. There are multiple risk factors associated with the disease. It includes malnutrition, weakened immune system, infections, and extreme poverty. If the child is malnourished and has recently been sick with an infectious disease, such as measles or chickenpox, they are at more risk for developing noma.

It is not contagious but tends to strike when the body's immune system is weak.

NOMA is sometimes called the '**Face of Poverty**' as it is a social marker of extreme poverty and malnutrition.

Significance of Including NOMA in the NTD's list:

- Amplify global awareness.

Impact: It can be fatal and may also cause severe disfigurement for survivors. **Treatment**: It involves antibiotics, advice and support on practices to improve oral hygiene with disinfectant mouth wash and nutritional supplements. In case of early diagnosis, proper wound healing without long-term consequences may take place. In severe cases, surgery may be necessary. **Cases** are mostly found in sub-Saharan Africa. Some cases are also reported from Americas and Asia. **Accurate estimation** of the number of noma cases is challenging due to rapid progression of the disease and the associated stigma.	• Catalyze research, stimulate funding and boost efforts to control the disease through multisectoral and multi-pronged approaches.

4) HEALTH: HIV

- **Why in news?**
  - » Hopes dashed as last HIV vaccine trial in Africa for his decade ends in failure (Dec 2023: Source - DTE)
  - » The WHO has released new scientific and normative guidance for human immunodeficiency virus (HIV) at the 12th International AIDS Society Conference on HIV Science on July 23, 2023.

- **Practice Question:**
  - » Highlight the current state of HIV/AIDs in India. Critically evaluate the effectiveness of National AIDS Control Program in addressing the challenges of HIV/Aids in the country. Give recommendations for strengthening the program's response in the context of India. [15 marks, 250 words]

- **Introduction:**
  - » **About virus:**
    - ▫ HIV are two species of Lentivirus (genus) *of Retroviridae* family. The virus first emerged in 1920 in **Kinshasa (then Leopoldville)**, Belgian Congo.
  - » The Human Immunodeficiency **Virus (HIV) targets the immune system** and weakens people's surveillance and defence systems against infections and some types of cancers.
    - ▫ As the virus destroys and **impairs the function of the immune cells**, infected individuals gradually become immunodeficient. Immune function is typically measured by CD4 cell count.
    - ▫ The most advanced for of HIV infection is **acquired immunodeficiency syndrome (AIDS),** which can take from 2 to 15 years to develop depending on individual. It is defined by developments of certain cancers, infections, or other severe chemical manifestations.

- **Note: CD4 cells** are a type of white blood cells that play a major role in protecting your body from infection. They send a signal to activate your body's immune response when they detect "intruders" like the viruses or bacteria.

- **Transmission**
  - » **Exchange of a variety of body fluids - blood, breast milk, semen and vaginal secretion**
  - » **Note:** Individual can't be infected through ordinary day to day contact such as kissing, hugging, shaking hands, sharing food or water etc.

- **Behaviours or conditions which can put individual on risk:**
  - » Unprotected sex (including anal)
  - » Having other STDs like syphilis, herpes, chlamydia etc.
  - » Use of contaminated needles, syringes etc. while injecting medicines or drugs.
  - » Unsafe blood transfusion and medical procedures
  - » Infected mother to unborn child.

- **Diagnosis**
  - » **Three types of tests:**
    - **Antibody test**: By detecting presence or absence of antibodies to HIV in blood; **most commonly used test**.
      - When someone is infected with HIV, the immune system produce proteins called **anti-bodies**, and they are directed against the unique proteins of HIV. Though, these antibodies are not able to eliminate the virus, but they serve as a marker to show that someone is infected with HIV.
    - **RNA** (viral load) test (RT-PCR)
    - **A Combination test**
      - It detects both antibodies and viral protein called p24 (antibody-antigen test, or HIV Ab-Ag test).
        - P24 forms part of the core of the virus (an antigen of the virus).

