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

Christian Hartmann

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

GLOSOLAN
GLOBAL SOIL LABORATORY NETWORK

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

GLOBAL SOIL PARTNERSHIP

Dr Christian Hartmann

IRD-France

GLOSOLAN steering committe

Institut de Recherche pour le Développement FRANCE

IEES PARIS

SEALNET | SOUTH-EAST ASIA LABORATORY NETWORK

I – INTRODUCTION:

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DEFINITIONS & CONCEPTS

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

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DEFINITIONS & CONCEPTS

QUALITY (Q), Q.Assura… …ntrol, Q. management….

SIMPLIFIED….

QUALITY: of a product…

A product has good quality when:

it fits with the requirements specified by the client.

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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…

A product has good quality when:

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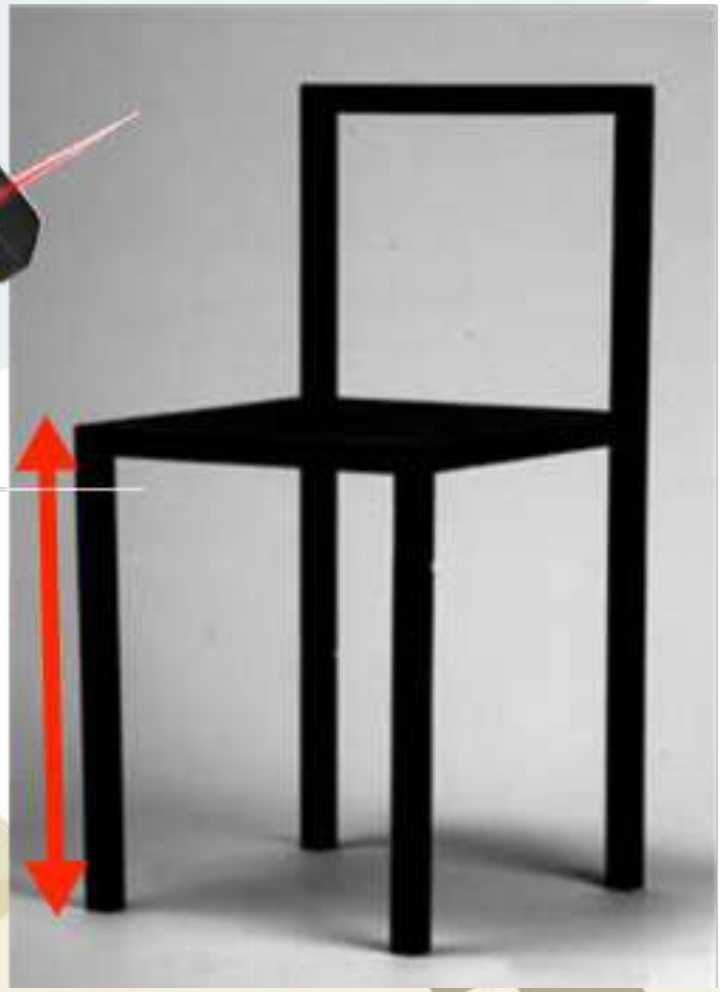
Client:

Factory **435 mm +/- 1 mm**



Restaurant **approx. 40 cm**

Analytical testing: your product is a result.

What is a good quality result?

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What is a good quality result?

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

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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.

Quality Assurance (QA)

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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 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.

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A good result will only be
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Why impossible to reach the true value?
because you will always have errors.

True value: possible if you are counting.

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Number of eggs = 3 x 4 = 12

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Finding 10 or 11 is a mistake, mistake ≠ error

True value: possible if you are counting.

Number of eggs = 3 x 4 = 12

Finding 10 or 11 is a mistake, mistake ≠ error

but measuring is different from counting!

measurement has imperfections

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==>measurement give rise to errors

measurement has imperfections

==>measurement give rise to errors

measures ==> errors

Error (some exemples):

Error:

Figure 20: Liquid in a Burette

Error:

Figure 20: Liquid in a Burette

≠ 39.7

≠ 39.8

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.

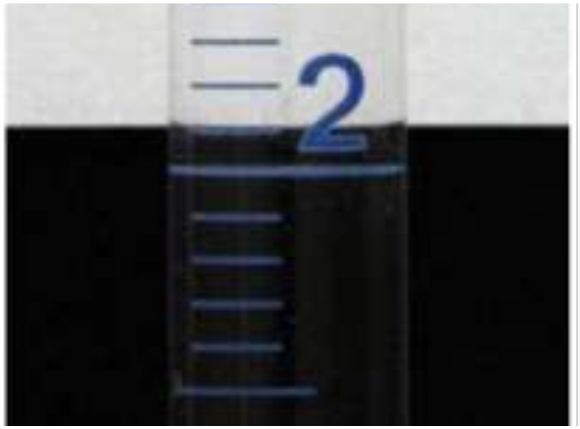
Error:

Error (one more exemple…):

1.4 !

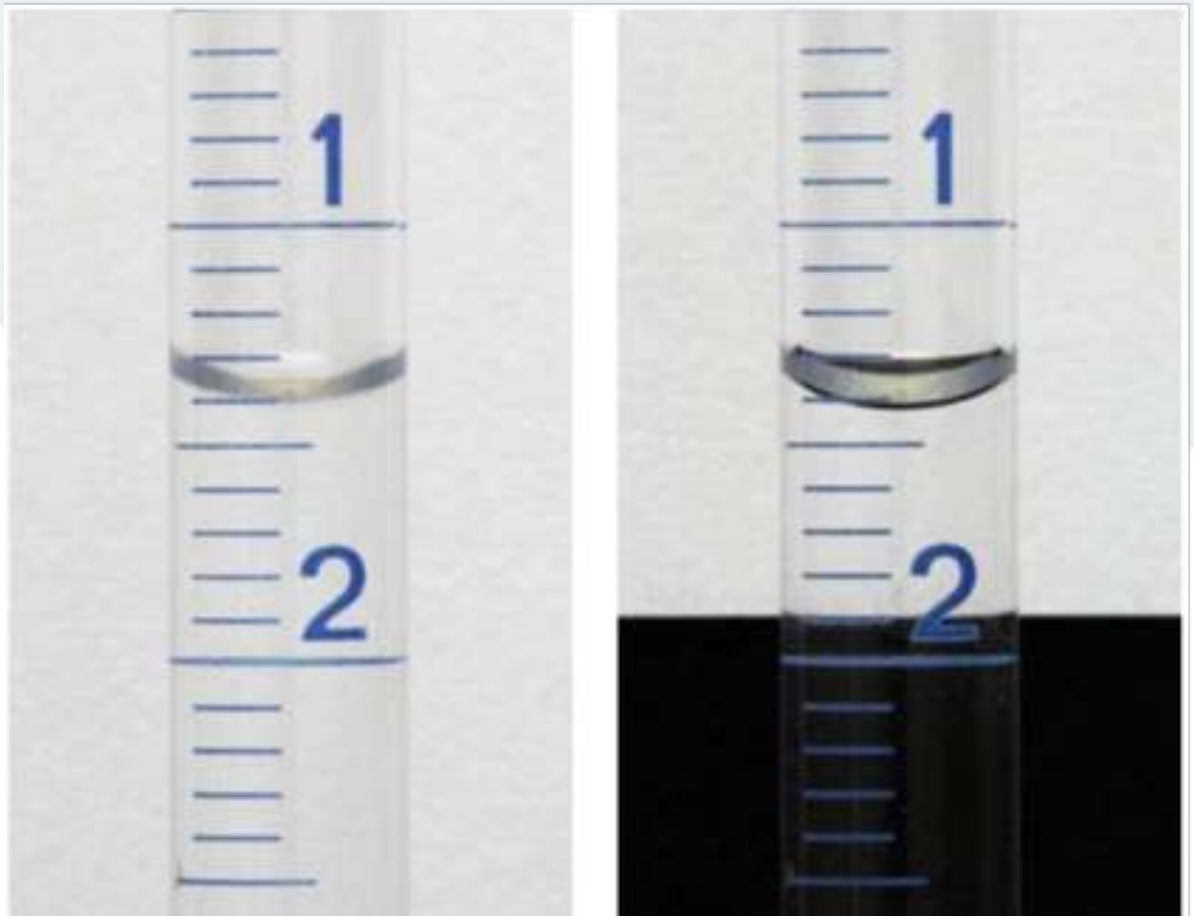
Error:

1.4 !



Error:

1.4 !



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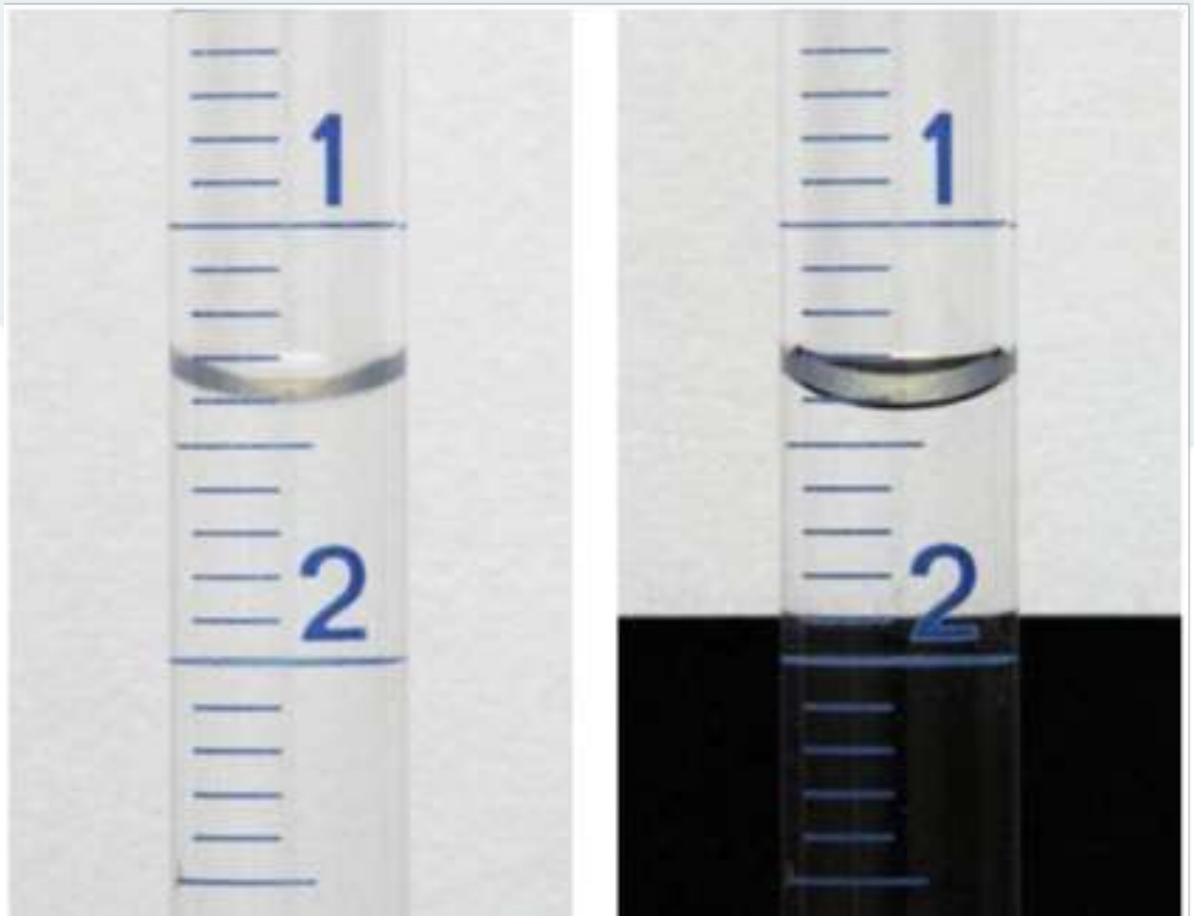
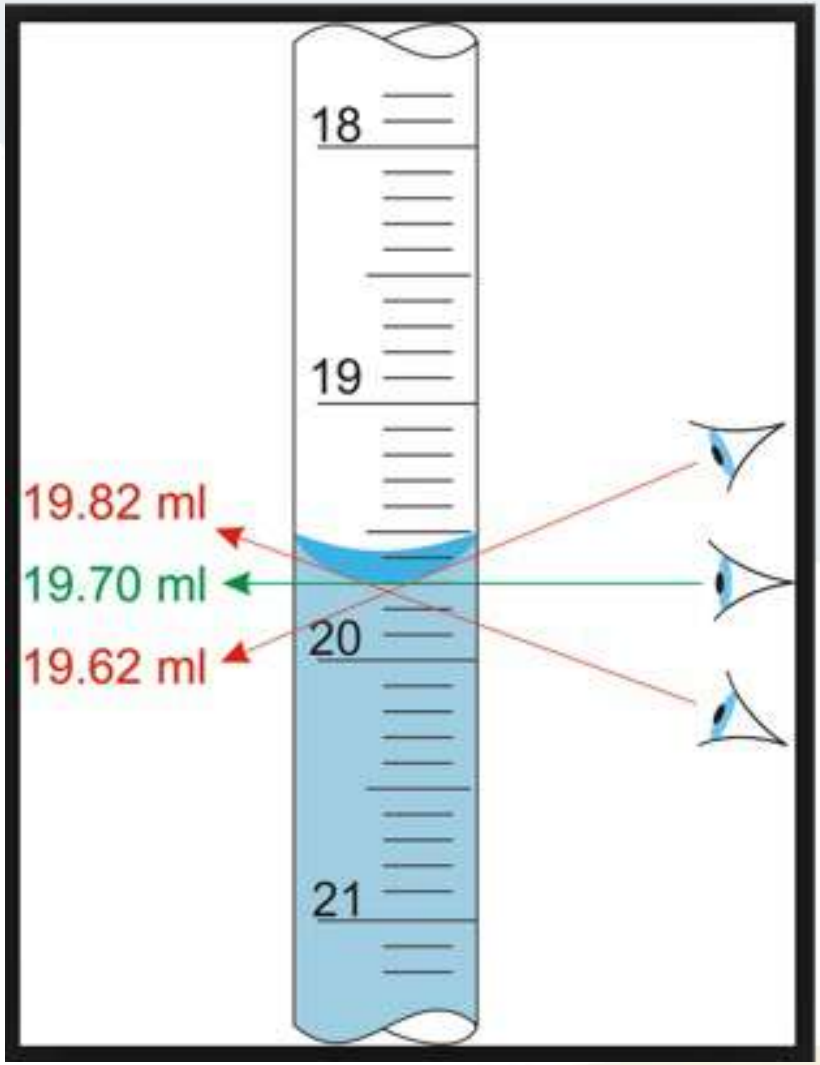


