Experience in Active Learning

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Abstract:
Participants will learn how to engage students in constructing new knowledge, applying this knowledge in problem solving, and in developing key science competences. We will work on-line on the activities that are based on the framework called the Investigative Science Learning Environment approach (ISLE) [1]. The participants will work in small groups (breakout rooms) using video recordings of experiments and Google slides to show their work (links to videos and Google slides will be provided by the workshop leader at the start of the workshop).

1. ETKINA, Eugenia, BROOKES, David, PLANINŠIČ, Gorazd. Investigative science learning environment: when learning physics mirrors doing physics. San Rafael: Morgan & Claypool Publishers, cop. 2019. IOP concise physics (Print). ISBN 978-1-64327-780-6, ISBN 978-1-64327-777-6, ISBN 978-1-64327-778-3. ISSN 2054-7307.

WORKSHOP PLAN

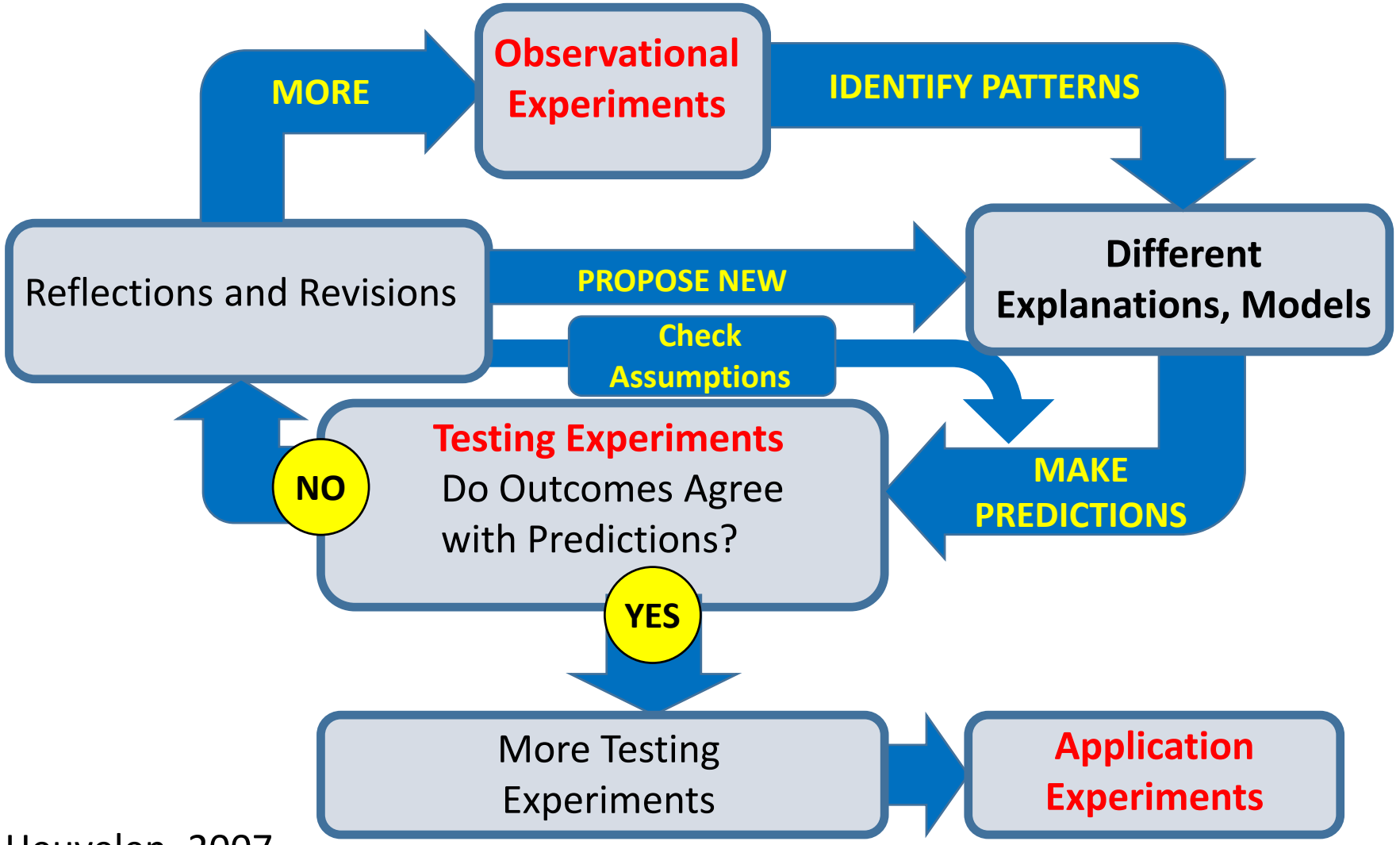
ACTIVITY 1. Wave optics (application of acquired knowledge)
Discussion: New type of problems (*Tell all*)

