



Integration of virtual laboratories in learning of biochemistry

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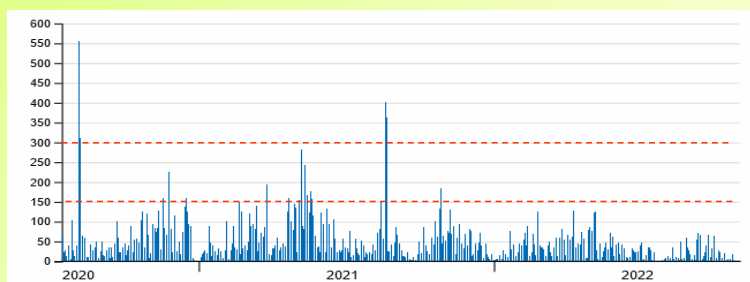
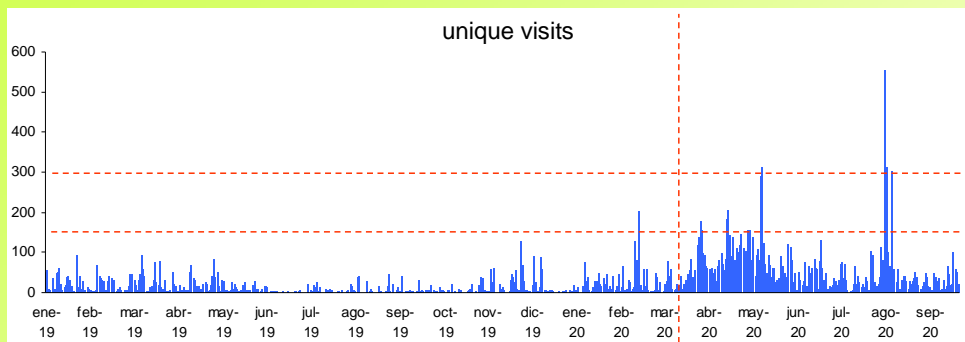


<https://bit.ly/2KhAC6p>

**What did the pandemic bring?
More awareness and greater need
for something that already existed**



Visits to "Cybertory" virtual laboratory



- 1) What we had before, but was not prominent,
- 2) what we discovered during pandemics,
- and 3) what must remain?

Physical and technical factors should not be which mark the guideline.

Reflection on the suitable methodology for a more efficient learning.

How to achieve practical lab work competencies?

Design activities that demand an active role of the student

The difference between seeing how something is done and doing it is large.

Any material should be accompanied by something that requires the student to get involved, extract information, answer a question, obtain a conclusion.

Force reflection and analysis about the development of the experiment.

not a movie, not a toy

When to use virtual laboratories?

Lack of instrumentation.

alternatives Lack of time or space.

Make good profit of time spent in the real lab.

come prepared, come trained

Before, during or after.

complement

Design tips



Adjustable parameters, variables that may be modified, rendering a different result.

Varied and unknown samples;
non-predictable results.



Negative results; experimental error.



Work protocol: not just instructions:
Description of aims.

List of activities to be performed –the resource
as a tool to discover something–.

Preparation of a laboratory notebook or activity
report and the results obtained.

Assessment.



How to achieve fruitful learning? Design of practical activities

Realistic experience, akin to a physical laboratory.

Not just for a good look; its variability is more important.

Use of the scientific method. Defining the problem. Posing hypotheses.

Design the experiment that will confirm (or not).

Obtain answers, extract conclusions.

Promote inquiry.

Change conditions, explore the effect of each variable.

Understand the basis.

Flexibility while designing the experiment to validate hypothesis.

Different samples: result is not anticipated; each student, each time,
gets different results.

Inaccurate results, experimental error.

Avoid the single path; flexibility, allow to make decisions.

Some environments with virtual laboratories

- **Labster.com**
 - commercial
 - integration in virtual campus (Canvas, Blackboard, Moodle, Google Classroom, Schoology, Sakai, Brightspace D2L)
 - partially translated (<https://rb.gy/sohwwh>)
- **LearnSci.com** (formerly Learning Science Co.UK)
 - commercial
 - rather than laboratories, complements
- ...
- **Biomodel.UAH.es/en**
 - free
 - most in Spanish, part in English
 - open to collaboration

Examples of activities

- Column chromatography
- SDS-PAGE

Techniques for separation and analysis of biomolecules

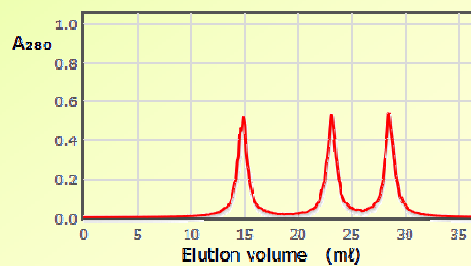
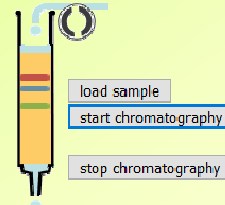
Simulation of column chromatography for proteins

Gel filtration,
ion exchange,
affinity

<https://biomodel.uah.es/lab/cromat/columna.htm?en>

Chromatographic matrix:

Elution buffer:



Techniques for separation and analysis of biomolecules

Electrophoresis simulators

Proteins on cellulose acetate strips.

