

## Lesson 2: Precision and Accuracy

In everyday language "precise" and "accurate" mean roughly the same thing... but not in physics.

**Precise** - after taking a lot of measurements, you notice that they are all very close to each other.

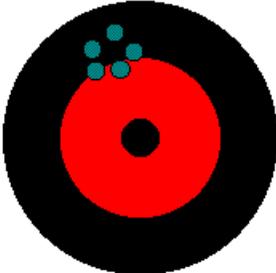
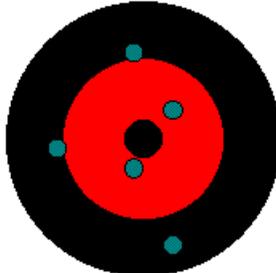
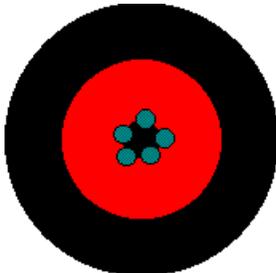
**Accurate** - after taking a lot of measurements, you find they agree with the true value

**Example 1:** You perform an experiment to measure the temperature at which water boils. You set up three containers of water and heat each one. At the instant the water boils you measure the temperature and get the following results:

|      |      |      |      |      |
|------|------|------|------|------|
| 67°C | 68°C | 68°C | 65°C | 66°C |
|------|------|------|------|------|

Notice these values are precise (they are almost the same, they agree with each other), but they are not accurate. They would have to be at about 100°C, the accepted value, to be accurate.

**Example 2:** I ask you to throw five darts at the centre of a dart board. You try three times with the following results.

|   |   |
|---|---|
|   | <p><b><i>All your darts hit off centre!</i></b></p> <p>If you look at the darts shown here, you'll agree that they all hit in more or less the same location on the dart board, but they did not hit the intended target.</p> <p><b>Good Precision</b> - all the hits are close to each other</p> <p><b>Poor Accuracy</b> - the hits are not near their intended target</p> |
|  | <p><b><i>Your darts are all over the place!</i></b></p> <p>On this turn your darts went flying all over the place. They look like they've been scattered randomly.</p> <p><b>Poor Precision</b> - the hits are not near each other</p> <p><b>Poor Accuracy</b> - the hits are not near their intended target</p>  |
|  | <p><b><i>Got It!</i></b></p> <p>Well, you've certainly showed just how all those physics lessons paid off! All of your darts hit the centre!</p> <p><b>Good Precision</b> - all the hits are close to each other</p> <p><b>Good Accuracy</b> - all the hits are near their intended target</p>  |

In science, it is important to be as precise and accurate as possible. But, there is such a thing as trying to be too precise and accurate.

**Example 3:** You give someone a metre stick and ask them “How tall is the doorway?” They come back to you and tell you it is 1.876534693 metres high. **Explain** if it is possible for them to make a measurement like this with a metre stick.

Nope! You can not be that precise or accurate with a metre stick! To do a measurement like that and actually have precision and accuracy you would need a device that uses a laser.

As a rule of thumb, look at the smallest unit on your measuring device. You can probably measure to within half of that...

- Most rulers show millimetres. You could safely measure something with a regular ruler to within half a millimetre.

**Example 4:** In the previous example, **explain** what a more reasonable measurement may be. It would be more reasonable for the measurement to be 187.65 cm (notice that I give the value to within half a millimetre). The units used (centimetres) are reasonable to use for a doorway.