



Quality Assurance (QA), Quality Control (QC), Good Lab Practices (GLP) in soil laboratories.

Christian Hartmann

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14 Nov. 2022 (10:30 – 11:00)
JICA training



Quality Assurance (QA) Quality Control (QC) Good Lab Practices (GLP) in soil laboratories.

Dr Christian Hartmann

IRD-France

GLOSOLAN steering committee



I – INTRODUCTION:



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DEFINITIONS & CONCEPTS

QUALITY (Q):
Q.Assurance, Q. Control, Q. management....

I – INTRODUCTION:

DEFINITIONS & CONCEPTS

QUALITY (Q), Q.Assurance, Q.Control, Q. management....

SIMPLIFIED....



QUALITY: of a product...

A product has good quality when:

it fits with the requirements specified by the client.

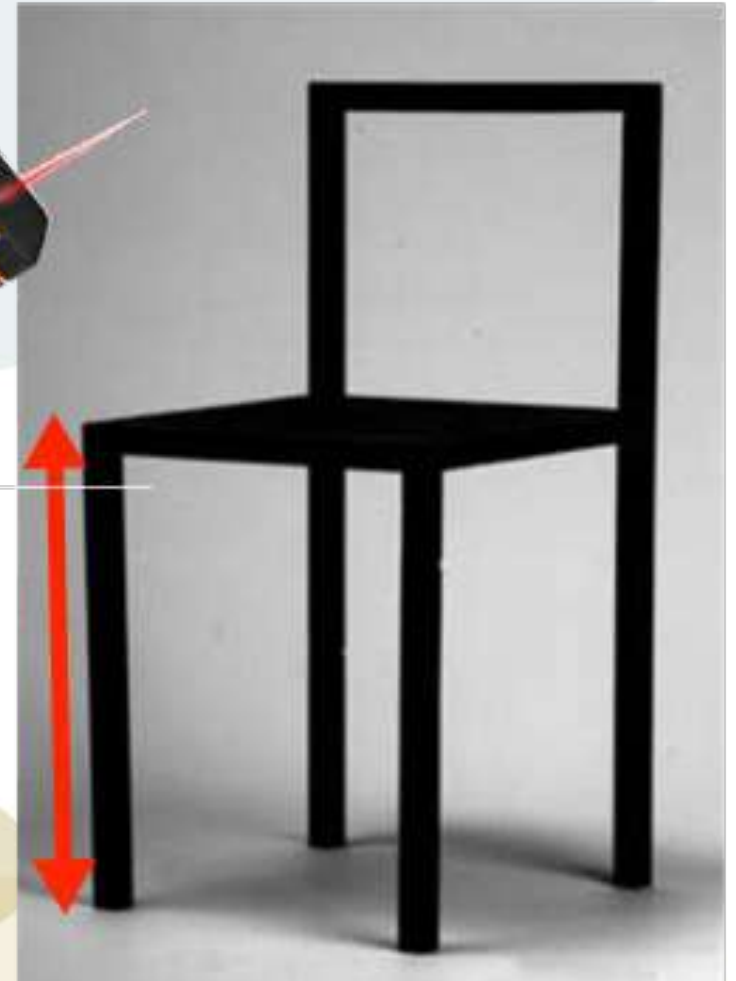


QUALITY: of a product...

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Client:



QUALITY: of a product...

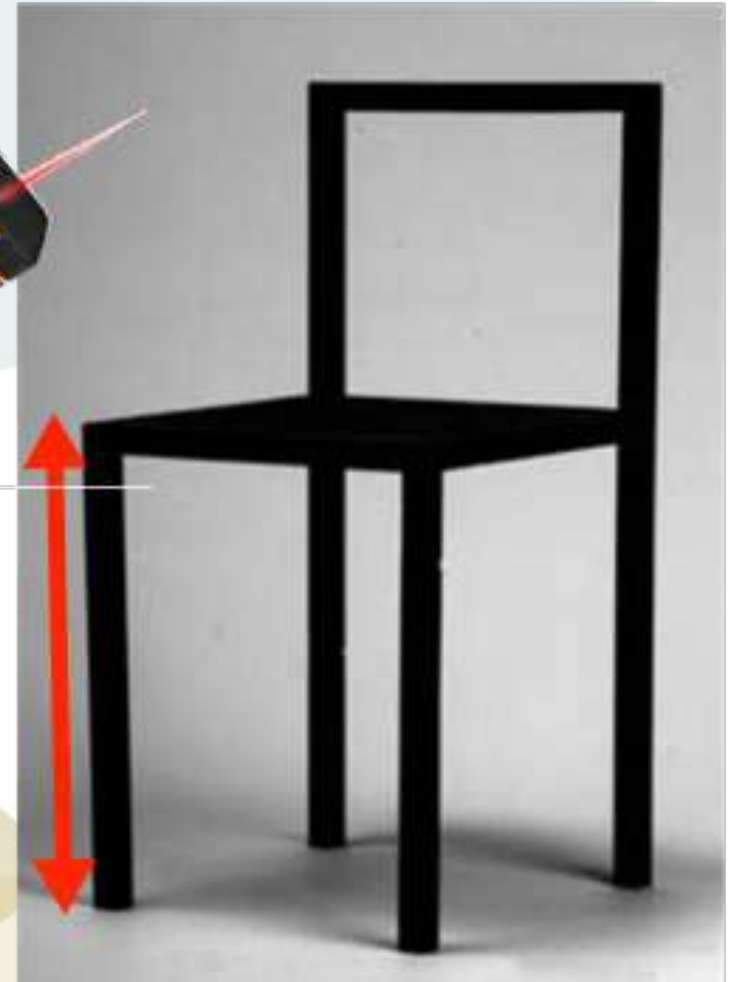
A product has good quality when:

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Client:

Factory

**435 mm
+/- 1 mm**



QUALITY: of a product...

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Client:

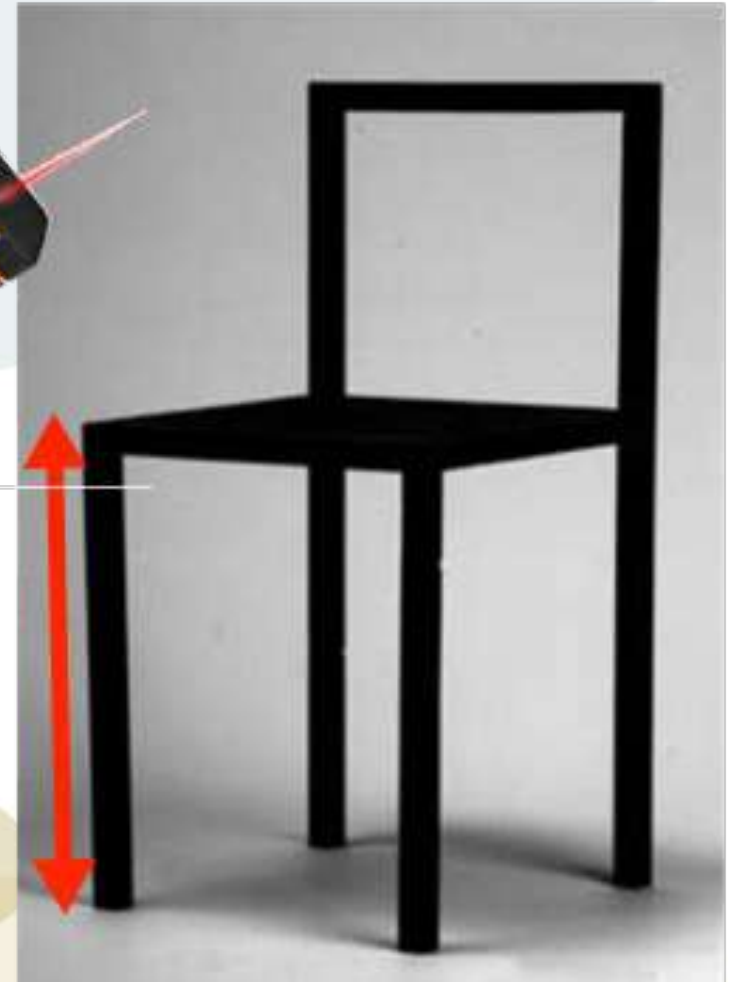
Factory

**435 mm
+/- 1 mm**



Restaurant

approx. 40 cm



Analytical testing: your product is a result.

What is a good quality result?



Analytical testing: your product is a result.

What is a good quality result?

**“A good result
provides a *reliable information*,
within an agreed precision and accuracy.”**



***Good Q. result = reliable information,
within an agreed precision and accuracy.***



***Good Q. result = reliable information,
within an agreed precision and accuracy.***

Quality Management (or Good Lab. Practices)

Quality Assurance (QA)

Quality Control (QC)

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Quality Management (or Good Lab. Practices)

Represents all activities which objective is the production of good quality results.

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Quality Assurance (QA)

All actions made to provide confidence in quality of your result.

(The Quality Assurance Officer should be someone independent of the work.
If no QA officer is available, then Laboratory manager (=YOU!) performs this job.)

Quality Control (QC)

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Quality Management (or Good Lab. Practices)

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All actions made to provide confidence in quality of your result.

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Quality Control (QC)

The techniques and activities that are used to satisfy quality requirements.



DEFINITIONS & CONCEPTS

(continued)

RESULT:



DEFINITIONS & CONCEPTS

(continued)

**RESULT:
TRUE VALUE, MISTAKE, ERROR, UNCERTAINTY,
PRECISION, ACCURACY....**



For analytical testing:
***impossible* to make an exact measurement**
==> impossible to get the true value.



For analytical testing:
impossible to make an exact measurement
==> impossible to get the true value.

**A good result will only be
as close as possible
from the true value.**



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Why impossible to reach the true value?



For analytical testing:
***impossible* to make an exact measurement**
==> impossible to get the true value.

**A good result will only be
as close as possible
from the true value.**

Why impossible to reach the true value?
because you will always have errors.




**True value: possible if
you are counting.**



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you are counting.**






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Number of eggs = $3 \times 4 = 12$






**True value: possible if
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**Finding 10 or 11 is a mistake,
mistake \neq error**





**True value: possible if
you are counting.**

Number of eggs = $3 \times 4 = 12$

**Finding 10 or 11 is a mistake,
mistake \neq error**

but measuring is different from counting!



measurement has imperfections



measurement has imperfections

==>measurement give rise to errors



measurement has imperfections

==>measurement give rise to errors

measures ==> errors



Error (some examples):



Error:



[Figure 20](#): Liquid in a Burette



Error:



≠ 39.7

≠ 39.8

[Figure 20](#): Liquid in a Burette



Error:



Figure 20: Liquid in a Burette

≠ 39.7

≠ 39.8

≠ 39.71?

≠ 39.72?