≠ 1.4 😟

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
(presicion)

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!

but if you stop training…

random again....

random again....

To describe the quality of analyses:

Precision: the closeness of the replicates.

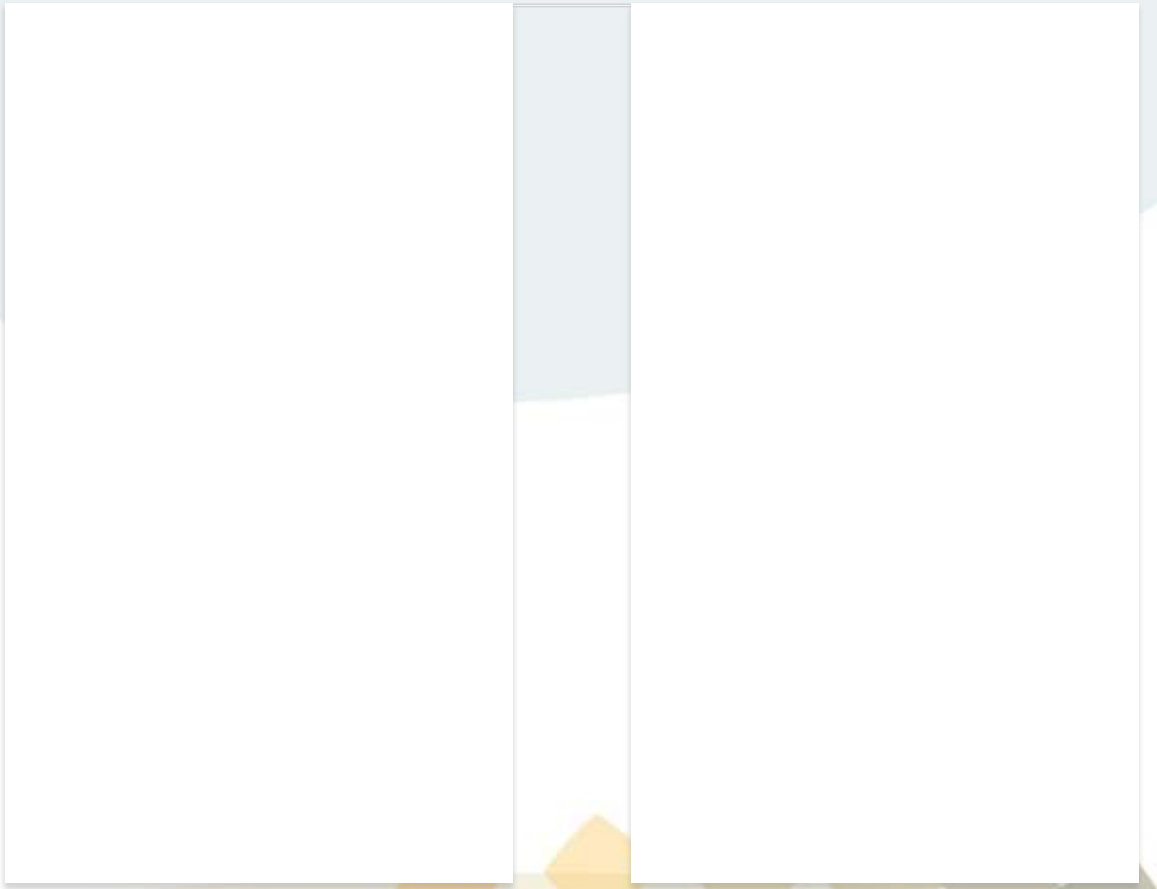
Accuracy: the closeness to the "true" value.

Precision: high low

Accuracy:

high

low



Precision: **high** **low**

Accuracy:

high

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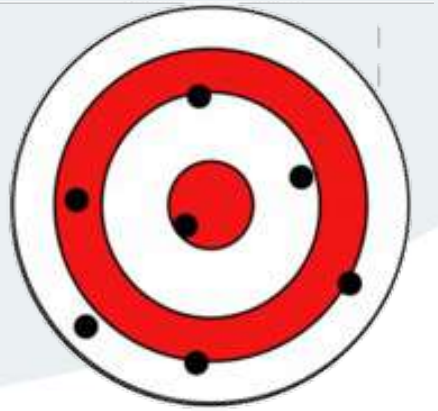
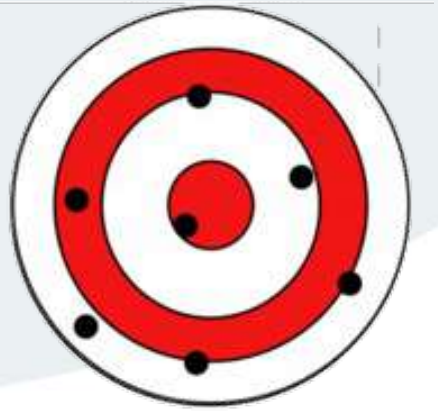


low

Precision: **high** **low**

Accuracy:

high



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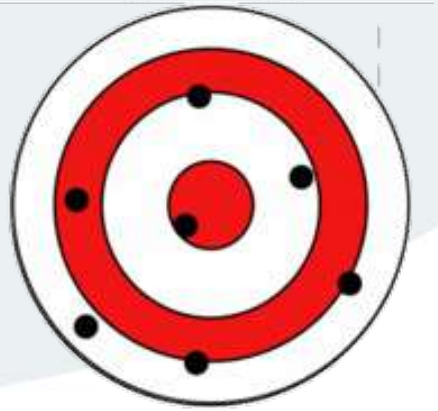

low

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….

