



Curiosity for Basic Sciences

Continuing ideas for exploring the environment through International Years *2022 IY Basic Sciences for Sustainable Development*

By Jeanie Clark

WOW! The United Nations International Year's (IYs) themes have gone from creativity and the Arts in 2021 to curiosity and the basic Sciences in 2022! [1] (Numbers in square brackets are found on the list of weblinks at the end of this article.) The General-Secretary for the IY of Basic Sciences for Sustainable Development (IYBSSD) observes that "Every day, we use very basic sciences results, without even knowing it." [2]. So this year, you may like to focus on the basic sciences in your built, urban or natural environment. This article will provide some background about and suggest some ideas for exploring this IY with learners of varying ages.

Falling

In which direction do things fall? It's a basic science question. From observations, children pick up the physics principle that they fall down.

It can be fun to do an observational experiment with young learners to emphasise this principle. Choose a range of items (that won't matter if they get damaged) from different materials, different sizes and different weights and drop them from different heights - and be sure to clean up any mess! It should confirm that, regardless of size or materials, things fall down, like this tree on our car, which illustrates why the advice, when there is a storm coming, is to not park under trees!



Does this lead to the question of 'why' do things always fall down? About 1666, a young Newton wondered about this. The answer he came up with was the force of 'gravity' - a major step in the basic science of Physics [3]. This illustrates the importance of observing as the first step in science, from which great discoveries can be made.

Do you know the real story of the apple falling? Newton's family had gone to their country property to escape the pandemic of the day (the Plague) [4]. The family was drinking tea under the shade of some apple trees. Newton started thinking about why apples fall to the ground. (note, not hit on the head!) You can read what Newton said in 1752 about this event and what he thought then, from his memoirs on the web at 'Newton's Apple: the real story' [5] or 'The Newton Project' [6]. (Use the 'find' button for 'apple' to go to the relevant paragraph)

Basic Sciences

Do you and your children curiously observe your environment and investigate questions that arise in it? What basic science questions might arise about a stream like the one in the header photo?

Maths and/or computers can be used to record things like its water temperature, salinity or pH. Knowledge of biology, chemistry

and/or physics can be used to help to explain observations or questions, like about what is able to live in a rocky stream and why. Citizen science programs, like Waterwatch, Estuary-watch and River Detectives provide equipment, training and a place to share such basic science observations about water places. (These programs can be found with a search on the web.)

What are the 'basic sciences'? How would your learners define this term? The International Science Programme (ISP) at Uppsala University, Sweden, defines basic sciences as 'the scientific disciplines of mathematics, physics, chemistry, and biology' [7]. The European Platform of Women Scientists adds 'computer science' to this list of Basic or Pure or Fundamental Sciences [8]. (As a literacy exercise, check definitions of these sciences and branches.)

Benefits

Why has the UN chosen to link basic sciences with their Sustainable Development Goals? "Basic sciences provide the essential means to meet crucial challenges such as universal access to food, energy, health coverage and communication technologies." [9] Can your learners think of examples of sciences involved in current challenges - like equal access to food and vaccine distribution (in early January at the time of writing this)?

Llewellyn Smith, of CERN (European Organization for Nuclear Research) discussed four classes of the benefits of sciences that are 'motivated by curiosity', which he defines as 'basic sciences':

1. Contributions to culture
2. The possibility of discoveries of enormous economic and practical importance
3. Spin-offs and stimulation of industry
4. Education." [10].

(This comes from a longer article 'What's the use of basic science?', which is suited to older learners.)

Chair

This third benefit seems to be about applying scientific knowledge to make things. Let's consider something concrete for young people.. Take a walk around your place looking at some manufactured things, e.g. chairs, and identify materials they have been made of and their qualities. What do they have in common? How do they differ?

A report could be created to group those made of similar materials, in writing or by images. Then, consider the basic sciences needed to create a chair. Maths for measurements? Physics for a weight-bearing design? Chemistry for suitable materials?

What can be learnt from these scientific observations to apply to creating a new chair? Help is available on the web for an activity like this. The University of Colorado Boulder's 'Teach Engineering' website has a 'Chair Design Hands-on Activity' for upper primary-lower secondary students. It has full instructions, including design planning, materials needed, and assessment [11].



There may be many things that you come across during this year, which you might like to use to challenge your learners to identify the basic sciences underlying their creation and how such scientific knowledge could help make a new one.

Smart phones

What about a smart phone? What basic sciences would your learner think are involved in its creation? "Your smartphone alone contains a battery, that wouldn't exist without a basic understanding of electrochemistry; a touchscreen and a lot of transistors that rely on our understanding of the moves of electrons in solid materials; applications that are powered by mathematical algorithms, etc.," [12].

The chemistry of these phones is really quite remarkable. The American Chemical Society reports that 'Of the 83 stable (nonradioactive) elements [in the periodic table], at least 70 of them can be found in smartphones. ... An average smartphone may contain up to 62 different types of metals.' [13]. Really? The article, from which this quote comes, lists some of them. Could this be the motivation/ time to explore the Chemical Elements Periodic Table! Search the web for an image to suit your learners of this Table and fun ways to learn it - there are lots of them!