**anyway my
result will
have an error**



Error:

**the difference between
your result and the "true" value.**

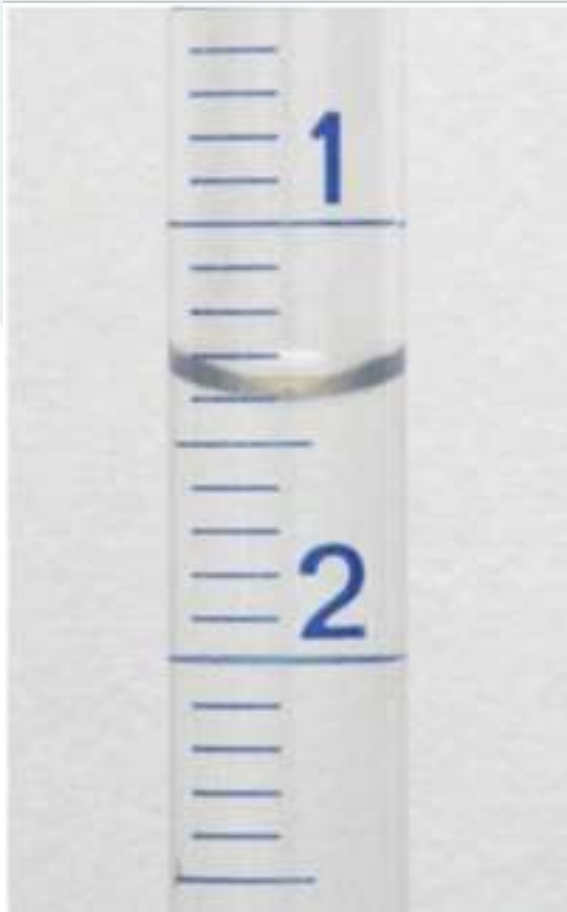


Error:



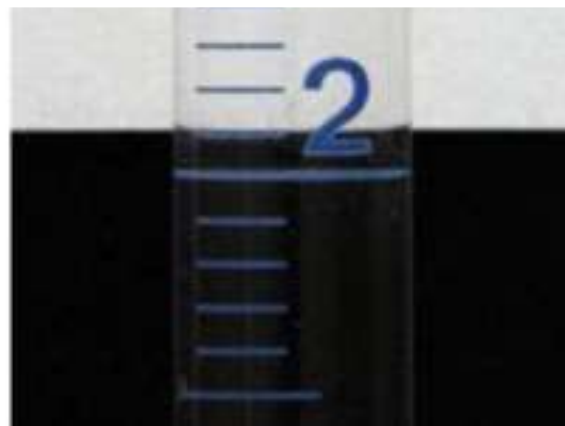
Error (one more exemple...):

1.4 !



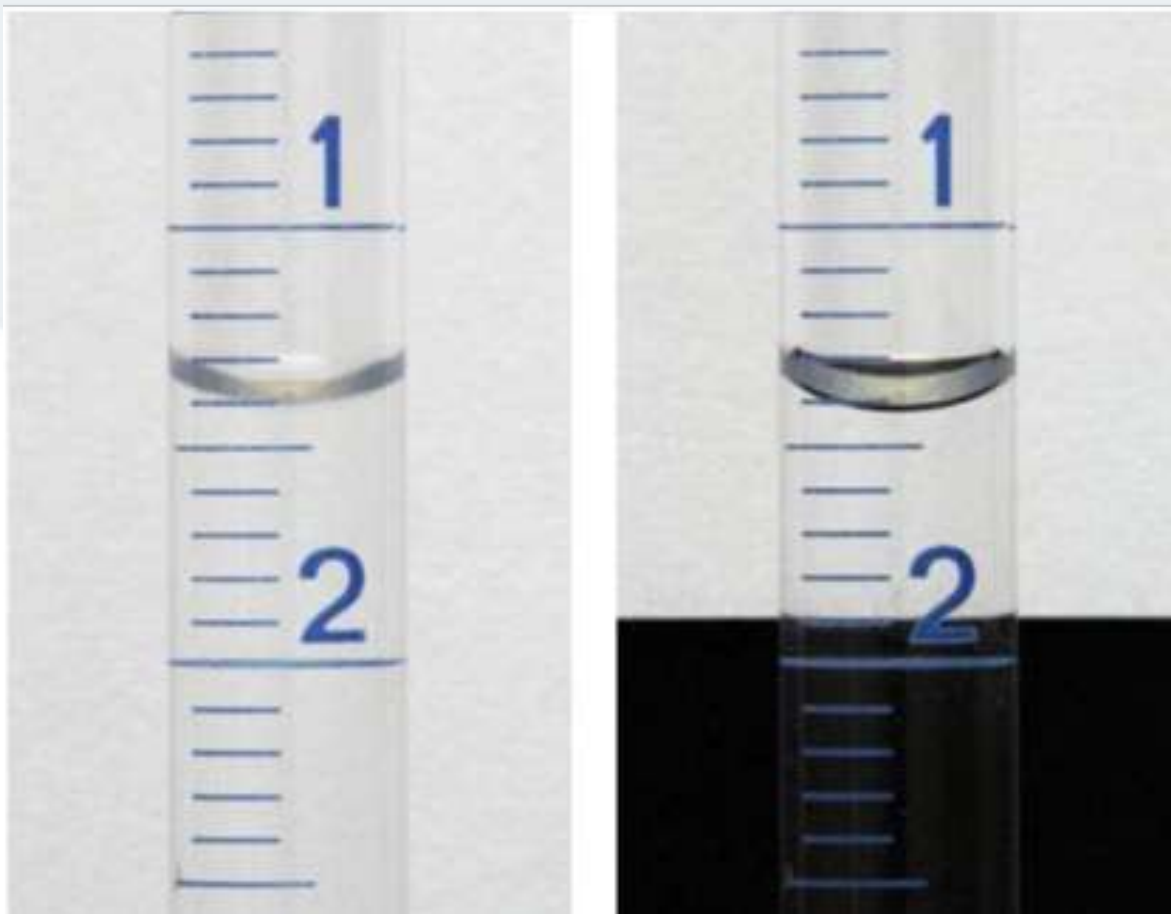
Error:

1.4 !



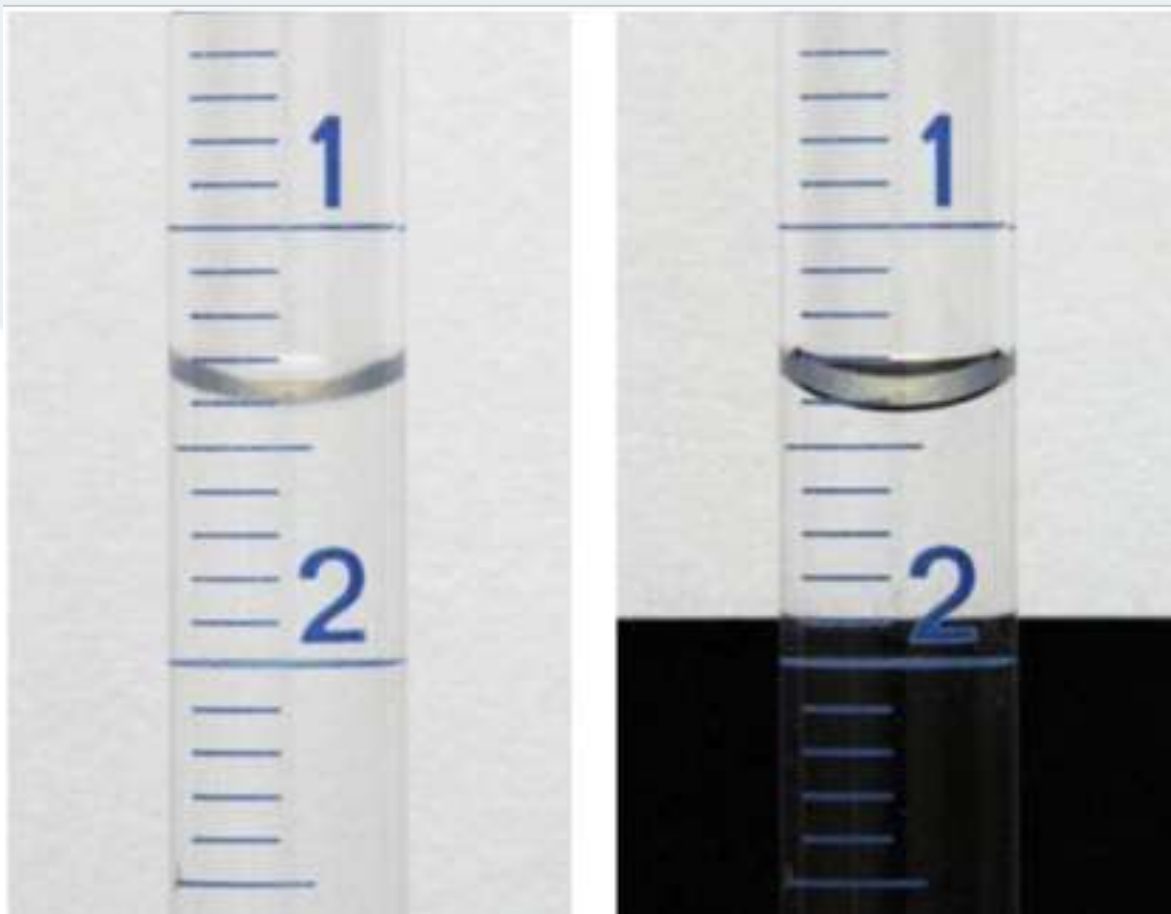
Error:

1.4 !



Error:

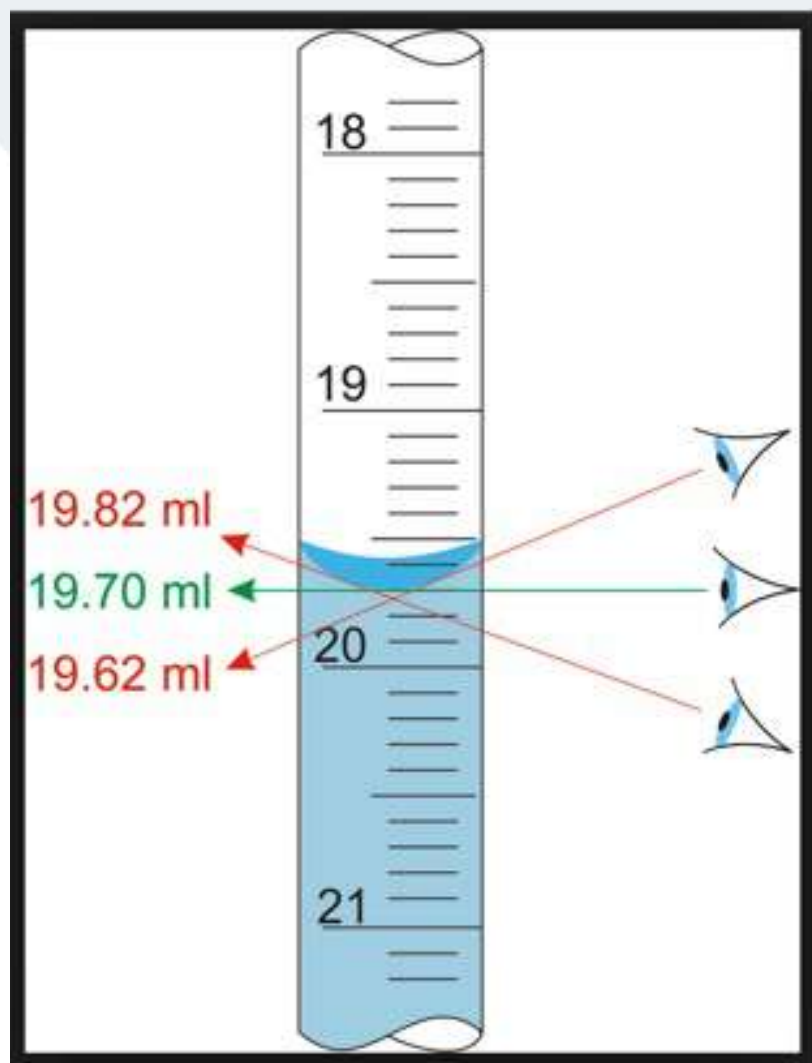
1.4 !