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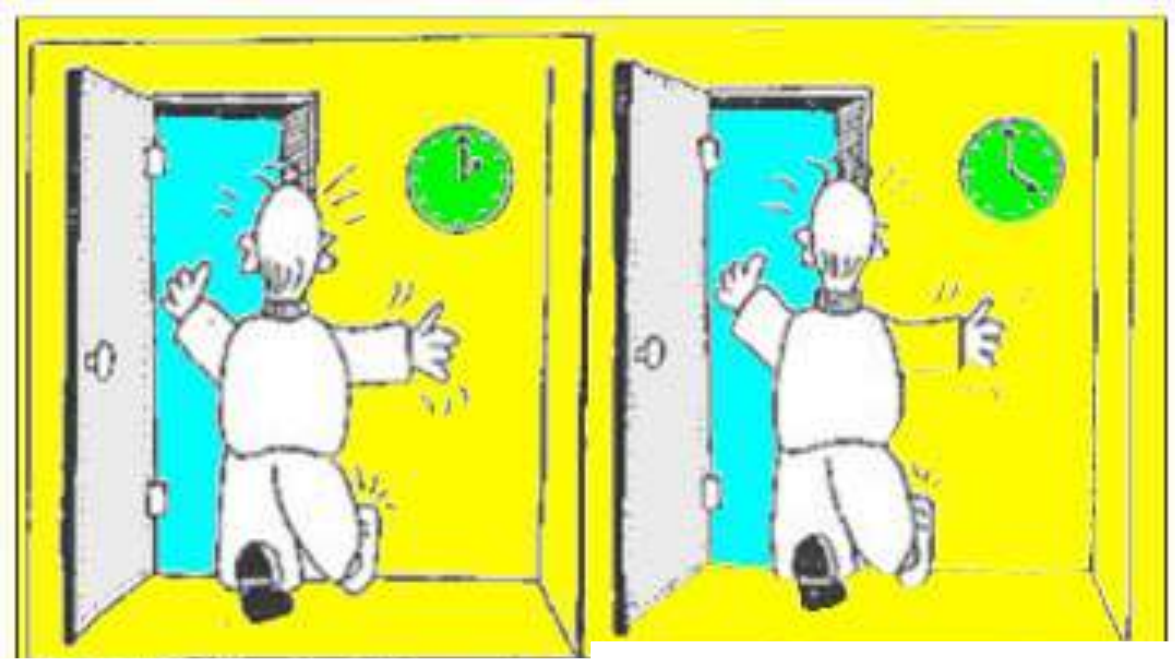
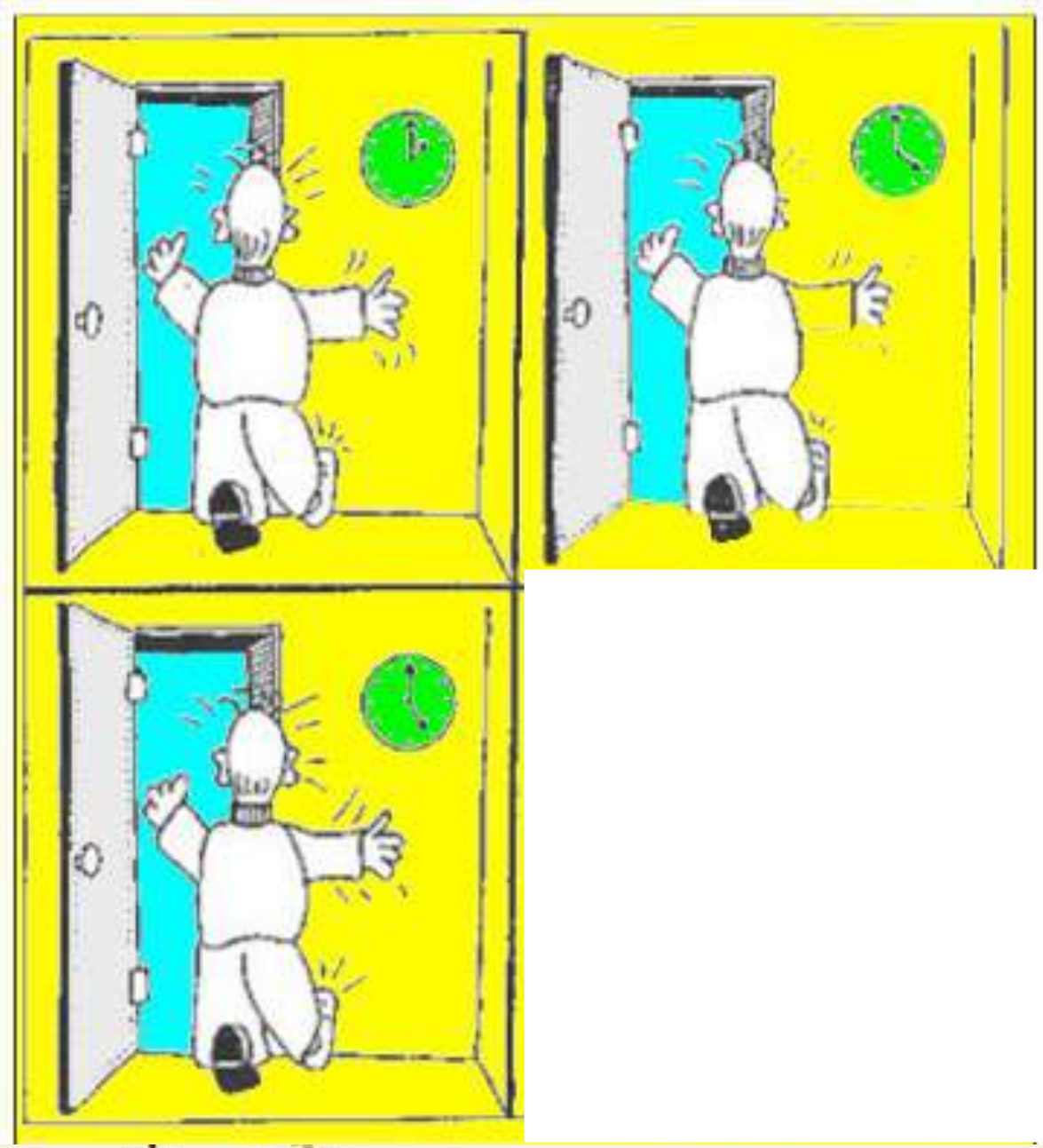


Accuracy and precision in every day life….



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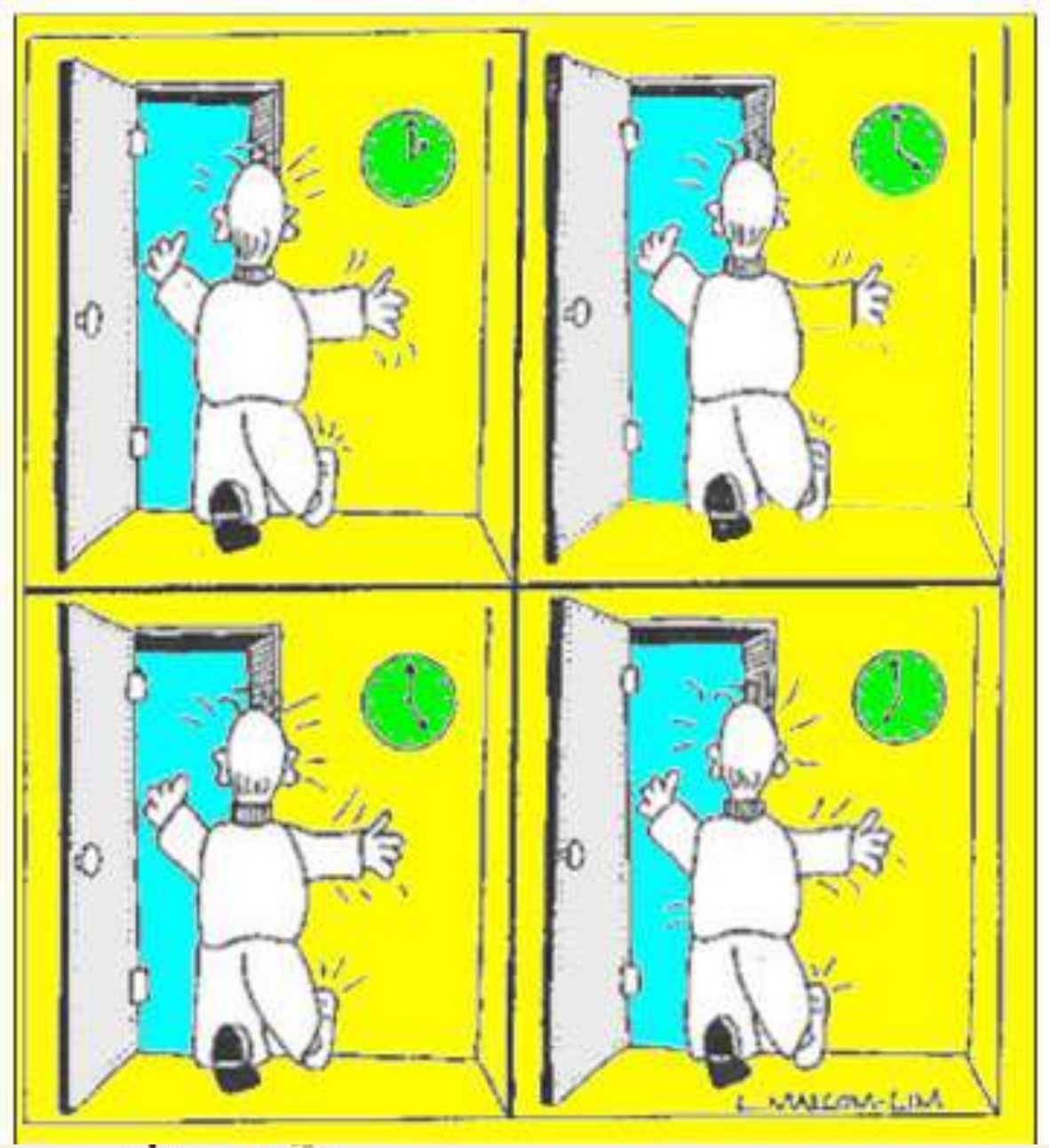

Accuracy and precision with machines….

Accuracy and precision with machines….

very nbecessary 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:

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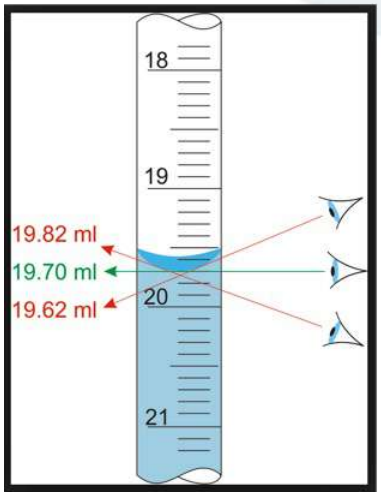
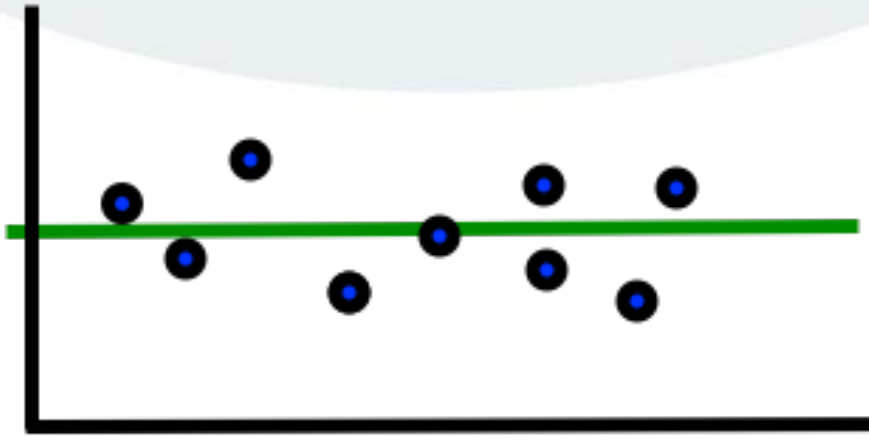
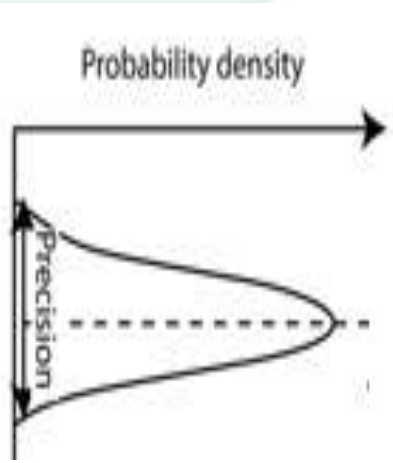
1.Random or 'unpredictable' deviations between replicates







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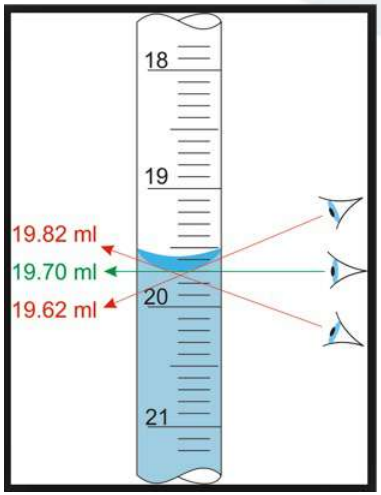

