Problems for the 4th IYNT 2016

"The first thing I want to say is thank you for letting me speak and thank you for not canceling my fellowship because I was younger than you might have expected. Often, I am younger than I might have expected, but this does not stop me from doing my work."
Reif Larsen, "The Selected Works of T.S. Spivet"

1. Invent Yourself: Air Traffic

Some web services, e.g. Flightradar24, aggregate and provide data on positions, altitudes, speeds, and other parameters of almost any commercial flight in the World. Suggest an investigation of an interesting scientific aspect of air traffic or flights using such data.

2. Invent Yourself: Weather Forecast

It is often argued that some of weather lore is true and has predictive value. Suggest a scientific test of two popular sayings forecasting respectively short-term and long-term weather trends.

3. Invent Yourself: Human Reaction Time

The time of human reaction to sound, light, and other stimuli is an interesting parameter. What does this time depend on? Propose an interesting experimental study that concerns the time of reaction.

4. Van der Graaf's Cat

A cat may crackle when petted. Parameterize and investigate the static electricity in cat's fur. How can one make this static discharge stronger or weaker?

5. Tempest in a Glass of Water

When water is poured into a glass, its dynamics is complex and intense. Even when the liquid surface settled down, it may take time before the water flow slows down and stops. Investigate this storm in a glass.

6. Dice

In many games, dice are thrown to obtain random results. How does the result of a die roll depend on its height above a table, if the die is released at zero initial speed?

7. Plants in Motion

Various plants can turn in response to the position of the sun or other light sources. Investigate this motion experimentally and theoretically.

8. Zipf's Law

Human language is described by unusual distributions. Take your favorite book and count how many times the most frequently appearing word (rank one) appears; the second most frequent word (rank two) appears, etc. Investigate and explain the dependence of the word count on its rank in the frequency table. Would it be the same for another book in the same or different language?

9. Cinder

In the Middle Ages, people used to wash the cloth in cinder. Study the effectiveness of cinder in washing clothes.

10. pH Indicator
The juice of many fruits or vegetable crops contains a natural pH indicator that changes colors according to the acidity or basicity of the solution. Investigate such pH indicator juices and their mixes. Propose the most precise and effective composition and compare its properties with those of common indicator paper.

11. Corrosiveness of Cola
It is often argued that cola is so corrosive that can be used to clean metal objects. Investigate this property of cola.

12. Ants and Food
Investigate what food attracts ants. Try different foods and introduce parameters to describe the reaction of ants.

13. Firelighting
Investigate various methods to start a fire by friction.

14. Effervescent Tablet
The rate of some chemical reactions may depend on surface area. Break effervescent tablets into smaller parts, or stir them into powder, to study how the dissolution rate depends on the surface area.

15. Mountain Peaks
What methods are used to determine the elevation of the World's highest mountains? Suggest your own experimental method and determine the height of a mountain or a hill of your choice.

16. Two Shovels
Sink two metal shovels deep into the soil outdoors, e.g. in a garden or in a field. Determine the dependence of the resistance between the two shovels on the distance between them in a sufficiently wide range, e.g. 0 to 25 meters.

17. Swadesh List
Many words in related languages (e.g. Kazakh and Turkish, or Croatian and Belarusian) can match or differ by a few sounds only. Study this similarity quantitatively for the language pairs of your choice. When did these languages separate from a common ancestor?