≠ 1.4 🙄



Error (the most common one):



Your objective:

to get as close as possible from the
true value,

that you can NEVER reach...



To describe the quality of analyses:

Precision: the closeness of the replicates.

Accuracy: the closeness to the "true" value.

True value = middle of the target..



If you are a beginner:



If you are a beginner:



random distribution!

large errors



after some training:



after some training:
you can improve, having arrows together
(**precision**)



after some training:
you can improve, having arrows together
but still not in the center, (not accurate)



after more trainings:
PRECISE and ACCURATE!



after more trainings:
PRECISE and ACCURATE!



congratulations

but if you stop training...



random again....



random again....



SEALNET | SOUTH-EAST ASIA LABORATORY NETWORK

To describe the quality of analyses:

Precision: the closeness of the replicates.

Accuracy: the closeness to the "true" value.

Precision:

high

low

Accuracy:

high

low



Precision:

high

low

Accuracy:

high



low



Precision:

high

low

Accuracy:

high



low



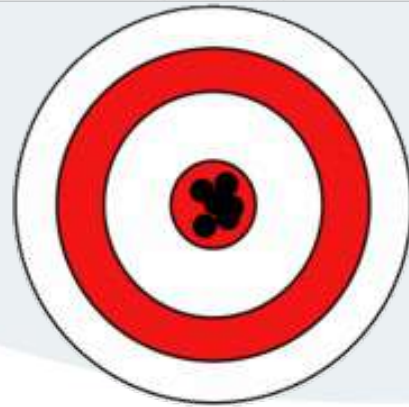
Precision:

high

low

Accuracy:

high



low



Precision:

high

low

Accuracy:

high



low



Precision:

high

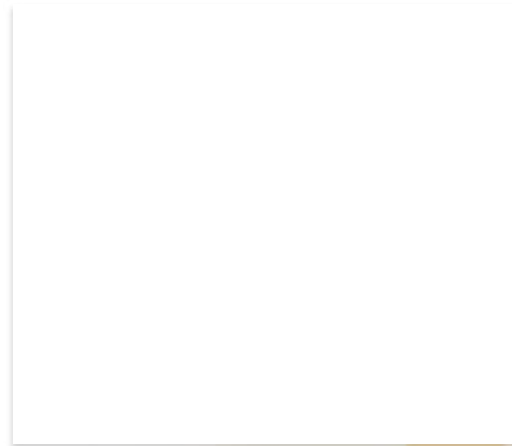
low

Accuracy:

high



low



Precision:

high

low

Accuracy:

high



low



Accuracy and precision in every day life....



Accuracy and precision in every day life....

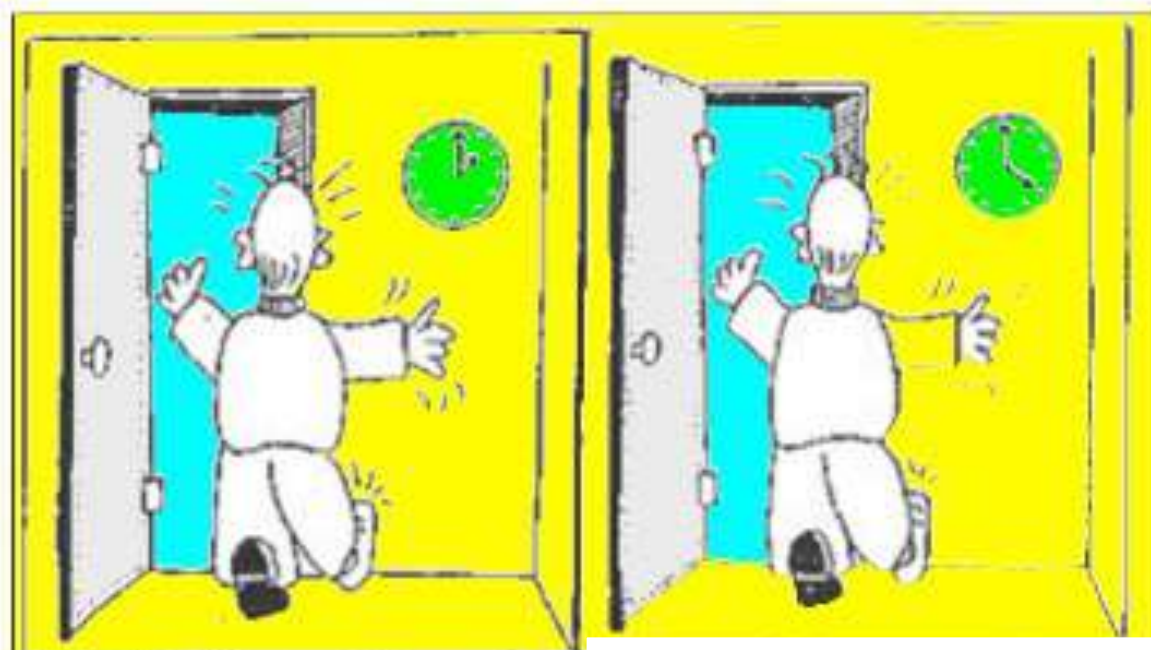
going through a door with:
high precision
but low accuracy



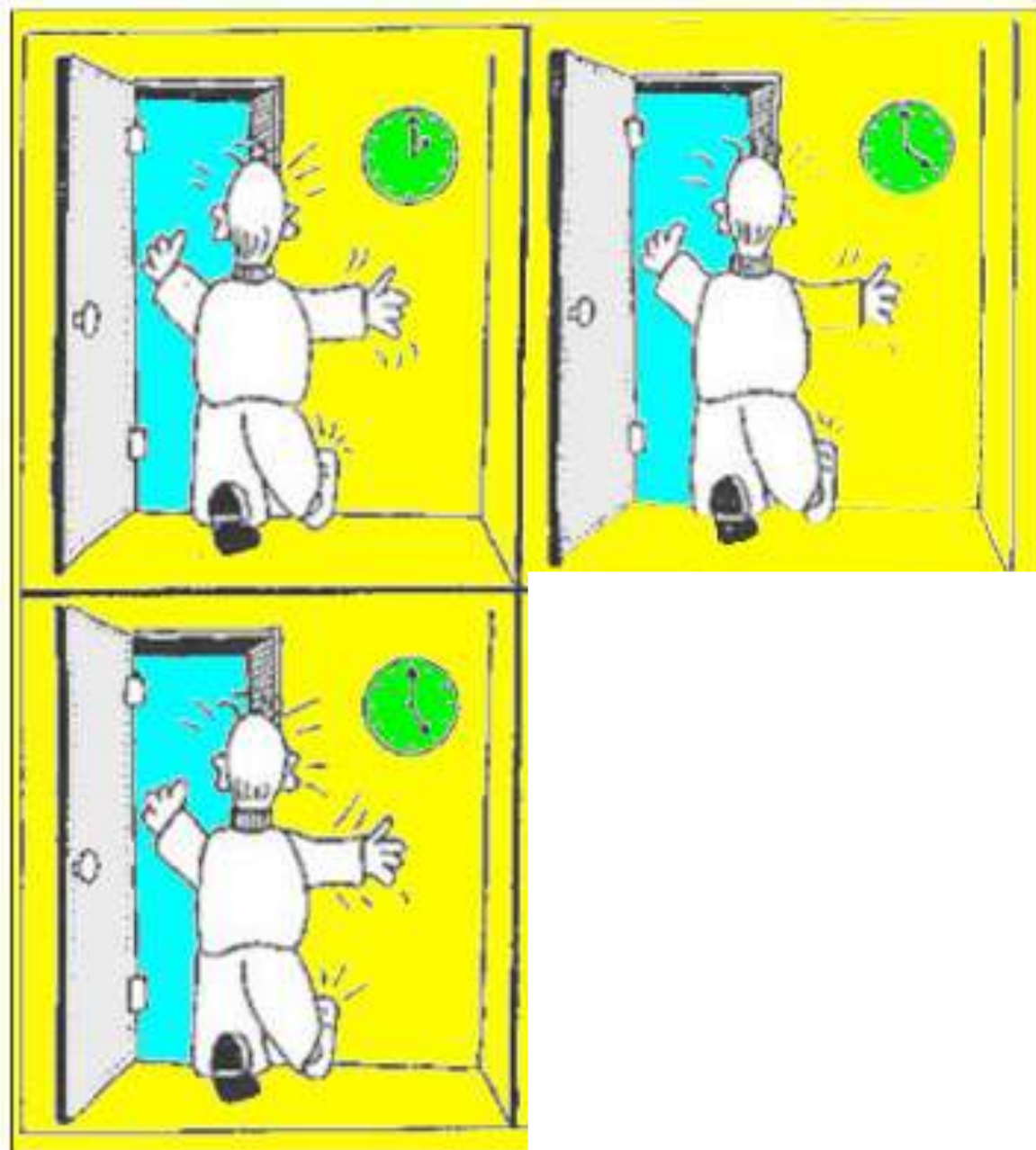
Accuracy and precision in every day life....