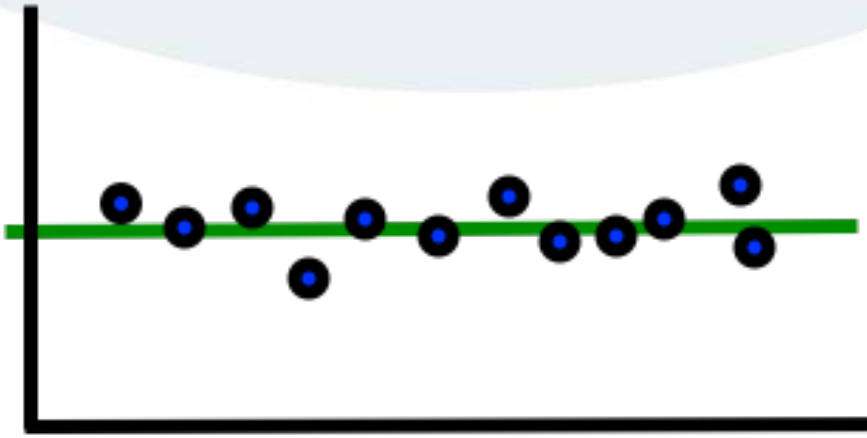

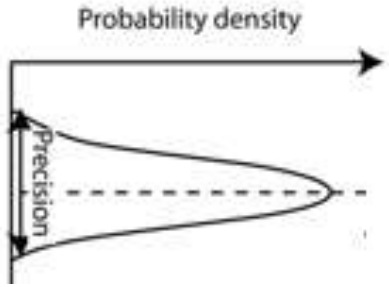

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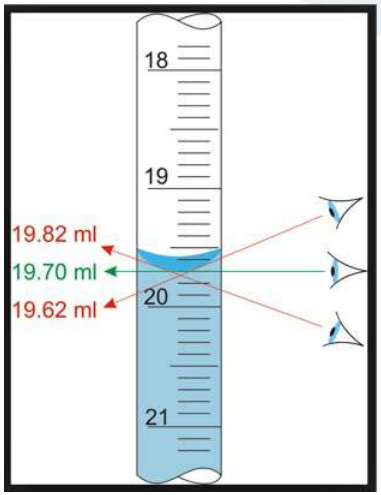
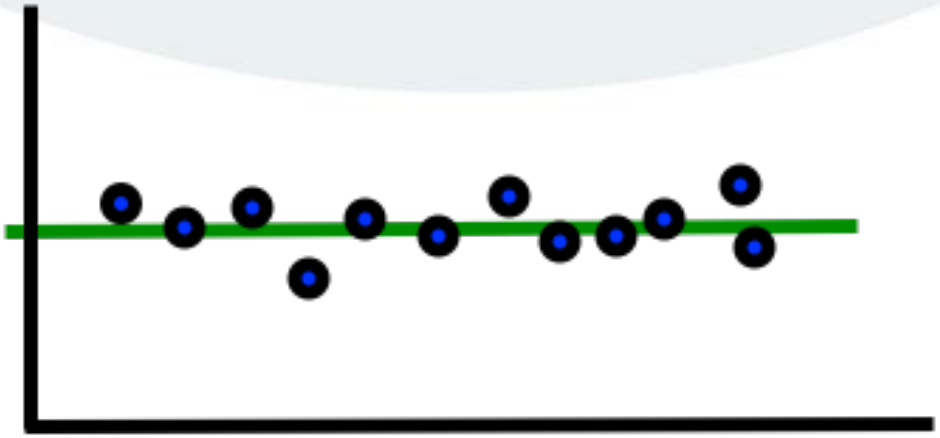
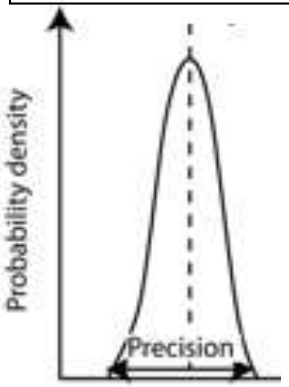


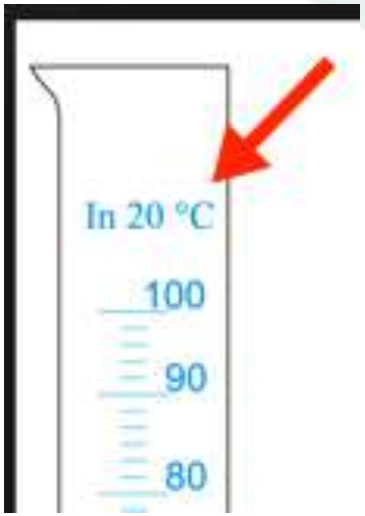


average, consensus value



Analytical errors can be of 2 categories:

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



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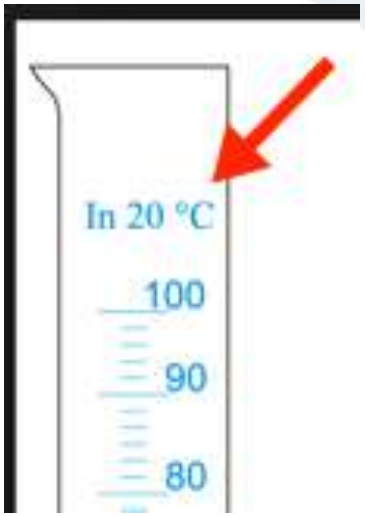

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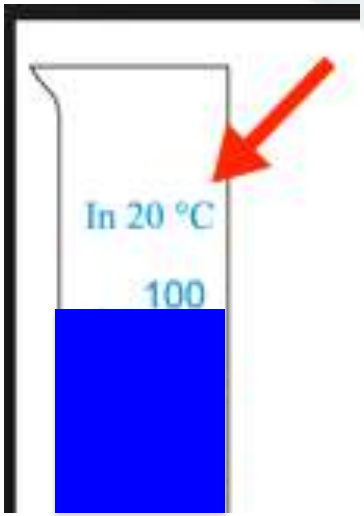

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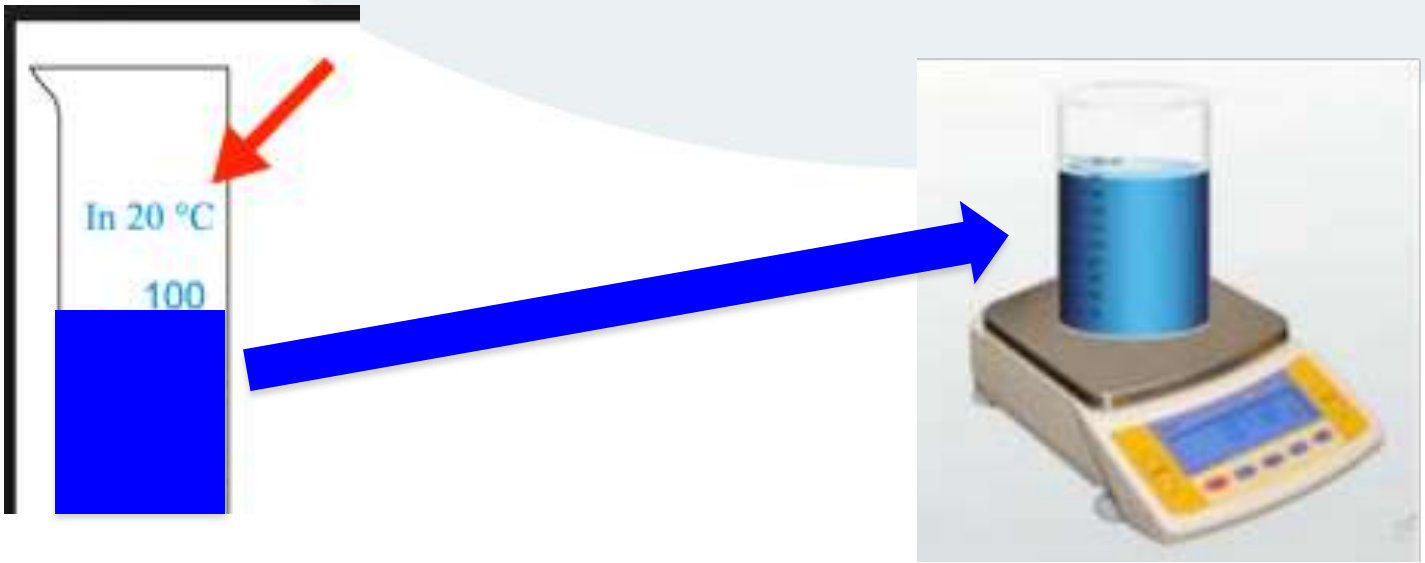

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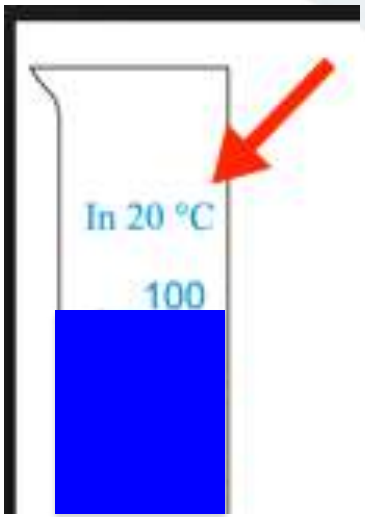

In France: 20° C

100 mL

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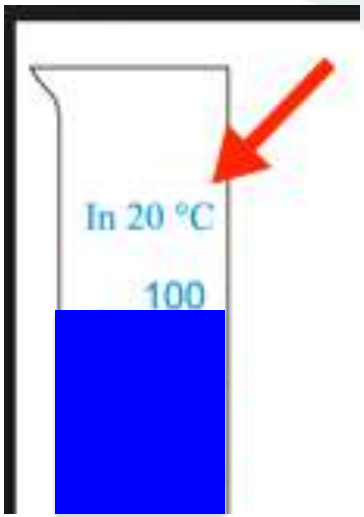

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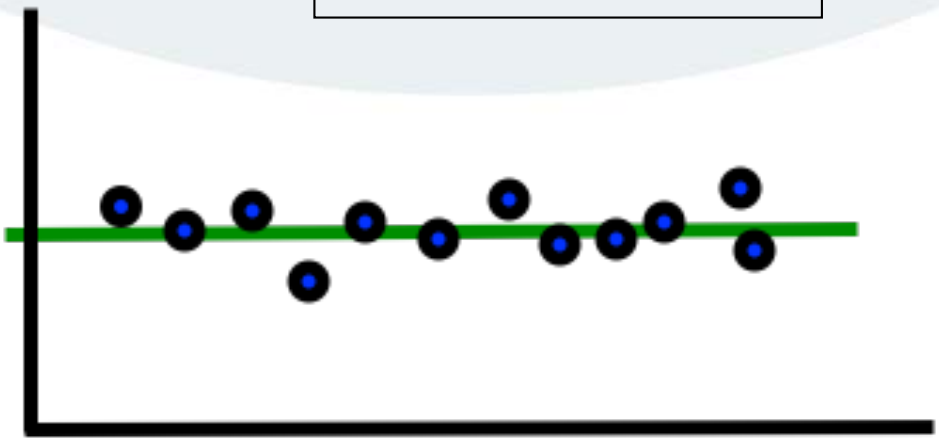

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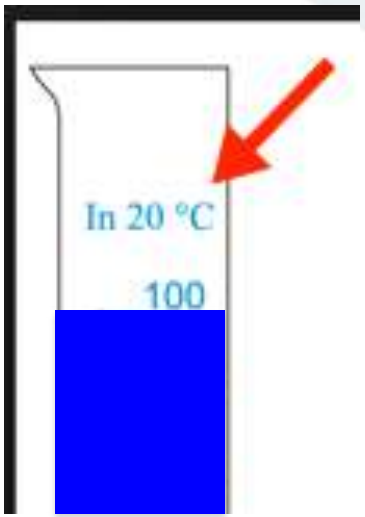

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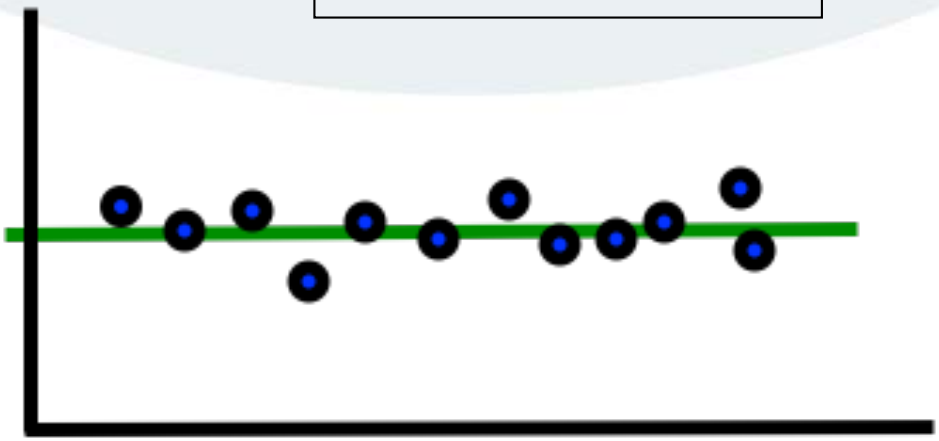