- **Prevention**
  - » **Avoid risk behaviours** (i.e. use condoms, test and counsel for HIV and STIs, Voluntary medical male circumcision, using only sterile injecting instruments)
  - » **Antiretroviral (ART) use for prevention.**
    - **ART as Prevention -** If an HIV positive person adheres to an effective ART regimen, the risk of transmitting the virus to their uninfected sexual partner can be reduced by 96%.
    - **Pre-exposure prophylaxis (PrEP) for HIV negative partner:** Oral PrEP of HIV is the daily use of ARV drugs by HIV uninfected people to block the acquisition of HIV.
    - **Post Exposure prophylaxis for HIV (PEP):** PEP is the use of ARV drugs within 72 hours of exposure to HIV in order to prevent infection. PEP includes counselling, first aid care, HIV testing, and administering of a 28-day course of ARV drugs with follow up care.

  - » **Drug releasing Vaginal Ring Cap:** To prevent HIV-AIDS in Women
    - The ring is made of flexible silicon matrix polymer. The woman inserts it into the vagina, where it, over the course of a month, **releases the antiretroviral drug dapivirine**. It has to be changed after 28 days.

- **Treatment**
  - » HIV can be **suppressed** by combination ART consisting of 3 or more ARV drugs. ART **doesn't cure** HIV infection but controls viral replication within a person's body and allows an individual's immune system to strengthen and regain the capacity to fight off infection. With ART, people living with HIV can live healthy and productive lives.

- **Stem Cell Therapy to treat HIV** have shown success:
  - » In 2022, a US patient was reported cured of HIV after stem cell transplant. By July 2023, six persons had been cured by this method.
  - » In the first five cases, the treatment teams specifically looked for **donors with CCR5 delta 32 mutation**. It is associated with lower risk of HIV.
    - ▫ People who inherit **CCR5 delta 32 mutation** from both parents don't from the receptors which are used by HIV virus to enter the cells. Those who inherit the mutation from one of the parents have fewer receptors and are less likely to get infection.
    - ▫ **Only 1% of the people** on earth carry 2 copies of CCR5-delta 32 mutation.

  - » **Why can't stem cell transplant become routine treatment for HIV?**
    - ▫ Finding matching donor for all 40 million patients would be impossible.
    - ▫ The CCR5 delta 32 mutation occurs mostly in Caucasians whereas most of the cases are in the African continent.
    - ▫ Further, stem cell transplant is a complex process and comes with its own risks.

- **SDG Goal 3.3**: To achieve the end of AIDS by 2030 i.e. zero new infection by 2030.

- **Global Situation of HIV**:
  - » **Successes Achieved in HIV Response**:
    - ▫ As per UNAIDS, in 2022, 39 million people globally were living with HIV, of whom 29.8 million were accessing ART.
      - Coverage of ART has becomes 4 times of the number in 2010.
    - ▫ **New Cases**: Around 1.3 million people got newly infected with HIV in 2022 - which is 59% lower from the peak in 1995.
    - ▫ It is possible to end AIDS by 2030: UNAIDS

- **WHO response**
  - » WHO is cosponsor of the United Nation Program on Aids (UNAIDS). Within UNAIDS, WHO leads activities on HIV treatment and care, HIV and tuberculosis co-infection, and jointly coordinate with UNICEF the work on the elimination of mother to child transmission of HIV.

- **Vaccination Efforts:**
  - » **Hopes Dashed as last HIV vaccine trial in Africa for this decade ends in failure** (Dec 2023)
    - ▫ The study, known as **PrEPVacc,** was led by African researchers with support from European Scientists.
      - They were testing two different vaccine regimes on about 1500 volunteers in Uganda, Tanzania, and South Africa.

- After, **multiple other high-profile trails** failed in the past, PrEPVacc researchers were quite optimistic and had described the latest study as the **final trial of the decade**.

- **HIV situation in India**
  - » More than 2 million people in India live with HIV.
    - HIV Epidemic has an **overall decreasing trend** in the country with estimated annual new HIV infections declining by 37% between 2010 and 2019.
  - » **Success in controlling AIDS**
    - 2015 HIV estimates results reaffirm the country's success story in responding to HIV/AIDS epidemic. India has **successfully achieved 6th Millennium Development Goal (MDG6)** of halting and reversing the HIV epidemic.
  - » **Emergence of three north Eastern States as new HIV Hotspots: Mizoram** (1.19%), Nagaland (0.82%), Meghalaya (0.73%), Tripura (0.56%) and Manipur (0.47%)
    - Reasons: Injecting Drug Users and Unsafe Sexual Practices.