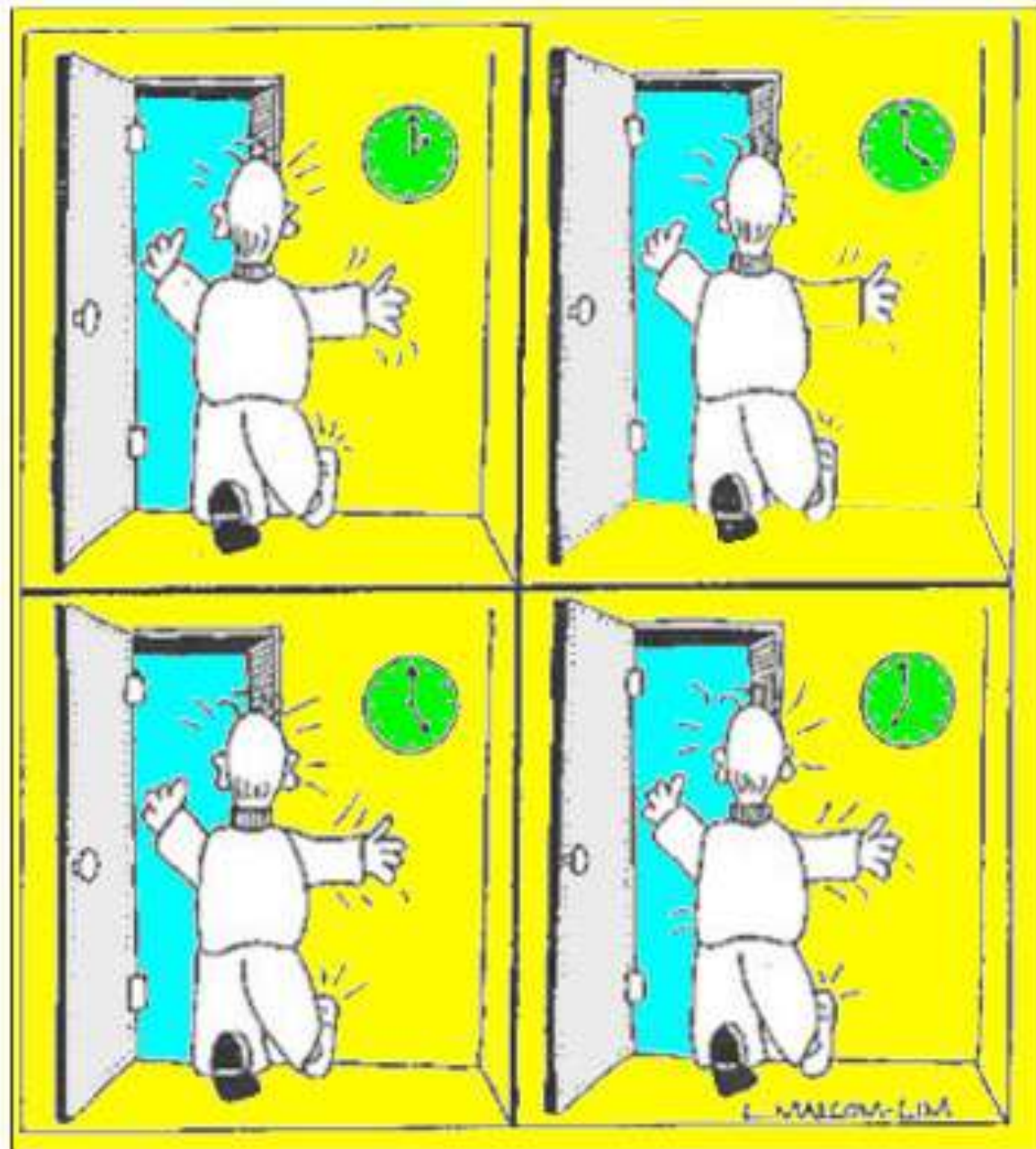
Accuracy and precision in every day life....



Accuracy and precision in every day life....



Accuracy and precision in every day life....



Accuracy and precision with machines....



Accuracy and precision with machines....

very necessary in this case...



Error:

**the difference between your
result and the "true" value.**

Where is the error coming from?

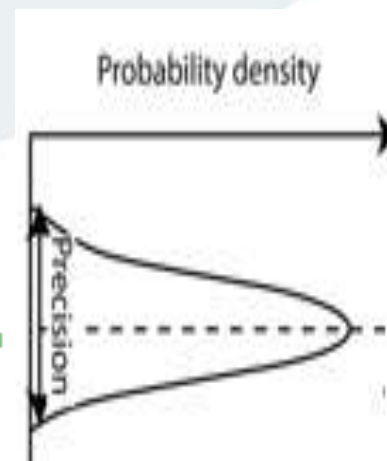
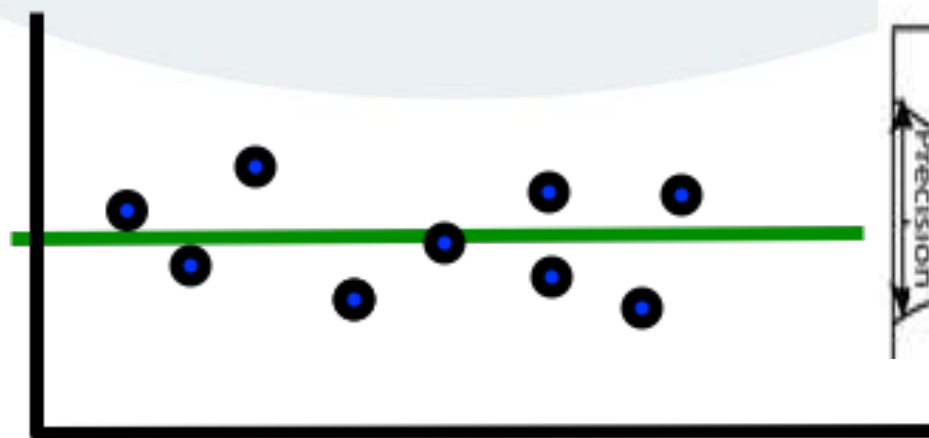
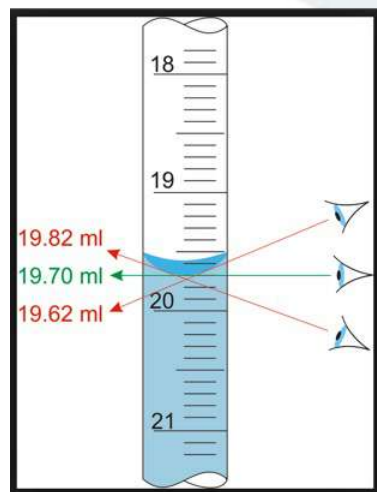


Analytical errors can be of 2 categories:



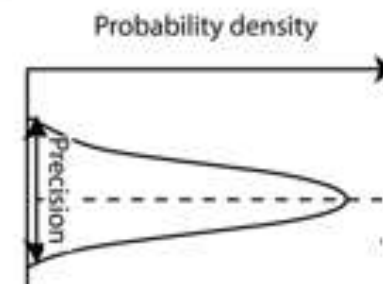
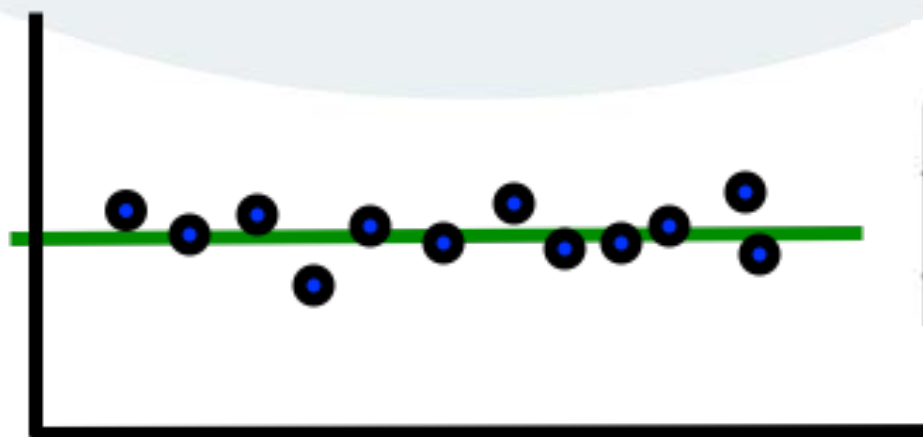
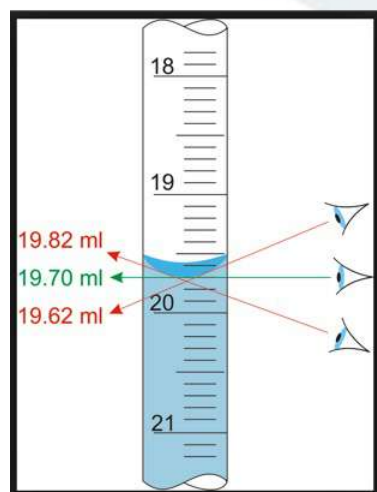
Analytical errors can be of 2 categories:

1. Random or 'unpredictable' deviations between replicates



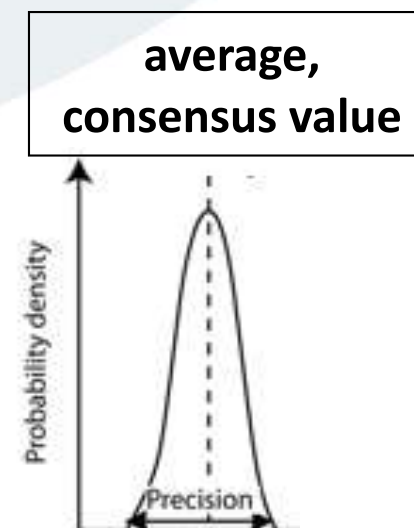
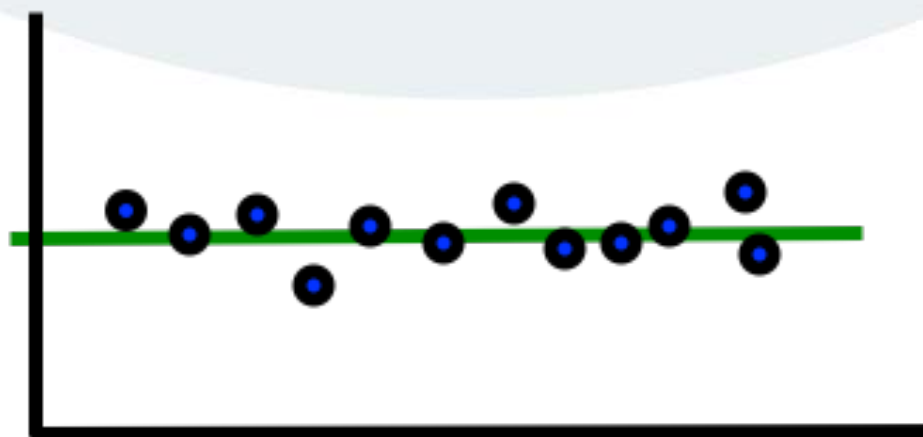
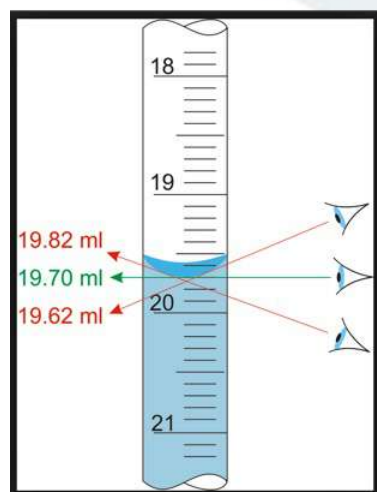
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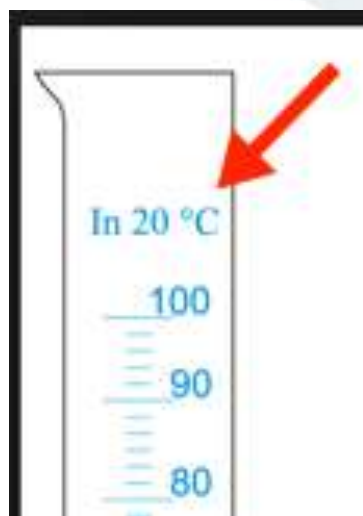
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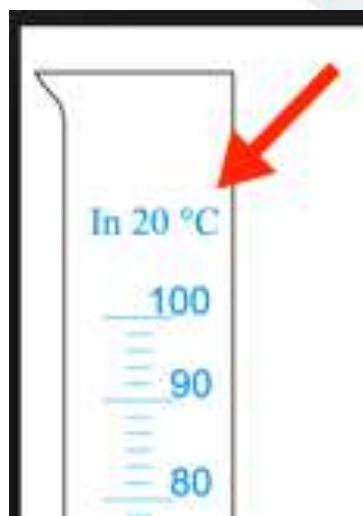
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2. **Systematic** or '**predictable**', regular deviation from the "true" value.