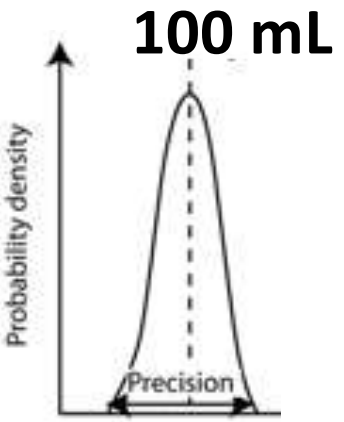

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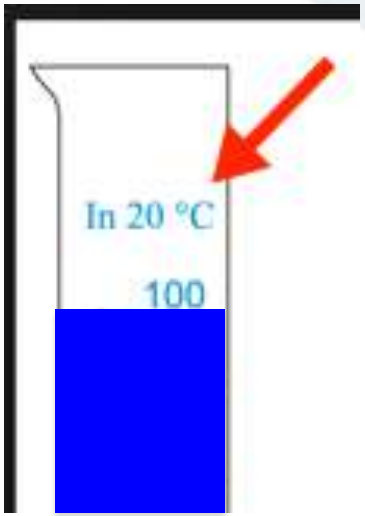
In Bhutan: 5° C (glass shrinkage)



100 mL

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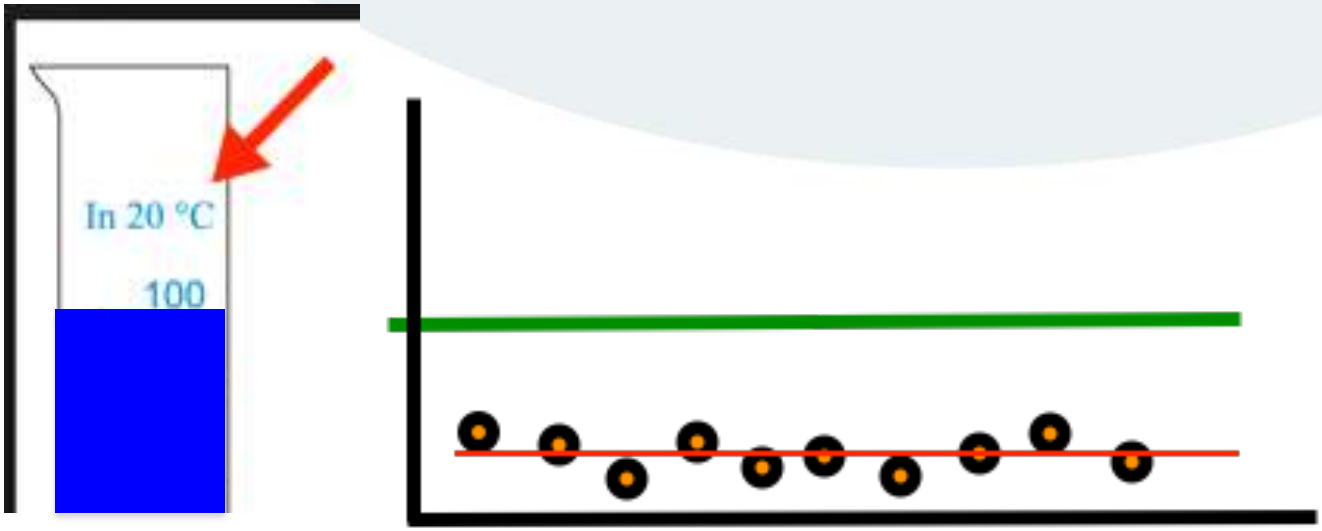

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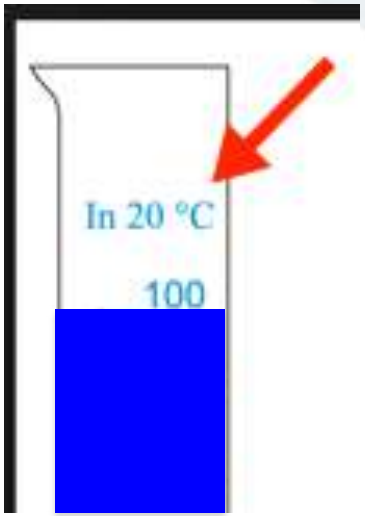

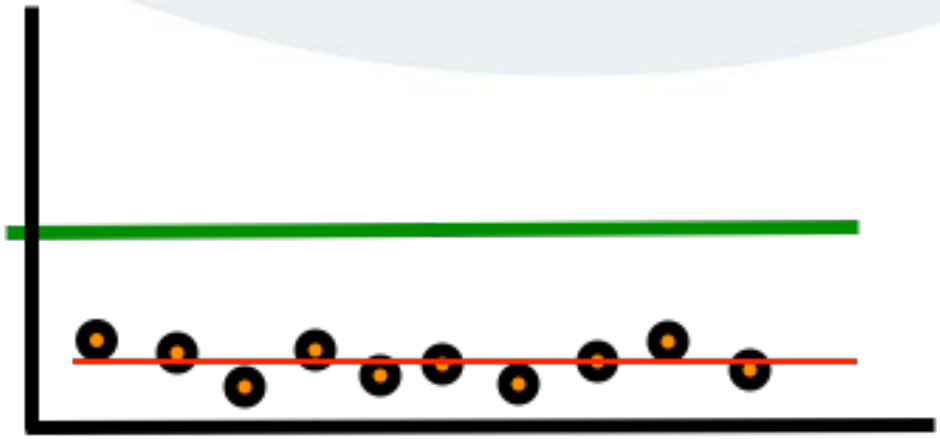

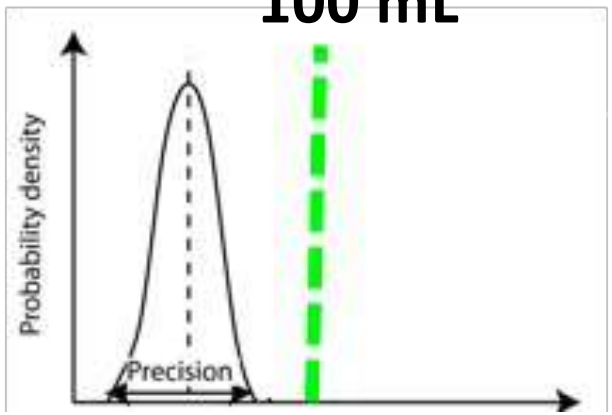

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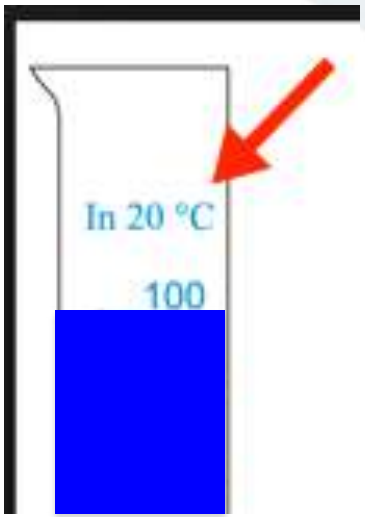
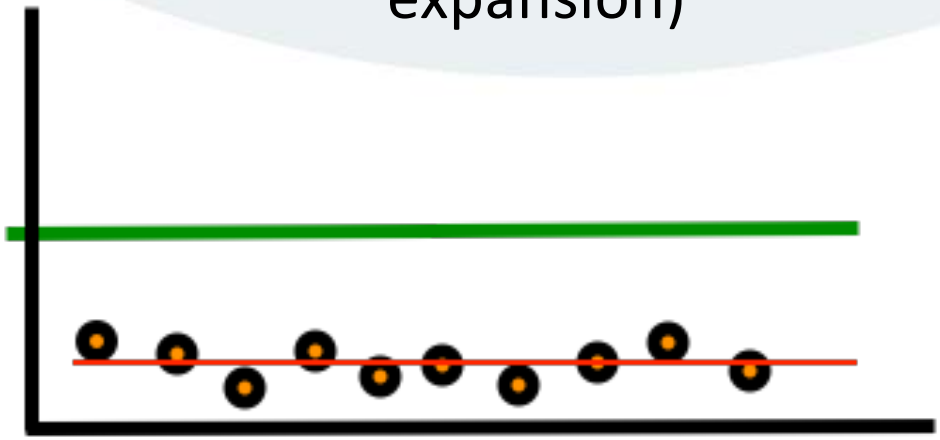
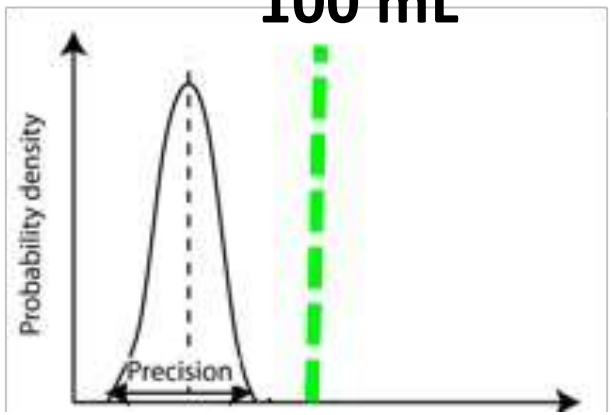
In Lao PDR: 35° C (glass expansion)







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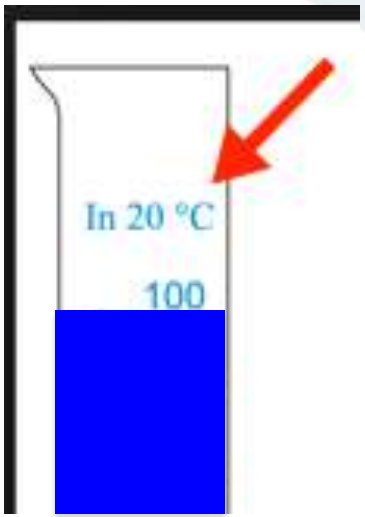
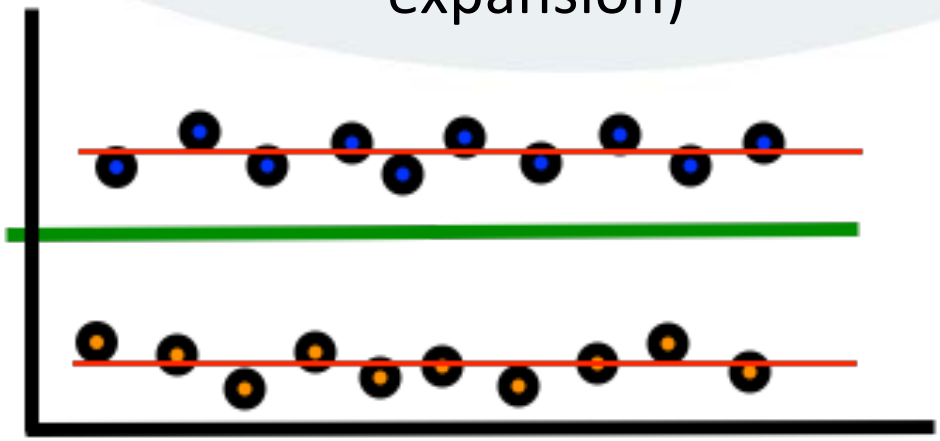
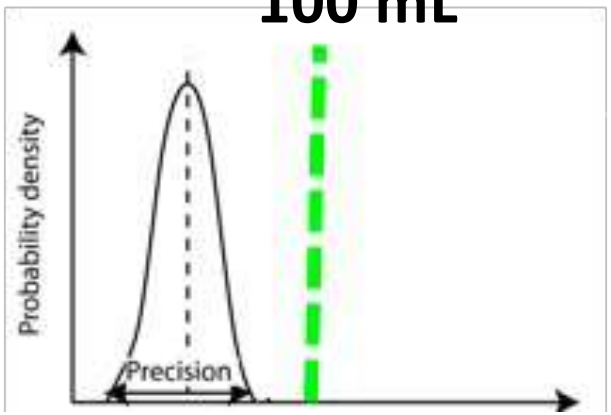




