

## ACCURACY AND PRECISION

In some languages, there is no distinction between **accuracy** and **precision**. But in scientific English they mean different things. Accuracy is the degree to which a result agrees with the theoretical value. Precision indicates how well that result can be repeated. If you think of archery, an accurate imprecise archer will shoot a series of arrows; the average of the series of shots will be the center of the target, but the individual arrows are scattered over the target's surface. A precise inaccurate archer will be able to repeat the position of the arrows very well, but the position of the arrows averaged over a number of shots will be far from the center of the target. A precise accurate archer hits the center of the target every time. Both accuracy and precision are useful to know when evaluating experimental results, especially when introducing a new technique or measuring fundamental constants.

Do the sentences below indicate accuracy, precision, or both?

1. As the gun warmed up, it was hard to repeatedly hit the target. \_\_\_\_\_
2. The students reported that the speed of light is  $2 \times 10^8$  m/s, an error of -33%. \_\_\_\_\_
3. The rest mass of the neutron is 1.008 665 012 amu (atomic mass units) with 0.037 ppm (parts per million) error. \_\_\_\_\_
4. Our mean value was 50 GPa; our standard deviation was 5 GPa. \_\_\_\_\_
5. The R value from the least-squares fit was 0.987. \_\_\_\_\_
6. We used a standard to calibrate our instrument. We think that the values we obtained are good to within 5%. \_\_\_\_\_
7. If you can measure the fine structure constant to three significant figures (137), then you don't have a very good instrument. However, if you can measure it to nine significant figures (137.035 963), then I want to see your lab! \_\_\_\_\_
8. The reproducibility of the experiment is a few degrees Centigrade. The temperature can be measured to plus or minus five degrees. \_\_\_\_\_

## ACCESS AND ASSESS

The words access and assess could easily be confused in scientific writing. They sound almost the same and are spelled similarly, but they have different meanings. Access means the ability or permission to approach, enter, speak with, or use. Assess means to evaluate, to fix a value, or to impose a tax upon. Both are transitive verbs, in other words, they require an object.

They can be made into adjectives—accessible and assessable. Access is also a noun, but assess is not (although assessment is).

### A few examples:

The images allowed us to assess the severity of the problem.

The room at the top of the stairs is not accessible by wheelchair.

I just installed my computer. I don't yet have access to the Internet.

Although this phenomena is complex, it is assessable.

### Try these yourself...

1. He gave me \_\_\_\_\_ to the lab.
2. Could you please \_\_\_\_\_ this paper?
3. Your server is not \_\_\_\_\_ by my computer.
4. This technique should give us \_\_\_\_\_ to the problem. Then we can make an \_\_\_\_\_ of how well we understand the phenomena, and what experiments we should do next month.

## AS, BECAUSE, SINCE

As, because, and since overlap in meaning. This can lead to confusion, because since and as have alternative definitions. Since also means "from a past time up to the present", and as has many (at least 32!) alternative definitions, including:

1. to the same degree, amount, or extent; similarly; equally
2. for example; for instance
3. thought to be or considered to be
4. in the manner of
5. at the same time that

Because is the only unambiguous one of the three. It means "for the reason that" or "by reason of". (Never use the redundant phrase "the reason is because".)

### Consider

- A. I didn't hear her enter as I was concentrating.  
B. Since the instrument broke, I've been very busy.

Does **A** mean that because I was concentrating, I didn't hear her enter, OR does it mean that she entered at the same time that I was concentrating? Similarly, for **B**, have I been very busy because the instrument broke, OR busy just in the time after the instrument broke until now?

Try finding the least ambiguous answer to put into the sentences below.

1. \_\_\_\_\_ in the kitchen, we are now going to cook up a sample.
2. \_\_\_\_\_ the first of the year, I was in America four times.
3. \_\_\_\_\_ you left the door of the refrigerator open, we will lose all our food.
4. \_\_\_\_\_ fat as the Titanic, he couldn't fit through the door.

## MAKE AND DO

"**Make**" and "**do**" are difficult for non-native speakers because often you use only one verb e.g. "**faire**", in French - to express the meanings of both "make" and "do".

It's impossible to list all of the different ways that "make" and "do" are used.

"Make" is used more frequently in the sense of fabrication, or of successfully achieving a goal.

"Do" is more often used for the sense of performing a task or used as an auxiliary verb. Here are some examples of the most common usages.

- ✓ Meeting someone at a party: "What do you do?" = "What is your profession?" "What do you make?" = "How much money do you earn?"
- ✓ Advent: "I made my business card" = "I designed and printed my business card"
- ✓ "I did my business card." = "I wrote and mailed my business card"
- ✓ Traveling: "Did you make your train?" = "Did you catch your train?"
- ✓ Between colleagues: "Do you need help?"....."Yes, I do."

**Now, here's a test- Two students are talking about their research project:**

Student 1: "Have you \_\_\_\_\_ the sample?"

Student 2: "No, I \_\_\_\_\_ it tomorrow, then I \_\_\_\_\_ the experiment."

Student 1: "If you \_\_\_\_\_ the experiment, \_\_\_\_\_ you want me to write the lab report?"

Student 2: "Yes, I \_\_\_\_\_. I hope that we can \_\_\_\_\_ our Professor happy."

Student 1: "It would \_\_\_\_\_ me happy if we \_\_\_\_\_."

## EXPERIENCE AND EXPERIMENT

An experiment is what you do to investigate something. It is the process by which you learn something. Also, don't use the word "experiment" to refer to the instrumentation with which you do the experiment. You can say "experimental setup", but the experiment is the PROCEDURE you use to test a hypothesis.

An experience is something that happens to you that is memorable in some way. Here are some of the definitions.

### Experience -noun

1. A particular instance of personally encountering or undergoing something: My encounter with the bear in the woods was a frightening **experience**.
2. The process or fact of personally observing, encountering, or undergoing something like a business experience.
3. Knowledge or practical wisdom gained from what one has observed, encountered, or undergone: a man of experience.

### Experience -transitive verb

4. to have experience of; meet with; undergo; feel: to experience nausea.

### Experiment

1. A test, trial, or tentative procedure; an act or operation for the purpose of discovering something unknown or of testing a principle, supposition, etc.: a chemical experiment.
2. The conducting of such operations; experimentation: a product that is the result of long experiment.

**To summarize, experiences are personal, and experiments are scientific.  
Test your knowledge!**

1. I went helicopter skiing last year. What an .....
2. The ..... indicates that the modulus of a single nanotube is approximately 1 TPa.
3. The sample is not fixed rigidly in place. Why don't you ..... with different glues?
4. I have little ..... with research. I'm still an undergraduate.