- **Steps taken by government of India in recent times to Reduce HIV transmission**
  - **National Aids Control Program** was launched in 1992 and its four phases have been completed so far. It is a central sector scheme.
    - » It has been extended for five years (1st April 2021 to 31st March 2026)
    - » It is a comprehensive program for prevention and control of HIV/AIDS in India.
    - » Under this, ART Centres run by National AIDS Control Office (NACO) provide lifetime free medicines, diagnostic kits and other essentials for those in need.
  - **National Aids Control Organization** (NACO), under MoH&FW, provides leadership to HIV/AIDS program.
  - **HIV & AIDS Prevention and Control Act 2017** provides a legal framework for protecting the rights of HIV positive people.
  - Implementation of **90:90:90** strategy adopted by UNAIDS
  - **Other steps** include - Multimedia campaigns; Red ribbon clubs in colleges; training and sensitization program for SHGs; etc;

- **Challenges in successful implementation of HIV prevention Programs**
  1. **Lack of Capital**
     - Funding that India and other developing countries had been getting from developed countries for HIV control has come down
     - Health budget is way below the requirement of 4% (NHP targets 2.5%)
  2. **Stigma Associated and lack of awareness**
     - It creates a big problem as HIV positive people don't come out for treatment and further accidently contribute in promotion of the infection
  3. **Shortage of Medicine**
     - There have been complaints about shortage of medicine stockpile related to HIV/AIDS.
  4. **Increasing drug abuse**
     - Increasing drug abuse in various parts of the country can become a factor for increasing spread of HIV.

5. **Lack of sex education at school level**
    - It prevents early education of children regarding prevention of sexually transmitted diseases.

- **Way Forward for India to deal with HIV**
    - » **More Resources/Funding**: More funds allocation for health sector, specially HIV/AIDS.
        - Affordable and accessible health care facilities.
        - Better drug procurement policy to get the adequate quantity in affordable price.
            - Here Tamil Nadu Model which goes for mass procurement from manufacturers can be a way forward
    - » **Sex education** in schools would ensure that adolescents and young adults are aware of all the precautions to be taken
        - **Reducing stigma and discrimination** will lead to early detection and control.
    - » **Fight drug addiction**: Focus on injectable drug users is needed to preventing any alarming rise of HIV in this group
    - » **Increases focus on target groups:**
        - Improved focused on vulnerable groups
            - Sex workers
            - Transgenders
            - Truck Drivers
                - NACO study shows that 2.5% of truck drivers in India are suffering from HIV
                - They are also bridge population as they play a key role in transmission
        - Special focus on high prevalent states.
    - » **Integrated Approach for a more comprehensive treatment**: HIV/AIDs patient should also be provided mental health support, legal support etc, other than being given free services under NAIDS.

5) HEALTH: NON-SUGAR SWEETNERS (NSS)

- **What are non-Sugar Sweeteners?**
    - » Non-Sugar Sweeteners (NSS) or Non-Nutritive Sweeteners (NNS) are **substances used in place of sweeteners that have sugar** (sucrose) or sugar alcohols. They have negligible or zero calories because, unlike sugar, they don't get broken down by the body into products that provide energy or calories.
    - » They are used as table top sweeteners as well as in food items marked as 'Sugar Free', 'Diet' etc.
    - » They are of primary **two types - i) Artificial, ii) Natural**
        - **Artificial:** These NSS are prepared in laboratories. Examples include Aspartame, Saccharine, Acesulfame-potassium, Sucralose, Neotame (derived from aspartame), Advantame (derived from aspartame) etc.
        - **Natural**: These are extracted from plants (e.g. Stavia, Thaumatin, Monk Fruit etc.)
    - » All the six artificial NSS and 3 natural NSS are approved by the US Food and Drug Administration. India's FSSAI has also approved all of them (except Advantame, and Mon Fruit).

- **Why are they used?**
    - » **TO reduce consumption of sugar** (which has led to global rise in diabetes and obesity).