100 mL



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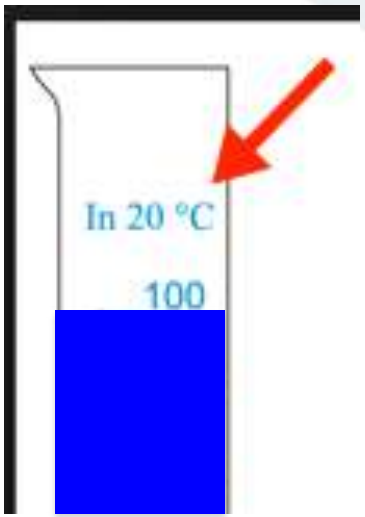
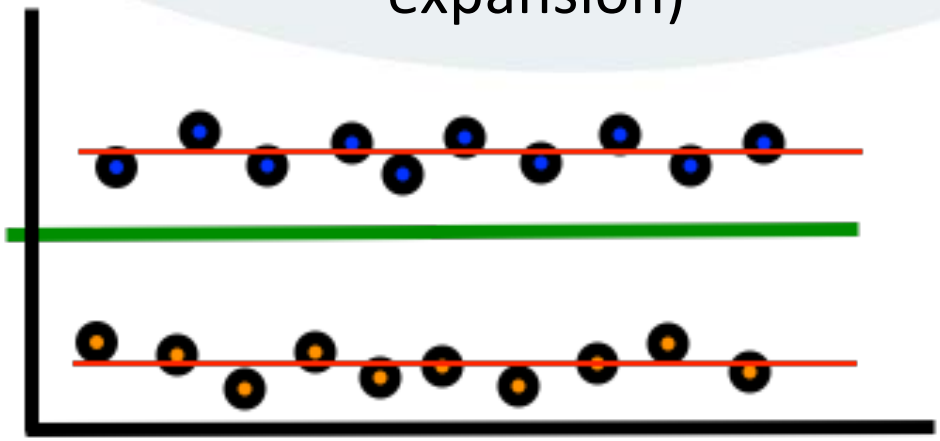
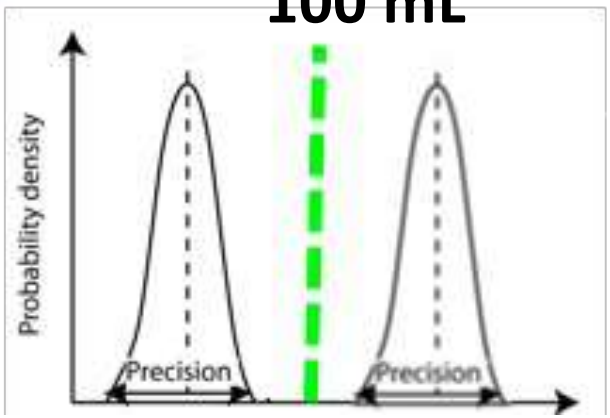
In Bhutan: 5° C (glass shrinkage)

In Lao PDR: 35° C (glass expansion)







Analytical errors can be of 2 categories:

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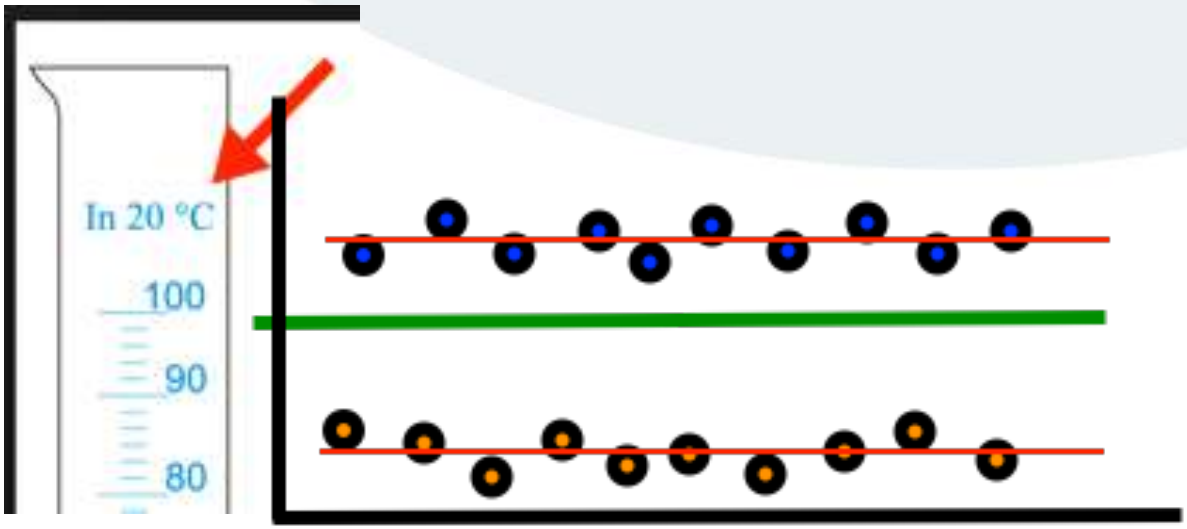

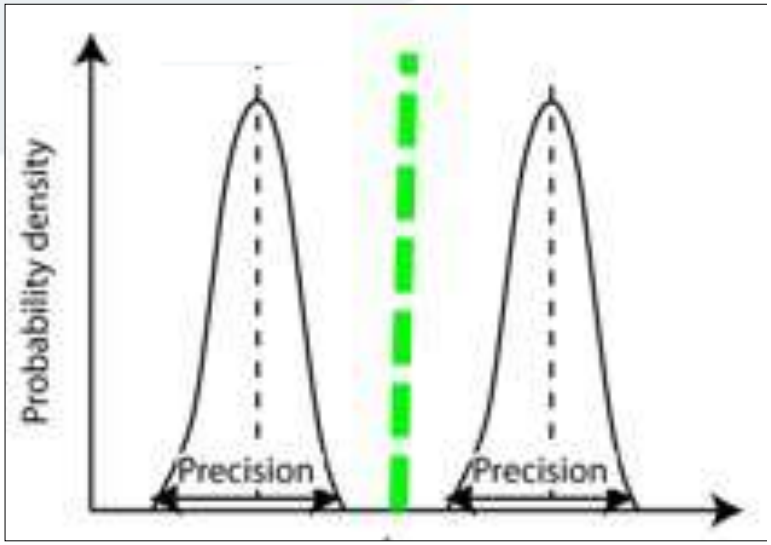

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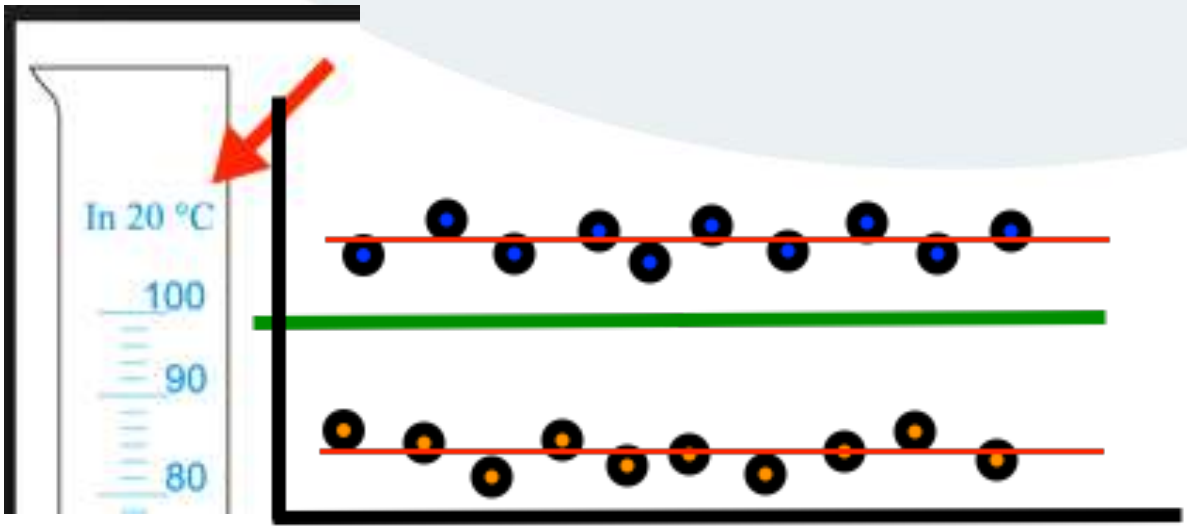