ACTIVITY 2. Photoelectric effect – introductory lesson (Construction of new knowledge, testing ideas, making predictions based on hypothesis)
Discussion: *ISLE process, ISLE-based labs*

ACTIVITY 3 Thermodynamics – gasses (application of constructed knowledge)
Discussion: New type of problems (*Make judgment based on data*)

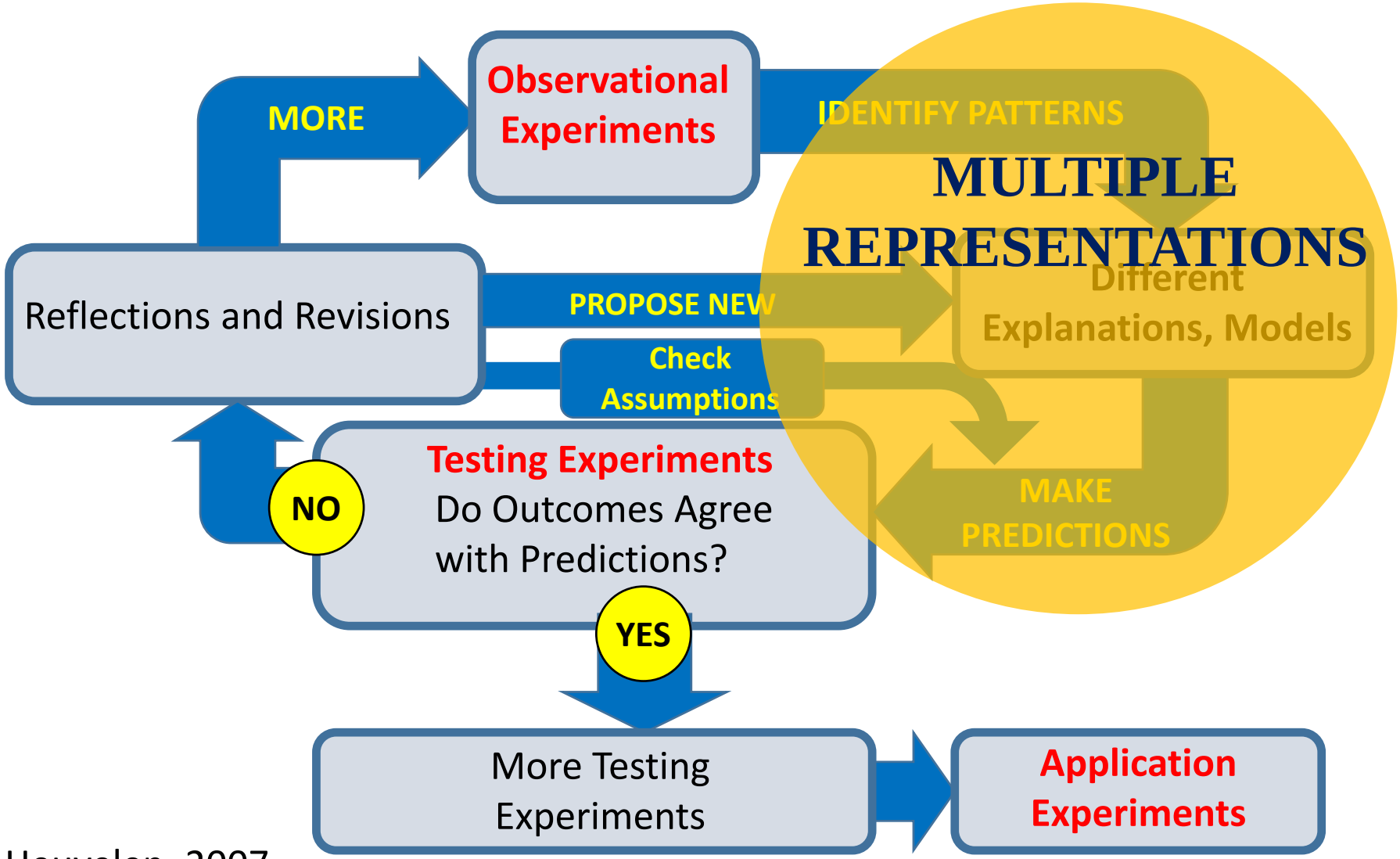
GENERAL DISCUSSION AND REFLECTIONS

Investigative Science Learning Environment (ISLE)