Further Benefits

For older learners, the ISP list of basic science benefits, includes the provision of 'a fundamental understanding of natural phenomena and the processes by which natural resources are

transformed.’[14]. This is much more complex and it needs to be applied in our lives to be better understood. An example could be using knowledge of the natural phenomena of plant growth and applying that to your natural resources of soil, water, seeds and sunlight to create a food garden.

Covid-19

Disease is another natural phenomenon. The IYBSSD reminds us that, despite how difficult the pandemic is, ‘Everything that helps us fight the pandemic and its consequences—are all rooted in basic sciences,’[15]. And so, cumulative knowledge gained from basic sciences helps us fight disease.

The IYBSSD has a timeline that shows some advances. Dating from 1800, it identifies eleven ‘discoveries and inventions ... based on curiosity-driven research, the applications of which were not foreseeable then’, but they have contributed to the fight against Covid-19 [16]. What would your learners add to this timeline?

The (developing) knowledge about the latest variant, now Omicron, first reported in South Africa, illustrates how our globalised world builds on research to respond to health challenges. Science

/ knowledge is growing in how to reduce potential impacts on productivity and economic growth, too. Older learners might investigate the sciences that underlie identifying, testing, treating, and communicating about this virus and its variants. [18]



With whatever is in your surroundings, may you inspire curiosity and the use of basic sciences to explore it. May you thus support the IYBSSD goal ‘to highlight ... the basic sciences that have played a fundamental part in development throughout the world, and that are needed even more for progress—sustainable progress—in the future’ [17], i.e. in sustainable development. May you enjoy doing many basic science activities in this 2022 IYBSSD.

© Text and photos Jeanie Clark, enviroed4all@, Warracknabeal 2022

Direct links to webpages in this article

- [1] IYBSSD 2022, ‘About IYBSSD 2022’ at <https://www.iybssd2022.org/en/about-us/>
- [2] Allemand, Luc. (IYBSSD general secretary). 2022 In *História, Ciências, Saúde—Manguinhos*. reprinted at <https://thecsrjournal.in/2022-international-year-basic-sciences-sustainable-development-un/>
- [3] Ravilious, Kate. 2020 ‘Isaac newton: Who he was, Why apples are falling’ in *National Geographic Resource Library*, 12 March 2020. At <https://www.nationalgeographic.org/article/isaac-newton-who-he-was-why-apples-are-falling/>
- [4] Open Mind, BBVA, 2021 the Legend of Newton’s Apple Tree” at <https://www.bbvaopenmind.com/en/science/physics/legend-of-newtons-apple-tree/>
- [5] Geffer, Amanda. 2010 “Newton’s apple: The real story” in *New Scientist*, 18 January 2010, at <https://www.newscientist.com/article/2170052-newtons-apple-the-real-story/>
- [6] Stukeley, William. 1752 *Memoirs of Sir Isaac Newton’s life*, published on line in ‘The Newton Project’ 2004 at <https://www.newtonproject.ox.ac.uk/view/texts/normalized/OTHE00001>
- [7] Upsala Universitet, ‘ISP and the basic sciences’ at <https://www.isp.uu.se/basic-sciences/>
- [8] The European Platform of Women Scientists, 2021. ‘EPWS becomes a partner of the International Year of Basic Sciences for Sustainable Development 2022’ at <https://epws.org/partner-international-year-of-basic-sciences-sustainable-development/>
- [9] Michel, Spiro. 2022 (President of International Union of Pure and Applied Physics) at <https://www.iybssd2022.org/en/about-us/>
- [10] Llewellyn-Smith, C.H. “What’s the use of basic science?” https://www-zeuthen.desy.de/~jknapp/JK/Reading_files/basic_science.html
- [11] School of Engineering, University of Colorado Boulder, Teach Engineering STEM curriculum for K-12, Hands-on activity. ‘Chair Design’ at https://www.teachengineering.org/activities/view/chair_design
- [12] Rohrig, Brian. “Smartphones – smart chemistry” in Chemistry Matters online at <https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues/archive-2014-2015/smartphones.html>
- [13] *ibid* [12]
- [14] *op cit* [6]
- [15] ‘Basic Sciences in the age of Covid-19’ at <https://www.iybssd2022.org/en/home/>
- [16] Dharmargajan, Guha (Uni Georgia), Allemand, Luc (Afriscitech) & Omungo, Rosalia “Basic sciences vs COVID_19: A long term fight’ at <https://www.iybssd2022.org/wp-content/uploads/IYBSSD-Timeline-COVID-A2.jpg>
- [17] International Council for Industrial and Applied Mathematics 2022: International Year of Basic Sciences for Sustainable Development (IYBSSD) at <https://iciam.org/news/21/6/15/2022-international-year-basic-sciences-sustainable-development-iybssd>
- [18] IYBSSD, 2022, ‘Logo of the International Year of Basic Sciences for Sustainable Development 2022’. at <https://www.iau.org/public/images/detail/ann21063a/>