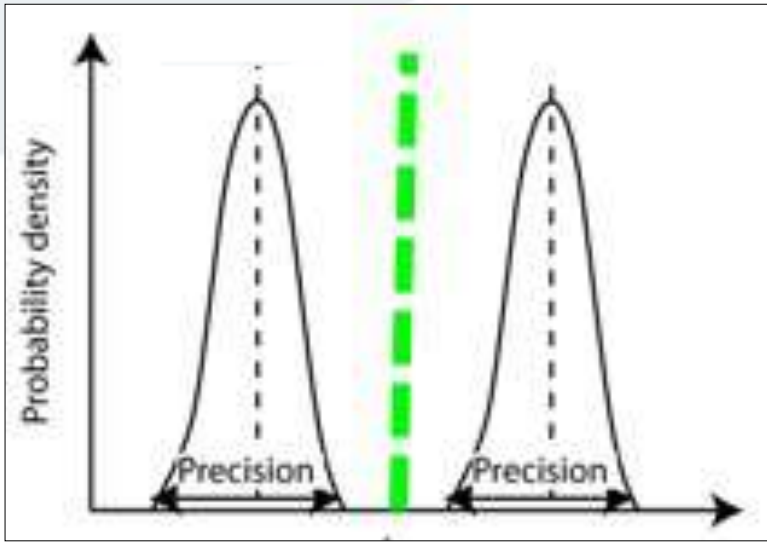

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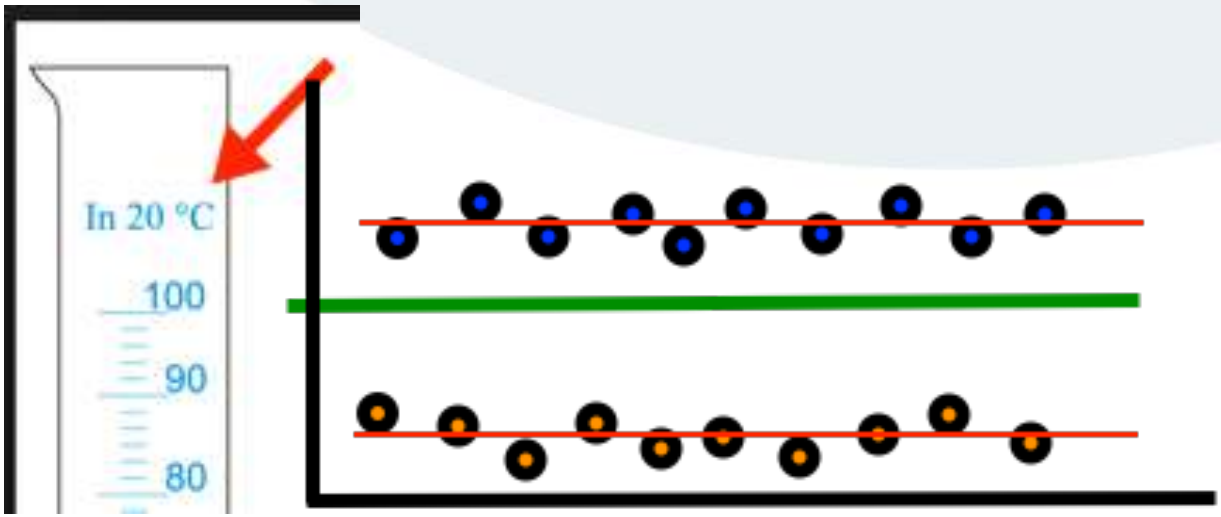
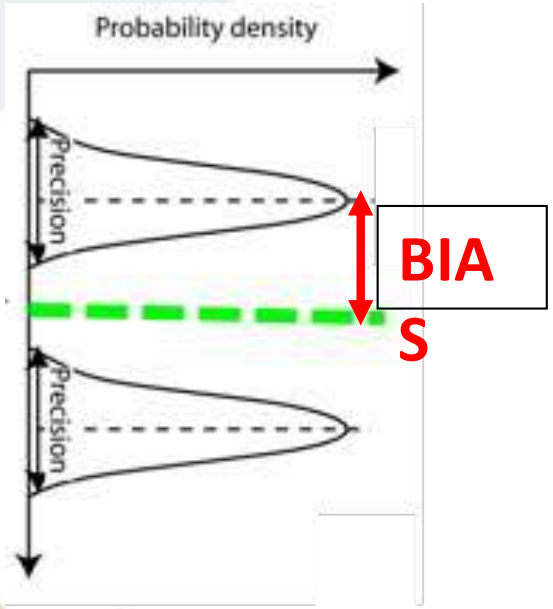
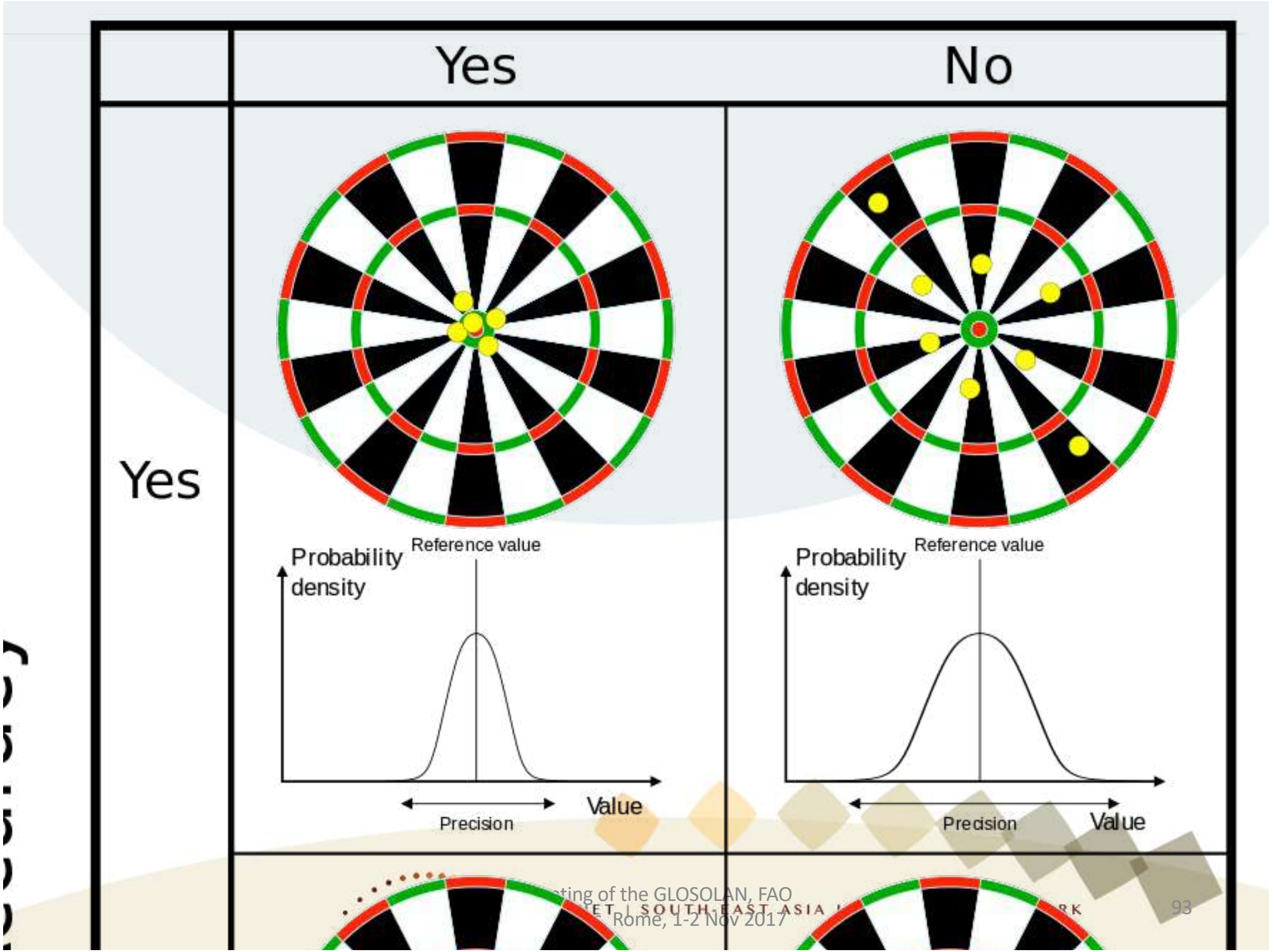
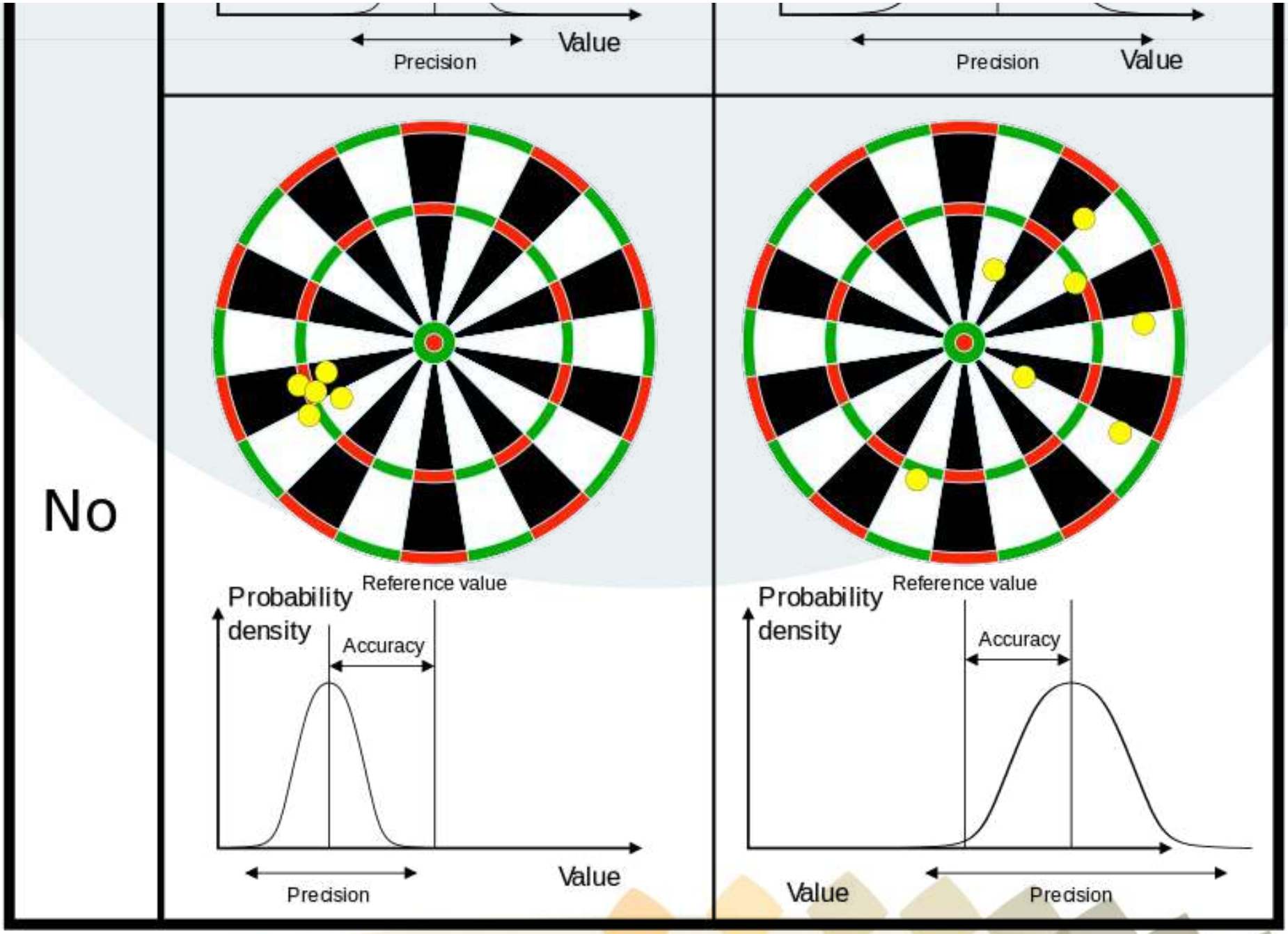





Yes
No
Yes
Probability density
Reference value
Value
Precision
Probability density
Reference value
Precision
Value


Precision
Value
Precision
Value
No
Reference value
Probability density
Accuracy
Precision
Value
Reference value
Probability density
Accuracy
Value
Precision

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); miust be detected and eliminated.

Error:

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

you must <u>always</u> keep in mind:

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Despite all efforts, you cannot avoid errors.

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= you will always make errors !

You will always make errors.

Good Laboratory Practices, will limit the errors.

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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.

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= 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*)

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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..