- Plasma proteins
- LDH isoenzymes

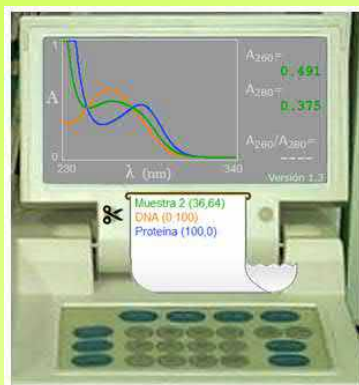
Proteins in gels: SDS-PAGE

<http://biomodel.uah.es/en/lab/#acetato>

<http://biomodel.uah.es/en/lab/SDS-PAGE>

Spectrophotometry

UV
absorption
of
proteins
and DNA

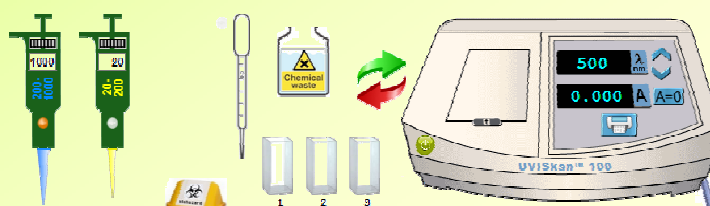


Virtual UV-VIS
spectrophotometer

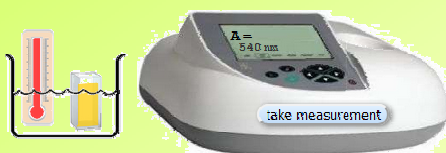
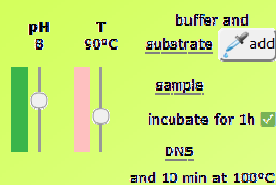
- Preparation of mixtures and dilutions.
- Absorbance measurement.
- Recording of spectra.
- Calibration curves.
- Quantitative determinations.

<https://biomodel.uah.es/en/lab/abs/uvProtDNA.htm>

<https://biomodel.uah.es/en/lab/abs/espectro.htm>



Enzyme activity, optimal pH and T



Lab notebook:
(write down the measurements)

	pH	T (°C)	A ₅₄₀
1			
2			
3			
4			
5			
6			

add another row



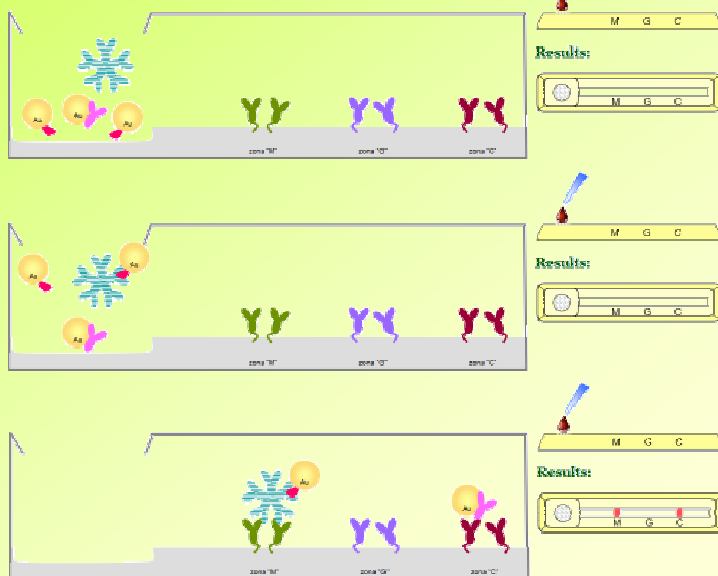
- Protocol for measuring enzyme activity.
- Design of the experiment.
- Absorbance measurement.
- Tabulating and processing data.
- Graphical plots.

https://biomodel.uah.es/en/abs/activ_enz.htm

Immunoassays

Rapid test for antibodies against SARS-CoV-2

Fundamentals.
Animated simulations.



<https://biomodel.uah.es/tecnicas/inmuno/CoV/inicio.en.htm>

"Cybertory": Virtual molecular biology laboratory

DNA fragmentation using restriction enzymes

RFLP assay:
β^S globin (sickle cell disease)
Forensic analysis.
Olive oil adulteration.

PCR amplification

RFLP assay:
Forensic analysis.
Paternity test.
CYP450 polymorphism.
Celiac disease markers.
Dairy products adulteration.
Viral infection (coronavirus)
RET protooncogene.



Analysis by gel electrophoresis

Agarose or polyacrylamide gel.
Fluorescence detection.

<http://biomodel.uah.es/en/lab/#cibertorio>

Some readings...

- E. Coyte, B. Heslop (2019) *Laboratory practicals: Goals, perspectives and ways of adding value to teaching labs in higher education*. FEBS Network, <http://bit.ly/2HASj0x>
- A. Herráez (2020) *Virtual laboratories as a tool to support learning*. Turkish Journal of Biochemistry 45: 20190146. doi:10.1515/tjb-2019-0146
- A. Herráez (2020) *Bendita virtualización, maldita virtualización*. Revista SEBBM 205: 40-42
- A. Herráez (2020) *Alternativas virtuales: trabaja en casa (casi) como si estuvieras en el laboratorio*. Revista SEBBM 206: 38-40

<https://revista.sebbm.es/> (open access, in Spanish)

<https://biomodel.uah.es/en/lab/> (CC-by-nc-sa licence)

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