- **Market**:
  - » As per a report by global market consultancy The Business Research Company the market for these NSS was worth $**20 billion in 2022** and it is expected to reach about $30 billion by 2027.

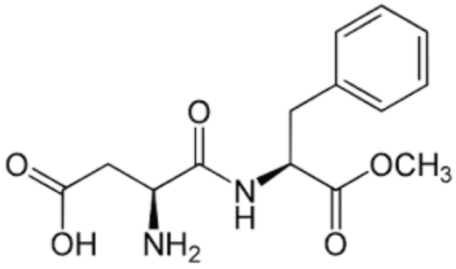
- **Criticisms:**
  i. **Little Evidence to substantiate the benefits of NSS** in controlling diabetes and obesity.
  ii. **Growing body of research** says that these NSS may lead to **cardiovascular diseases, cancers, and type-2 diabetes**.
    - For e.g. WHO in its July 2023 guidelines have classified Aspartame as "**possibly carcinogenic o humans"**.

- **Way Forward:**
  - » **Experimental Studies:** More detailed experimental studies should be conducted to bring more clarity on the health impact of NSS.
  - » **FSSAI** should update its standards based on these artificial sweeteners.
  - » **Citizens** should also avoid artificial products unless it's very necessary. We need to go for a more natural way of life which is not only healthy but also more sustainable.

A) PRELIMS FACTS: ASPARTAME

Aspartame is an artificial sweetener which was invented in 1965 and has been in use in USA since early 1980s.
It is a compound of carbon, hydrogen, nitrogen, and oxygen with chemical formula **$C_{14}H_{18}N_2O_5$**.
It is among the most popular sugar substitute used in the world.
Several Studies have highlighted problems associated with Aspartame:

- The **WHO** analyzed some 1,300 studies, and cited the following three, to declare aspartame "**possibly carcinogenic to humans)** -> European Journal of Nutrition, 2016; Cancer Epidemiology, 2022; Cancer Epidemiology, Biomarkers & Prevention, 2022;



- **WHO has placed aspartame in Group 2B**. This group consist of those substances which are possibly carcinogenic.
- **Details about various Groups:**
  - » **Group-1**: **Carcinogenic:** These substances have shown sufficient evidence in humans and animals to be treated as carcinogenic. It includes tobacco smoking, alcohol consumption, Solar Radiation, ionizing radiation.
  - » **Group-2A: Probably Carcinogenic**: Limited evidence in humans but sufficient evidence in animals. It includes insecticide DDT, Red Meat, Night Shift Work, Emission from high temperature frying etc.
  - » **Group-2B: Possibly Carcinogenic**: Limited evidence in humans or sufficient evidence in animals. It includes aspartame, gasoline engine exhaust, heavy metal lead;
  - » **Group-3: Not classified as carcinogen:** Inadequate evidence in humans an in animals. It includes coffee, Mercury, Paracetamol, crude oil etc.

B) CONCEPTUAL CLARITY: UNDERSTANDING HOW DIABETES MAY BE CAUSED BY NSS

- **How Sugar causes diabetes**:
  - » Under normal circumstances, glucose in the blood signals pancreas to make insulin, which then enters the blood. Insulin, in turn, helps sugar enter the body's cells so it can be used for energy.
  - » **When a person consumes high levels of sugars,** the pancreas pumps out more insulin to get blood sugar into cells. If this continues, the carefully orchestrated process goes haywire. The body's cell stops responding to all that insulin and become insulin resistant even if pancreas keep making more insulin to try to get the cells to respond. **Eventually the pancreas gives up** and stops releasing insulin, and blood sugar continues to spike, leading to diabetes.

- **How Non-Sugar Sweeteners may cause diabetes?**
  - » Pancreases react similarly to sugar and NSS as it can't differentiate between the two. As a result, they release insulin, increasing their levels in the blood. Subsequently cells become resistant to insulin and **pancreas become overworked and stop producing insulin**.

6) BIOTECHNOLOGY: GM INSECTS: NEW GUIDELINES

- **Practice Questions**:
  - » Discuss various applications of Genetically Engineered (GE) insects. Evaluate the various risks associated with the introduction of such insects and suggest measures to ensure sustainable and safe usage of GE insects [15 marks, 250 words]

- **A genetically modified (GM) insect** refers to insects whose DNA has been engineered through various genetic engineering tools like CRISPR CAS9.