Analytical tasks

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.

with GLP you need:

STANDARD OPERATING PROCEDURES (SOP)

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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STANDARD OPERATING PROCEDURES (SOP)

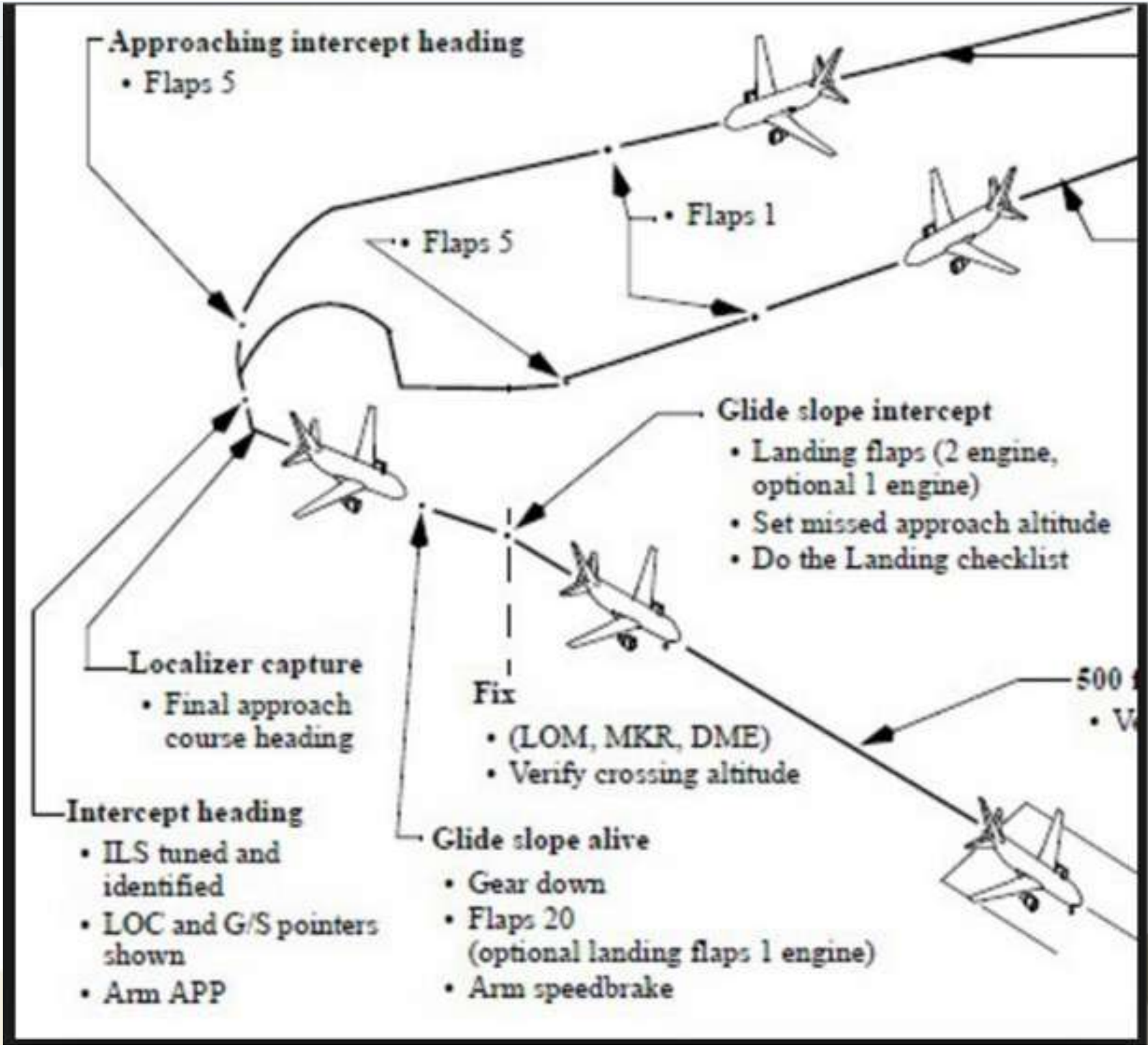
Detailed, **written instructions** to achieve uniformity of the performance of a specific function.

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

SOP are mandatory instructions!

You have to strictly follow a SOP, not to adapt it.

SOP !!!

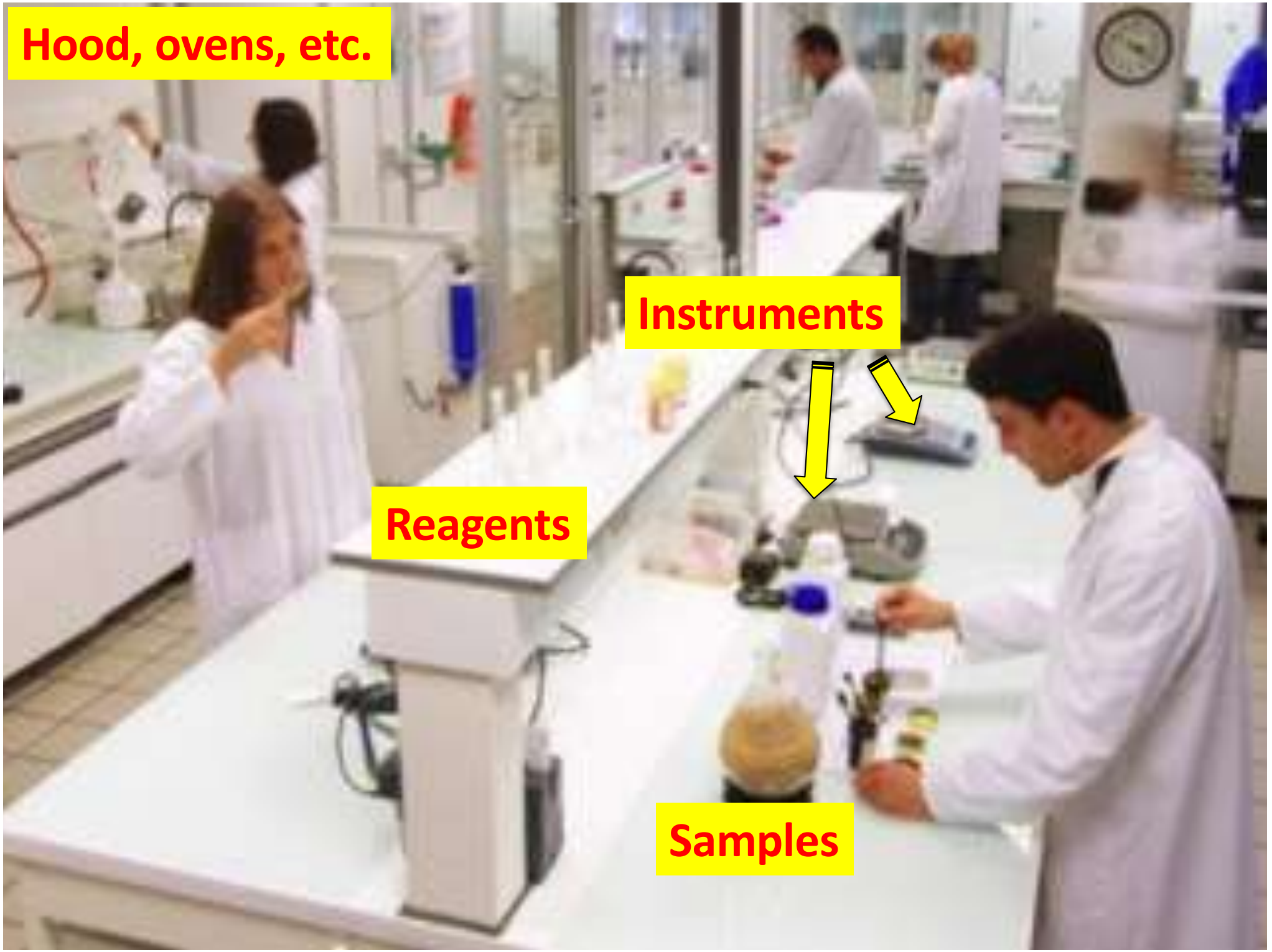

Approaching intercept heading
• Flaps 5
• Flaps 5
• Flaps 1
Glide slope intercept
• Landing flaps (2 engine, optional 1 engine)
• Set missed approach altitude
• Do the Landing checklist
Localizer capture
• Final approach course heading
Fix
• (LOM, MKR, DME)
• Verify crossing altitude
Intercept heading
• ILS tuned and identified
• LOC and G/S pointers shown
• Arm APP
Glide slope alive
• Gear down
• Flaps 20 (optional landing flaps 1 engine)
• Arm speedbrake

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*'.

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= pHmeter, spectrophotometers, etc.

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

<u>Instruments should be:</u>

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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For all apparatus, you must have:
- an '*Operation Instruction Manual*',
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<u>Apparatus should be:</u>

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

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

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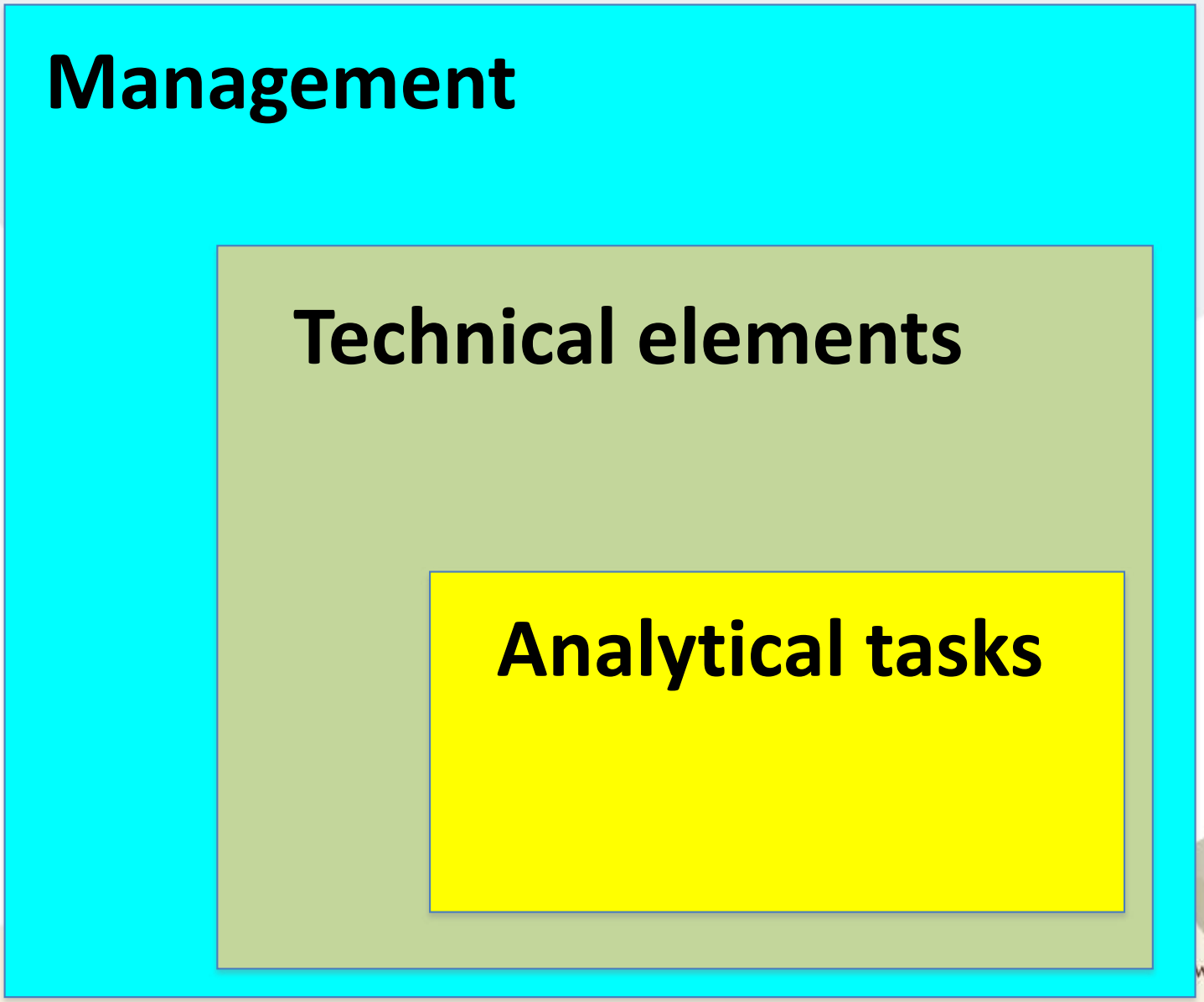
Need of proper packaging, labelling and man agement of samples before going to the laboratory.

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.



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

III –
INTERNAL & EXTERNAL QUALITY CONTROL (QC).

GLOSOLAN
GLOBAL SOIL LABORATORY NETWORK

Thanks for your attention

GLOBAL SOIL PARTNERSHIP