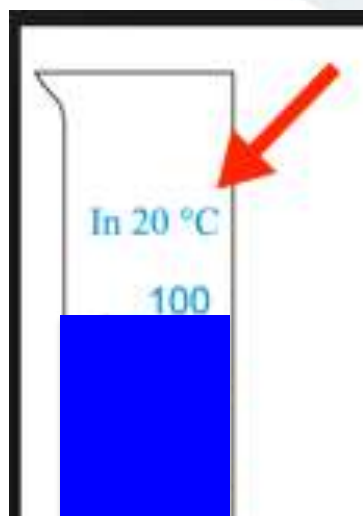
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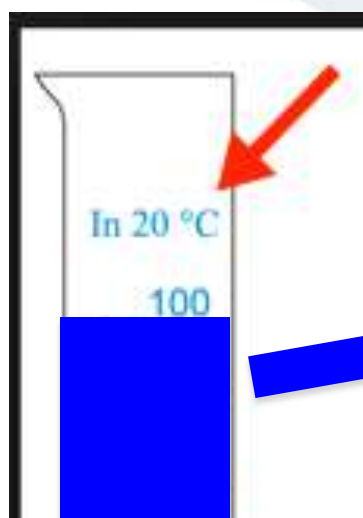
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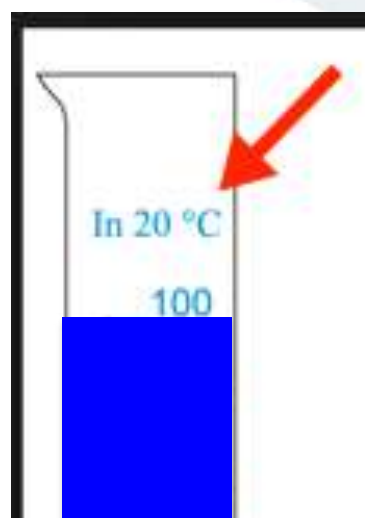
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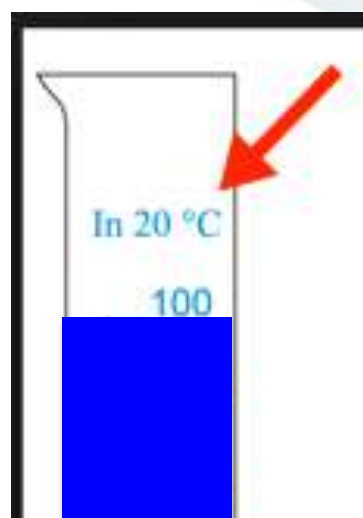
In France: 20° C

100 mL

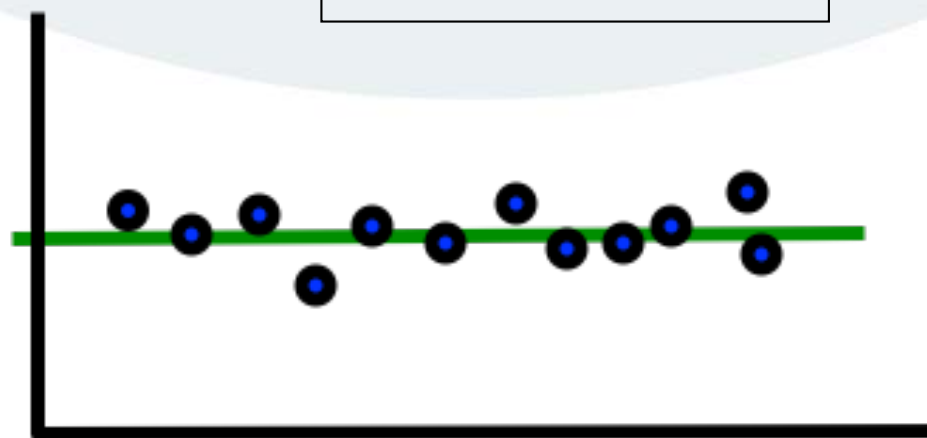


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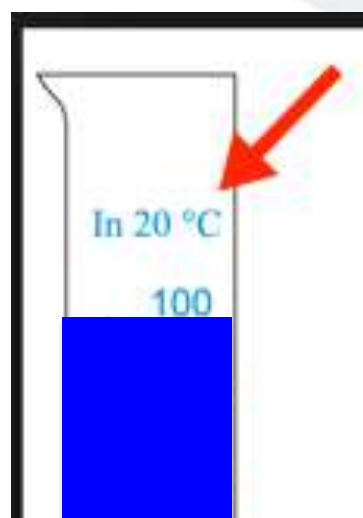


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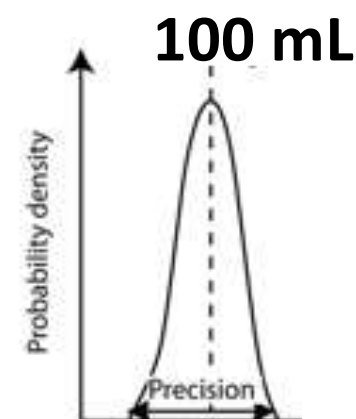
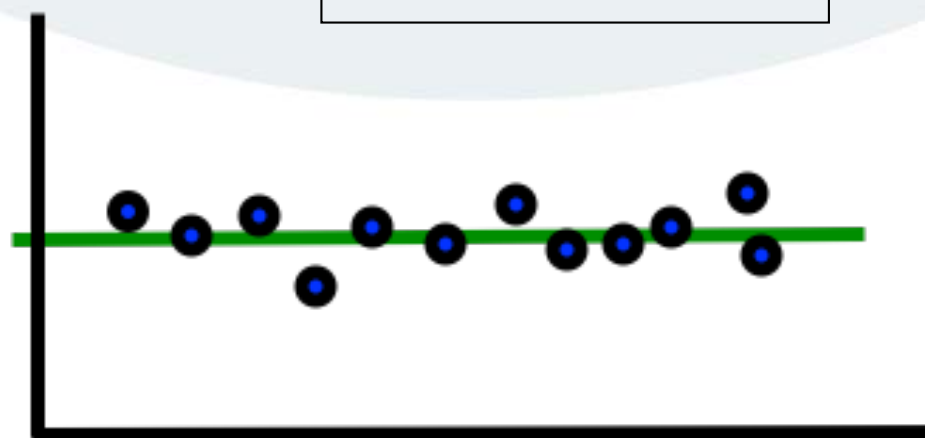


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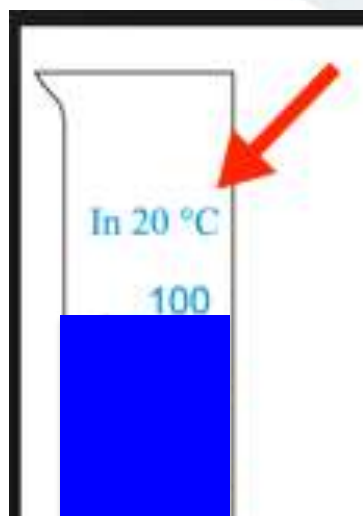


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In Bhutan: 5° C (glass shrinkage)

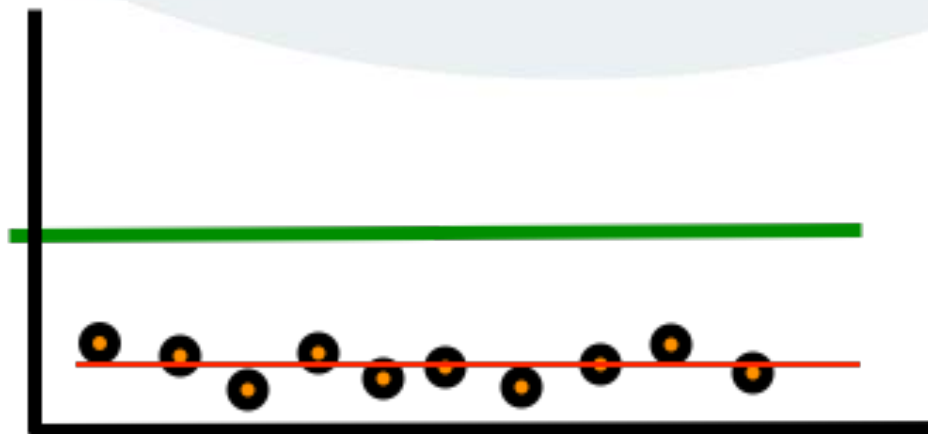
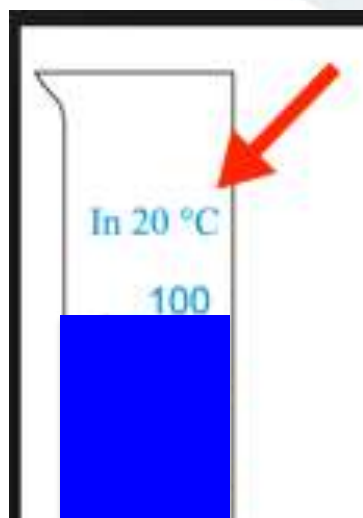
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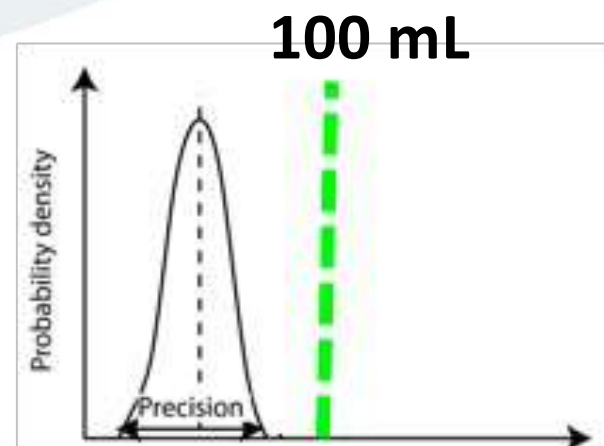
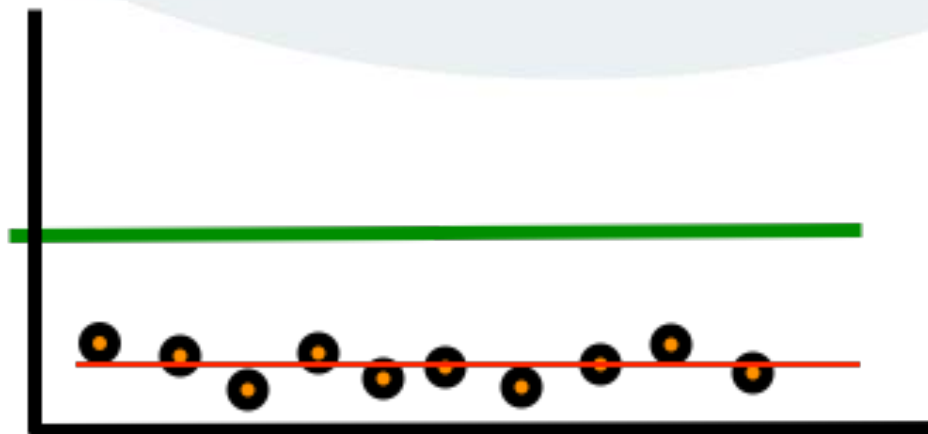
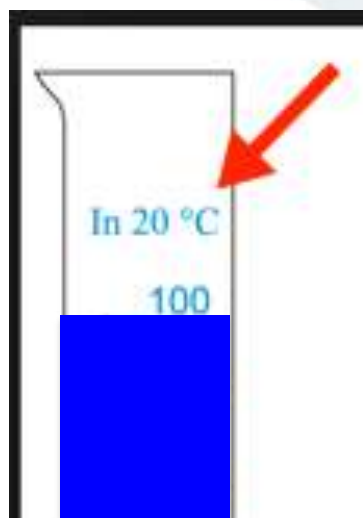
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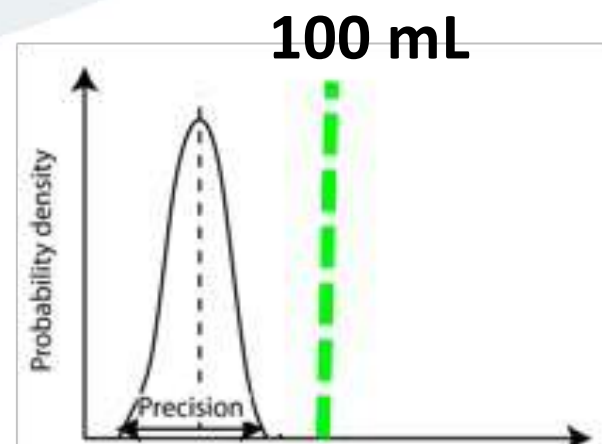
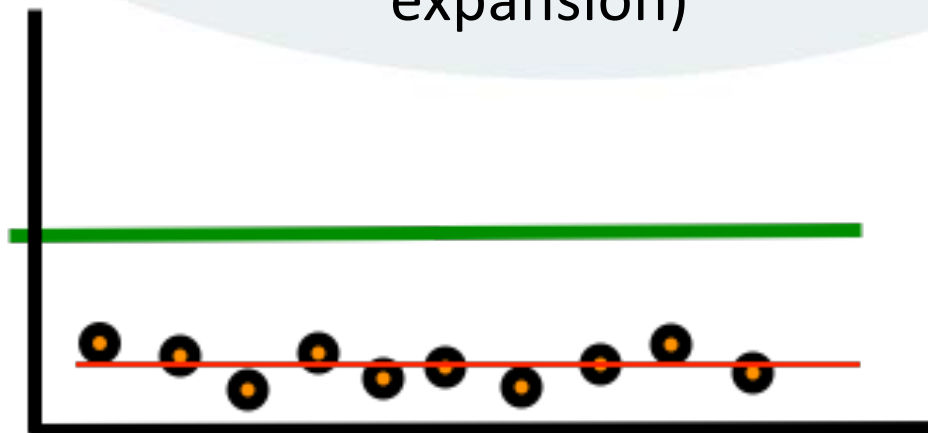
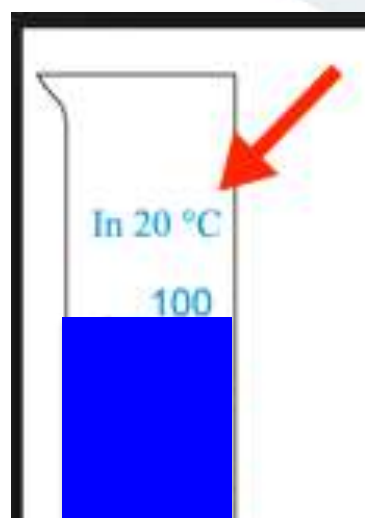