- Various GE insects are available globally today. The **development and application of GE insects** offers applications in various fields:
  - » **Improving Human Health:**
    - » **Vector Management** in human and livestock health: GE mosquitoes for e.g. can be designed to carry genes that limit their ability to transmit diseases such as dengue, malaria etc.
    - » **Reduction in use of chemicals** -> Maintenance and improvement of both human health and environmental health.
  - » **Food Security:**
    - » **Management of crop insect pests**: Insects can be genetically engineered to carry traits that reduce the population of agricultural pests.
      - For e.g. introducing sterile males can help control pest population.
    - » **Increased food production: Protein production** for healthcare purposes; **honey production** etc.
      - Engineering honeybees to make better-quality and/or quantities of honey can contribute to reduced imports and may facilitate exports.
    - » **Improvement** in **beneficial insects** like pollinators, predators, parasitoids etc.

- **Economic Application:**
  - Other than improved agri production, improvements in productive insects (e.g. silkworm, lac insect) etc can promote economic growth.
    - E.g. GE silkworms can produce finer and/or cheaper silk, affecting prices and boosting sales.

- **Fighting pollution and ensuring environmental sustainability**:
  - Reduction in use of chemical will contribute to reduced pollution and environmental sustainability. Similarly, improved pollinators can contribute to biodiversity production.
  - Some GE insects can be used as bio-indicators to monitor pollution or detect some specific substance in environment.

- **Some Concerns**:
  - **Ecological Risk**: Once introduced in the environment, it's very difficult to contain these insects. And if some future problem emerges, it would be difficult to control.
  - **Unforeseen health implications** when these GM insects interact with humans.
  - **Bioweapons**: GE insects may be used to produce bioweapons.
  - **Regulatory challenges:** Government guidelines like Guidelines for Genetically Engineered insects; National Guidelines for Gene Therapy Product Development and Clinical Trials' have similar ambiguity.
  - **Ethical concerns**: GE insects raise a question – "If human being should act as God" and make changes in the living organisms around it.

- **Way Forward**:
  - **Updating policies and guidelines** to remove any ambiguity and defining clear purpose and goals of GE insects.
  - **Increased R&D and better Regulatory Oversight**: Increasing the capacity of DBT and other associated institutions to promote for R&D in the development and evaluation of GE insects.
  - **Effective Monitoring and Evaluation**: A robust monitoring and post-release evaluation mechanisms will be needed to track the impact of GE insects on health, biodiversity, and the ecosystem.
  - **International Collaboration** through bodies like FAO on understanding the impact of GE insects and sharing the best practices and technology.
  - **Stakeholder Engagement**: Participation of all the stakeholders including citizens, scientists, farmers, doctors etc in understanding the need of GE insects, their development and associated risks can give diverse perspective to decision making.
- **Conclusion**:

GE insects have the potential to solve a number of problems associated with health, food security and environment. But the expansion of their usage should by synchronized with comprehensive risk assessment, robust regulatory framework and inclusive stakeholder engagement

A) GUIDELINES FOR GENETICALLY ENGINEERED (GE) INSECTS: RELEASED BY DBT IN APRIL 2023

- The guidelines provide procedural roadmaps for those interested in creating GE insects.
  - » It intends to help Indian researchers navigate regulatory requirements.
  - » The guidelines are harmonized to guidance from WHO on GE mosquitoes.

- But **experts have identified some issues with the guidelines**:
  - » **Uncertainty of Purpose**: The guidelines don't specify the purpose for which GE insects may be approved in India. It only provides regulatory procedures for R&D on insects with some beneficial applications.
  - » **Uncertainty for Researchers**: The guidelines are applicable only to research and not to confined trials or deployment.
    - ▫ Government authorities will also have to closely follow the deployment of these insects. Once deployed, the GE insects can't be recalled, and unlike GM foods, they are not amenable to individual consumer choice.
  - » **Uncertainty of Ambit**: The guidelines offer SOPs for GE mosquitoes, crop pests, and beneficial insects – but what 'beneficial' means, in the context is GE insect is not clear.