Problems for the 9th IYNT 2021

Nature cannot be fooled.
Richard Feynman

Main Problems for Science Fight 1

1. Coin in a balloon
An inflated air balloon contains a coin and is gently moved to set the coin rolling around the inside of the balloon. Explain and investigate the buzzing sound produced in this experiment.

2. Liquid layers
Water and vegetable oil do not mix and form two layers in a beaker. It is possible to fill the beaker with many more layers of immiscible fluids. How many layers can you obtain? Investigate the motion of the interfaces if the beaker is disturbed or shaken.

3. The Purkinje shift
As light levels decrease, human eyes perceive relative brightness and contrast of various colors differently. Perform experiments in controlled conditions to investigate this effect.

4. Making butter
Investigate the methods to produce homemade butter from milk or cream. Investigate how properties of the butter depend on relevant parameters.

5. Lake water
A drop of water from a natural pond may contain bacteria, archaea, algae, fungi, protozoa, and other organisms. Perform observations to identify as many species of living organisms as possible. What are the chances that another drop contains a different selection of species?

6. Tall towers
A tower is built by stacking rectangular bricks on top of each other. Some people argue that the maximum height of the tower is limited by the human skill to place the bricks gently; others may say that the limiting factor is non-perfect shape of the bricks. Perform experiments to outline the factors that limit the maximum height of such a tower.

Main Problems for Science Fight 2

7. Electricity meters
Energy meters installed at your home have been measuring power usage for decades. Collect periodic readings for a sufficiently long period of time, e.g. last 20 years, and identify subtle or significant changes in energy using behavior at your home. When did your family switch from incandescent to fluorescent or LED bulbs? Is there a history of electric heating or air conditioning? Are there regular seasonal variations in power usage?

8. When dumplings rise
Frozen dumplings sink in water. However, they rise to the surface when cooked in boiling water. Are the dumplings ready once they float? Investigate this effect.

9. Salt and ice
Study the effectiveness of salt to melt ice cubes.

10. Blurred text
Printed text is well visible if covered with a piece of transparent film. As the film is lifted, the text becomes blurred and may gradually disappear. What parameters of the film are relevant? Investigate this phenomenon.

11. Oxygen from plants
Suggest an experimental method to measure how much oxygen is produced by a green plant.

12. Zinc layers
If a copper coin and small granules of zinc are immersed into a solution of zinc sulphate and then heated, a layer of zinc appears on the coin. What is the thickness of the zinc layer? What other metals can be covered with zinc in such an experiment? Investigate and explain the effect.

Problems *Invent Yourself* for Science Fight 3

13. Invent Yourself: Skin conductance
Conductance of human skin is often dependent on psychological condition and emotional stimulation. Suggest an interesting problem requiring experimental measurements of respective parameters.

14. Invent Yourself: Epidemiology
The human society has been profoundly affected by the COVID-19 pandemic. Propose a study involving analysis of available epidemiological data for the pandemic.

15. Invent Yourself: Hearing range
There is a considerable variation in the range of frequencies that can be heard by humans and other mammals. Suggest a problem to investigate the lowest and highest audible frequencies for specific species of societal groups.

16. Invent Yourself: Weak signals
Controlling signal-to-noise ratio is important in many measurements to distinguish a meaningful signal from statistical fluke. Propose a problem requiring experiments to detect very weak signals.

17. Invent Yourself: Standing waves
Formulate a problem about an interesting experiment where standing waves are observed.