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In Bhutan: 5° C (glass shrinkage)

In Lao PDR: 35° C (glass expansion)

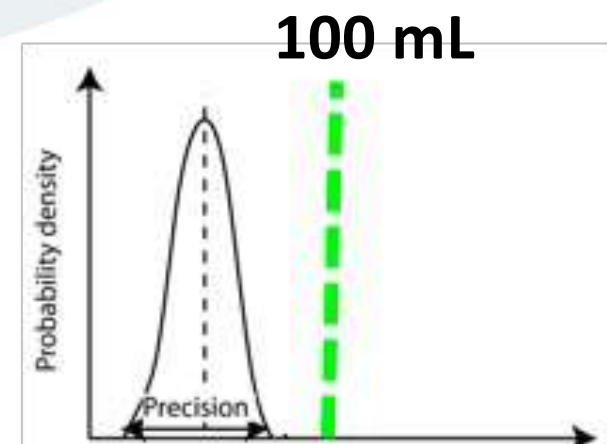
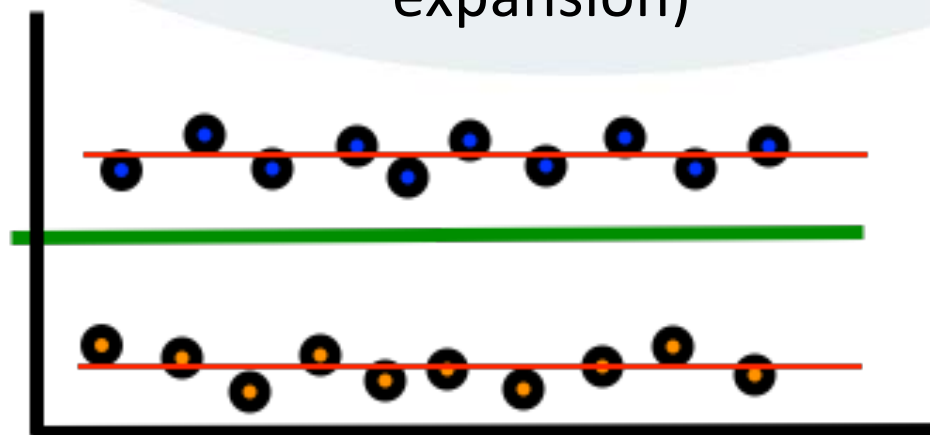
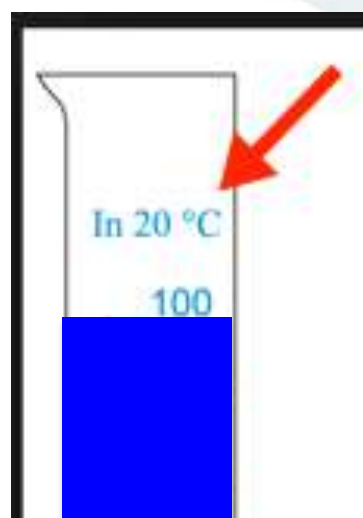


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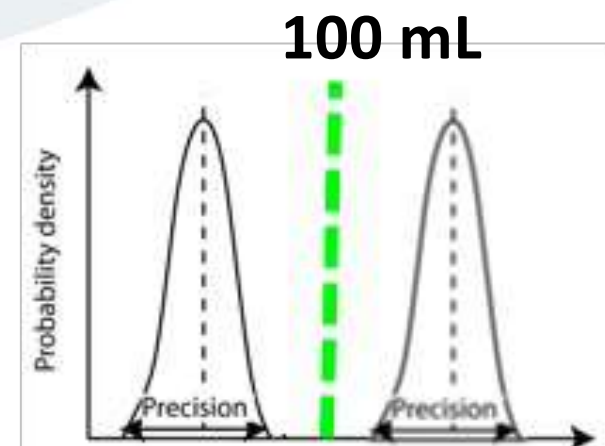
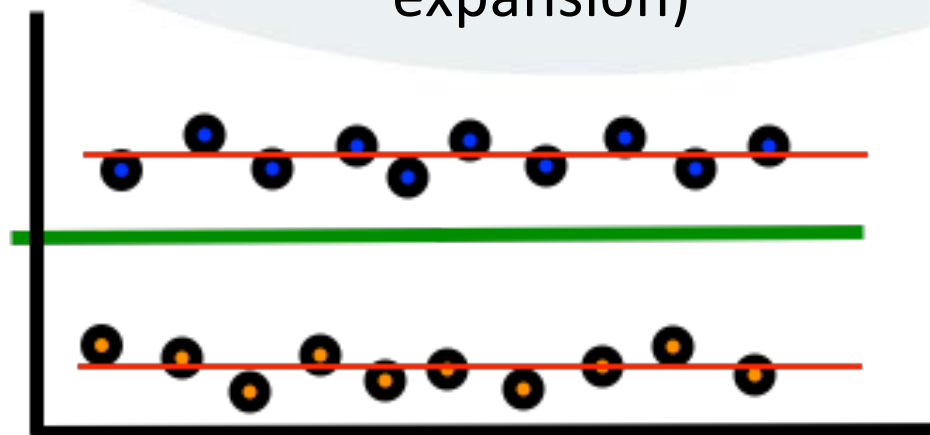
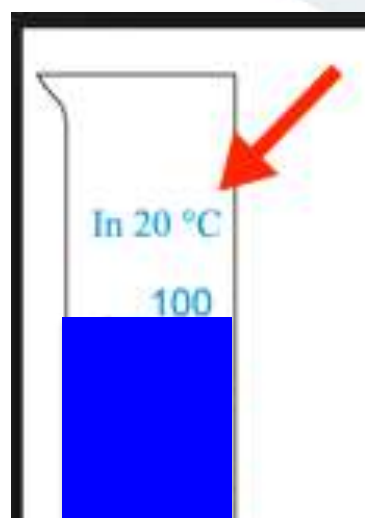


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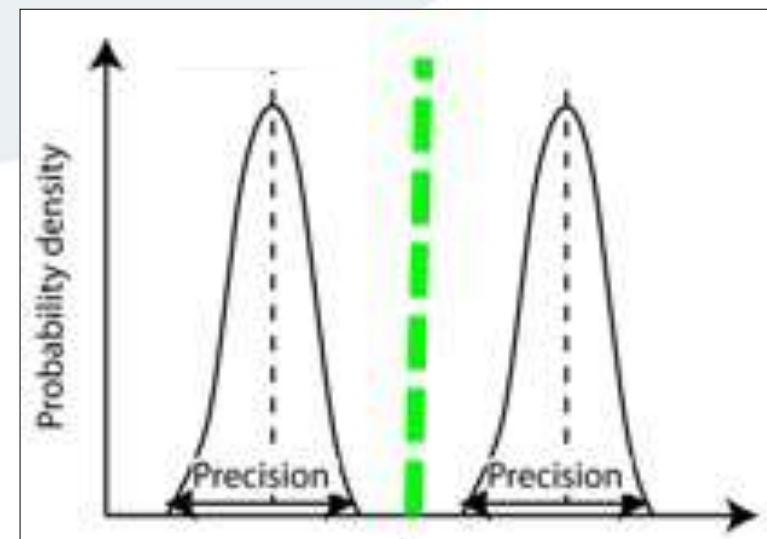
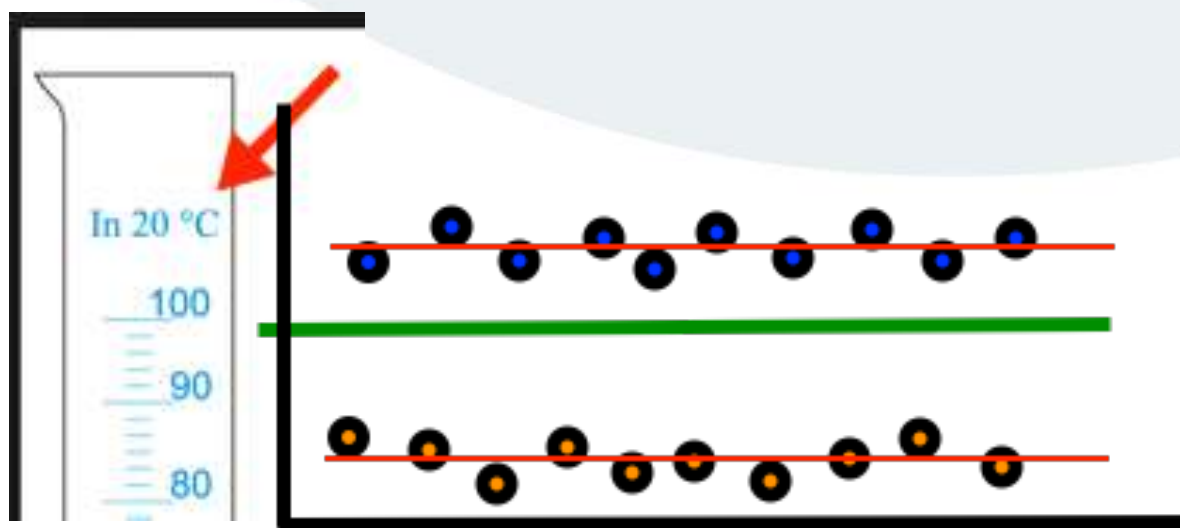
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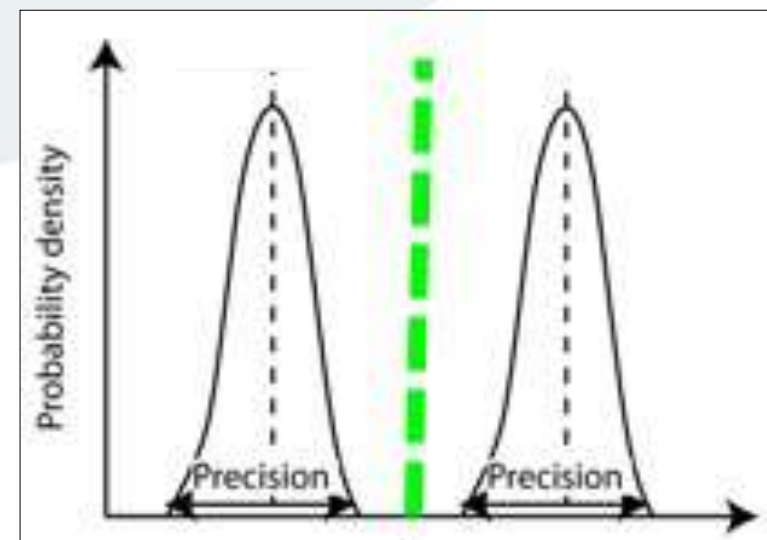
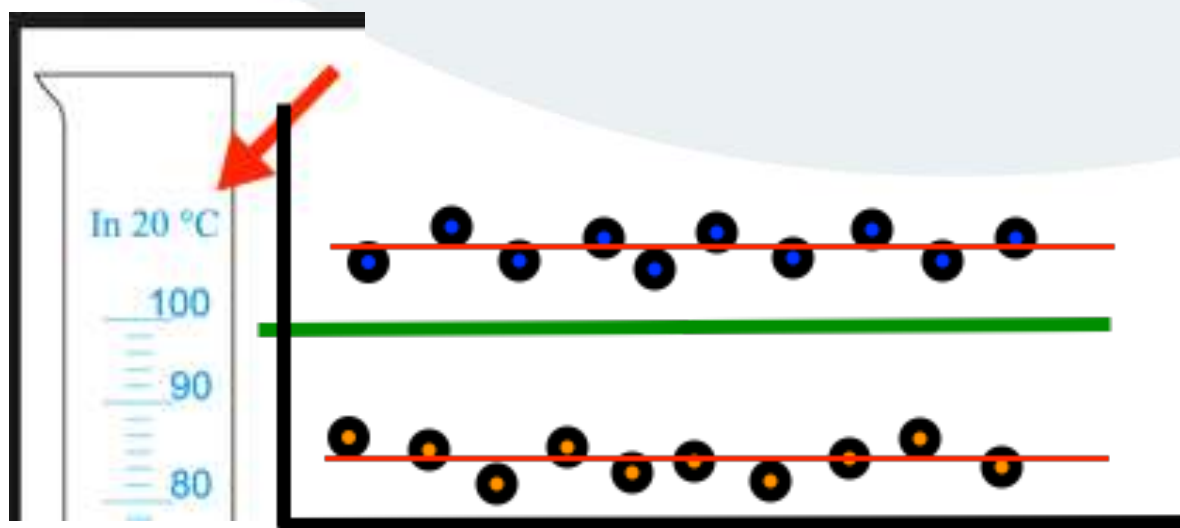
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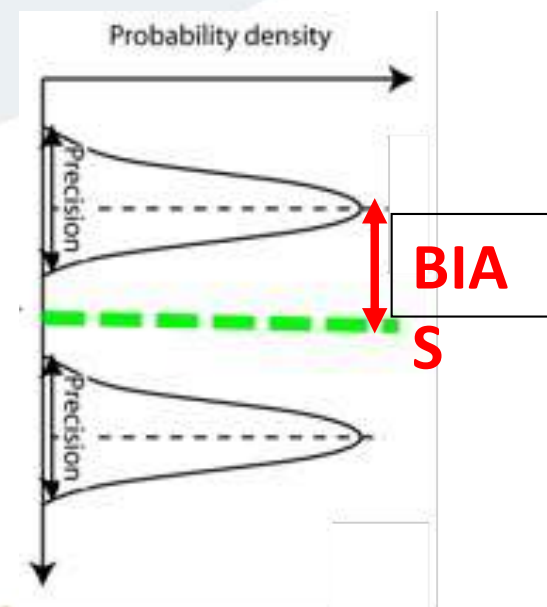
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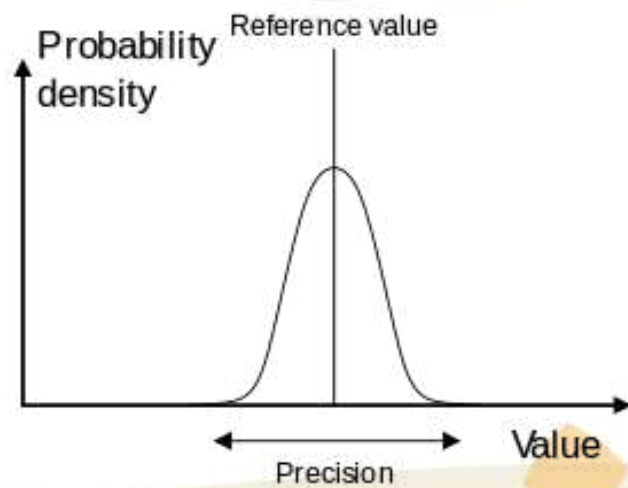
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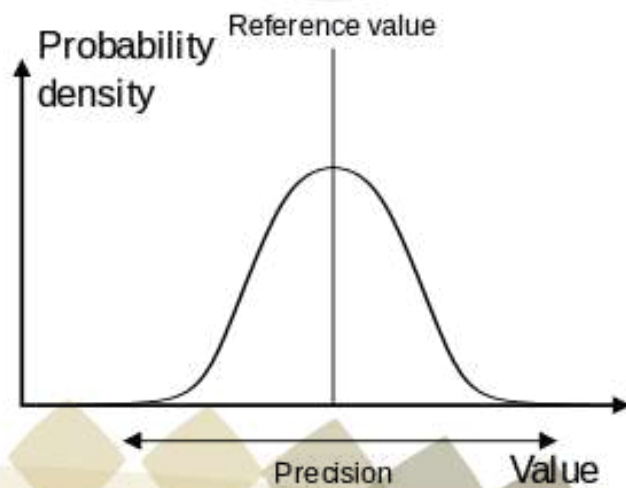


Yes

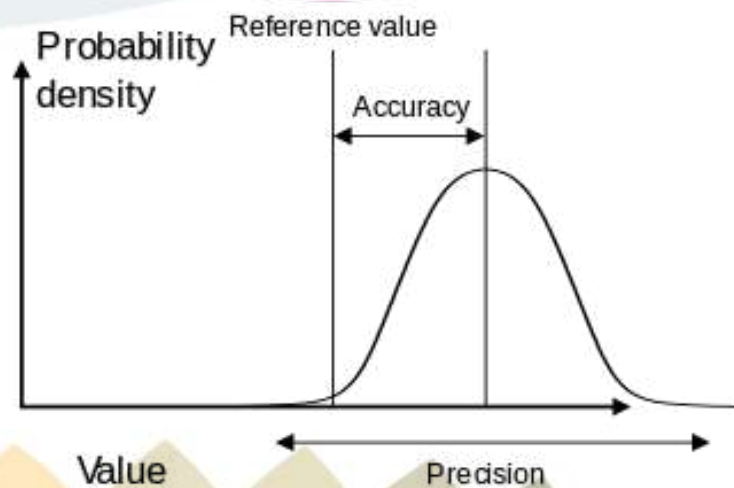
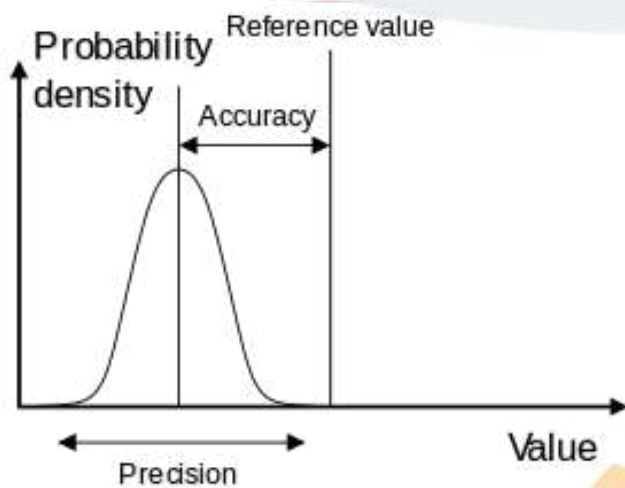
Yes



No



No



Analytical errors can be of 2 categories:

1. Random (or 'unpredictable' deviations between replicates); must be made as small as possible.
2. Systematic (or 'predictable' regular deviation from the "true" value); must be detected and eliminated.



Error:

**it is an idealised concept:
errors cannot be known exactly.**



you must always keep in mind:



you must always keep in mind:

**Despite all efforts,
you cannot avoid
errors.**



you must always keep in mind:

**Despite all efforts,
you cannot avoid
errors.**

**= you will always
make errors !**

You will always make errors.

**Good Laboratory Practices,
will limit the errors.**



You will always make errors.

**Good Laboratory Practices,
will limit the errors.**

**Quality Control (QC) help you
to *detect* the remaining errors.**



II – Description of GOOD LAB PRACTICES.



‘GLP’

= low-cost basic measures that will improve the performances of your laboratory.



‘GLP’

= low-cost basic measures that will improve the performances of your laboratory.



This process can be successful only with:

- 1. a change in daily attitudes & practices,**
- 2. a change that all the staff must adopt.**

GLP tries to correct 'old habits' by **providing written documents for all important actions.**

The success of GLP also depends on the cooperation, participation, involvement and contribution of all laboratory staff.



Benefits of GLP:

- **minimize errors**
- **improve efficiency** (thus reducing costs)
- **allow quality control** (tracking errors & their origin)
- **stimulate and motivate all the staff.**



What are the:

**Good Laboratory Practices?
(*GLP*)**



What are the:

**Good Laboratory Practices?
(GLP)**

**the laboratory structure:
nested activities.**



The laboratory structure: nested activities.

Management

Technical elements

Reagents, instruments, etc..

Analytical tasks

pH, NPK, etc..





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pH, NPK, etc..



with GLP you need:
STANDARD OPERATING PROCEDURES
(SOP)

**The objectives of a SOP is
to do all the important operations:
(i) correctly,
(ii) always in the same way.**



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Detailed, written instructions to achieve uniformity of the performance of a specific function.

Repeated application of unchanged processes and procedures, and their documentation.



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SOP are mandatory instructions!
You have to strictly follow a SOP, not to adapt it.



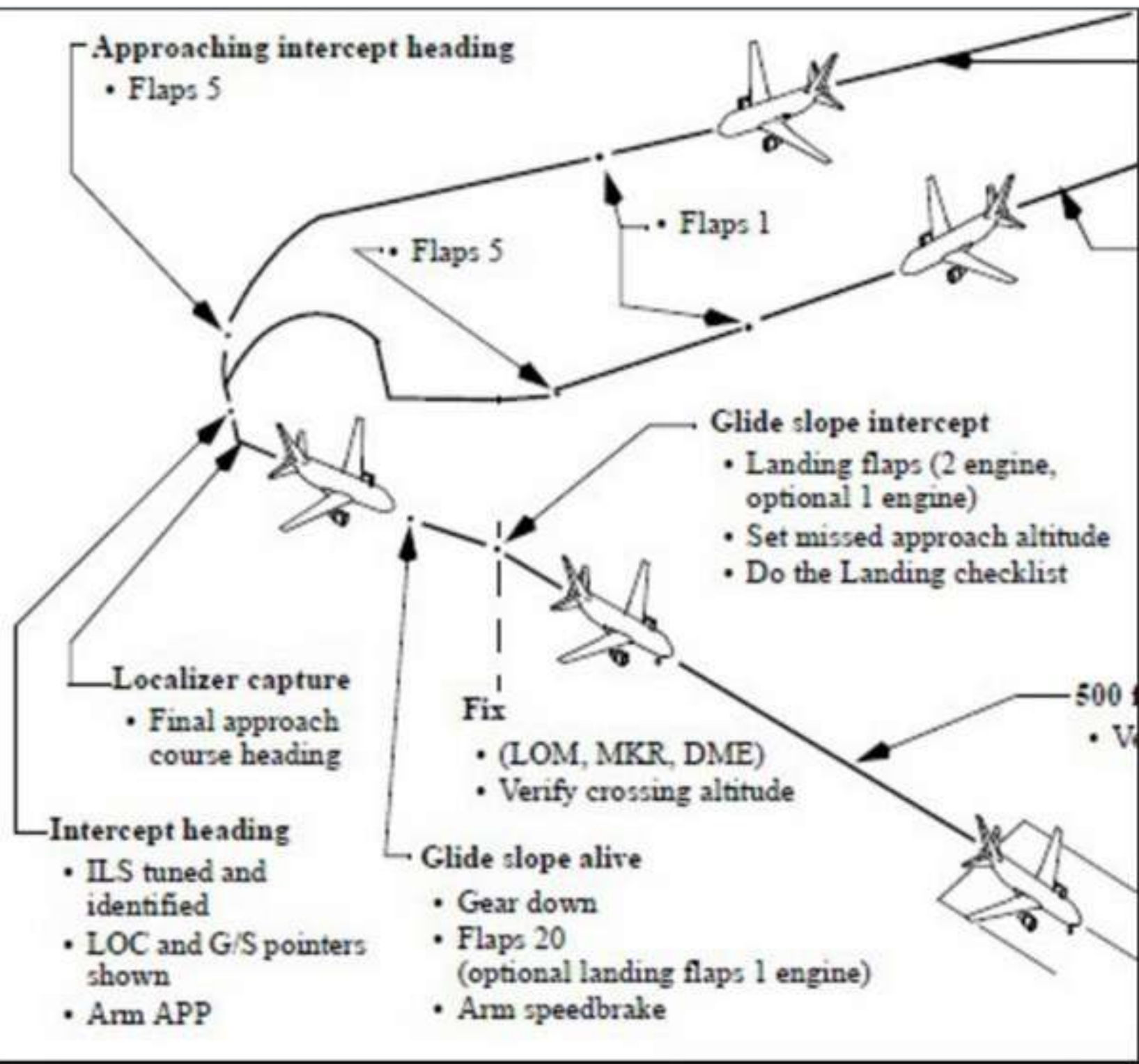


SOP !!!





SEALNET | SOUTH-EAST ASIA LABORATORY NETWORK



The laboratory structure: nested activities.

Technical elements

Reagents, instruments, etc..

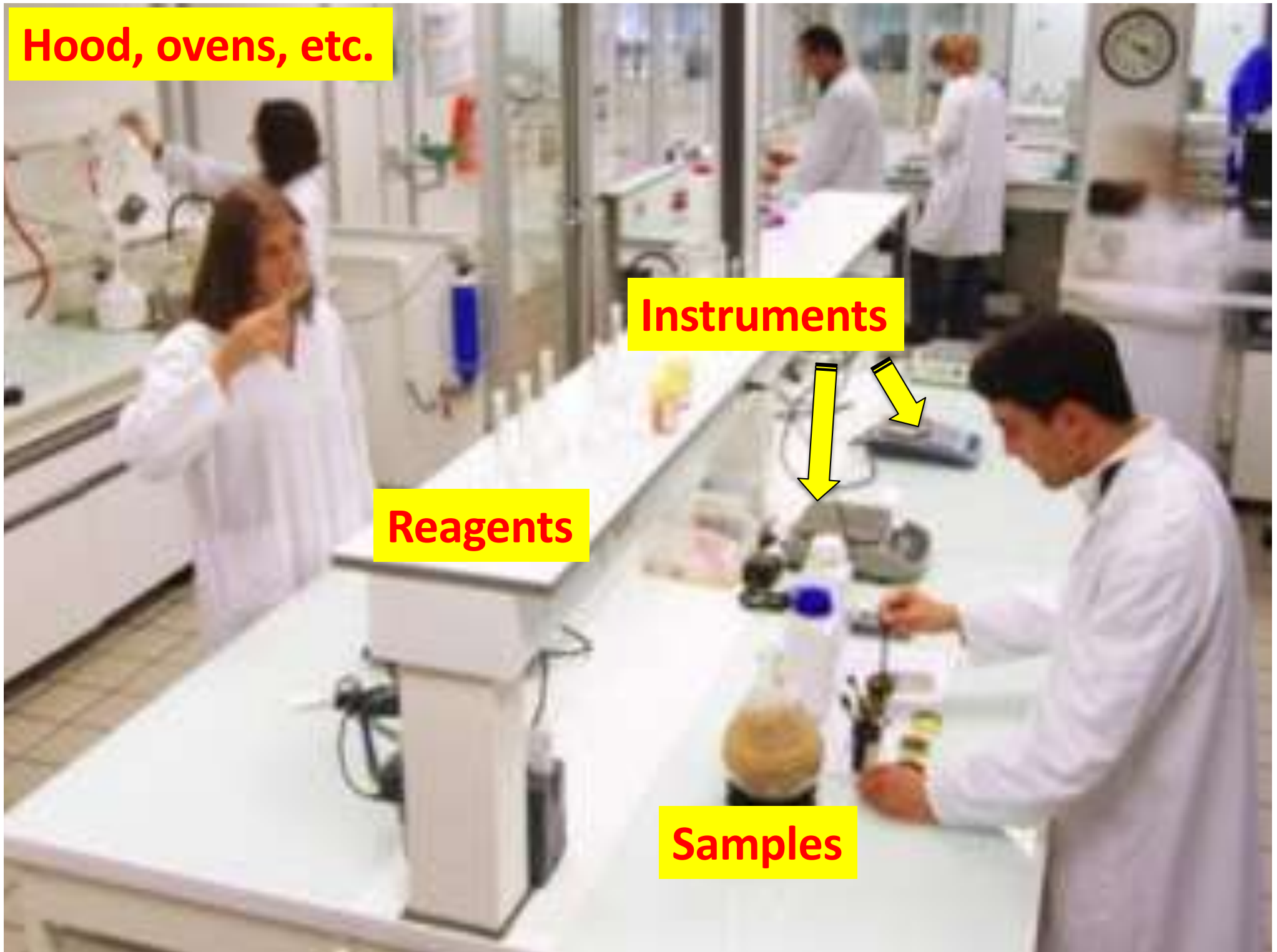
Analytical tasks

Hood, ovens, etc.

Instruments

Reagents

Samples



Technical elements

- 1. Primary measuring equipment,**
- 2. Analytical instruments,**
- 3. Miscellaneous equipment,**
- 4. Reagents,**
- 5. Soil samples.**

Technical elements

1. Primary measuring equipment,

= pipettes, diluters, burettes, thermometers, balance, sieves, crushers, etc.

They do not provide analytical results, but are necessary to prepare your samples, reagents, solutions, etc.

They must be clean and calibrated.

They must be used correctly.

Technical elements

vieux
pHmetre
pourri

2. Analytical instruments

= pHmeter, spectrophotometers, etc.

Technical elements

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For all instruments, you must have:

- an '*Operation Instruction Manual*',
- a '*Maintenance Logbook*'.

Technical elements

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= pHmeter, spectrophotometers, etc.

For all instruments, you must have:

- an '*Operation Instruction Manual*',**
- a '*Maintenance Logbook*'.**

Instruments should be:

1. suitably located and adequate capacity,
2. periodically inspected, cleaned, maintained, and calibrated according to SOP.

Technical elements

3. Various equipment & materials

= ovens, fridges, pumps, stills, glassware, etc.

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Technical elements

3. Various equipment & materials

= ovens, fridges, pumps, stills, glassware, etc.

For all apparatus, you must have:

- an '*Operation Instruction Manual*',**
- a '*Maintenance Logbook*'.**

Apparatus should be:

1. suitably for the job,
2. properly organized, well cared for.

Technical elements

4. Reagents

Technical elements

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One of the most important sources of the errors is: using wrongly prepared or old reagents.

Technical elements

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One of the most important sources of the errors is: using wrongly prepared or old reagents.

Reagents have to be :

- prepared very carefully,
- well labelled with: preparation date, expiry dates, operator's name.

Record preparations in a Reagents Book.

Technical elements

5. Soil samples

Technical elements

5. Soil samples

Need of proper packaging, labelling and management of samples before going to the laboratory.

Technical elements

5. Soil samples

Need of proper packaging, labelling and management of samples before going to the laboratory.

Avoid

- samples being accidentally interchanged,
- being contaminated (broken bags),
- losing their identity (i.e. their label or number)
- or getting lost.

The laboratory structure: nested activities.

Management

Technical elements

Analytical tasks

**Quality control in the soil laboratory:
a statistical process
to monitor and evaluate
the analytical process & results' quality.**



III – INTERNAL & EXTERNAL QUALITY CONTROL (QC).





Thanks for your attention