Etkina and Van Heuvelen, 2007
Etkina, 2015
Etkina *et al,* 2019

Investigative Science Learning Environment (ISLE)



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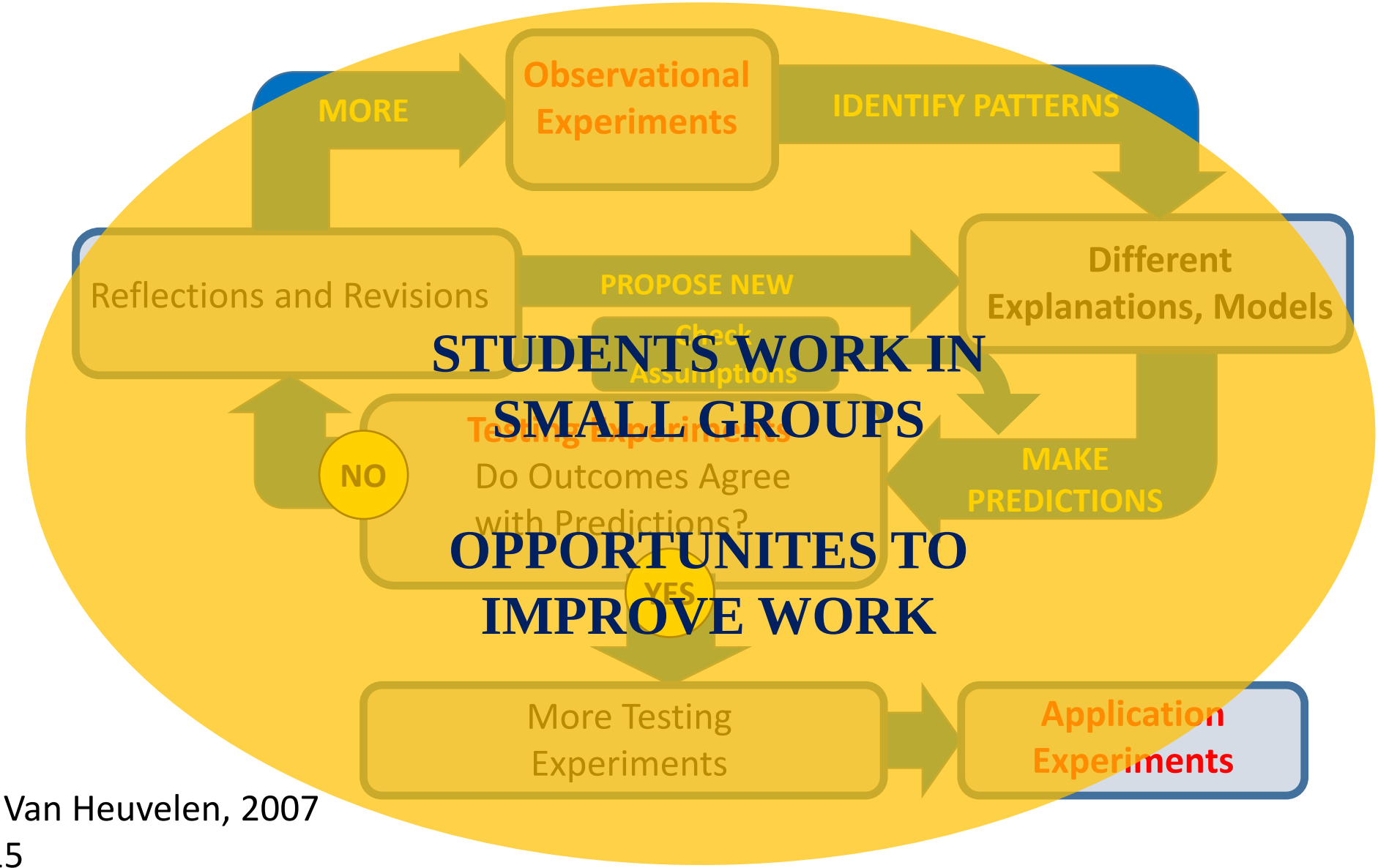
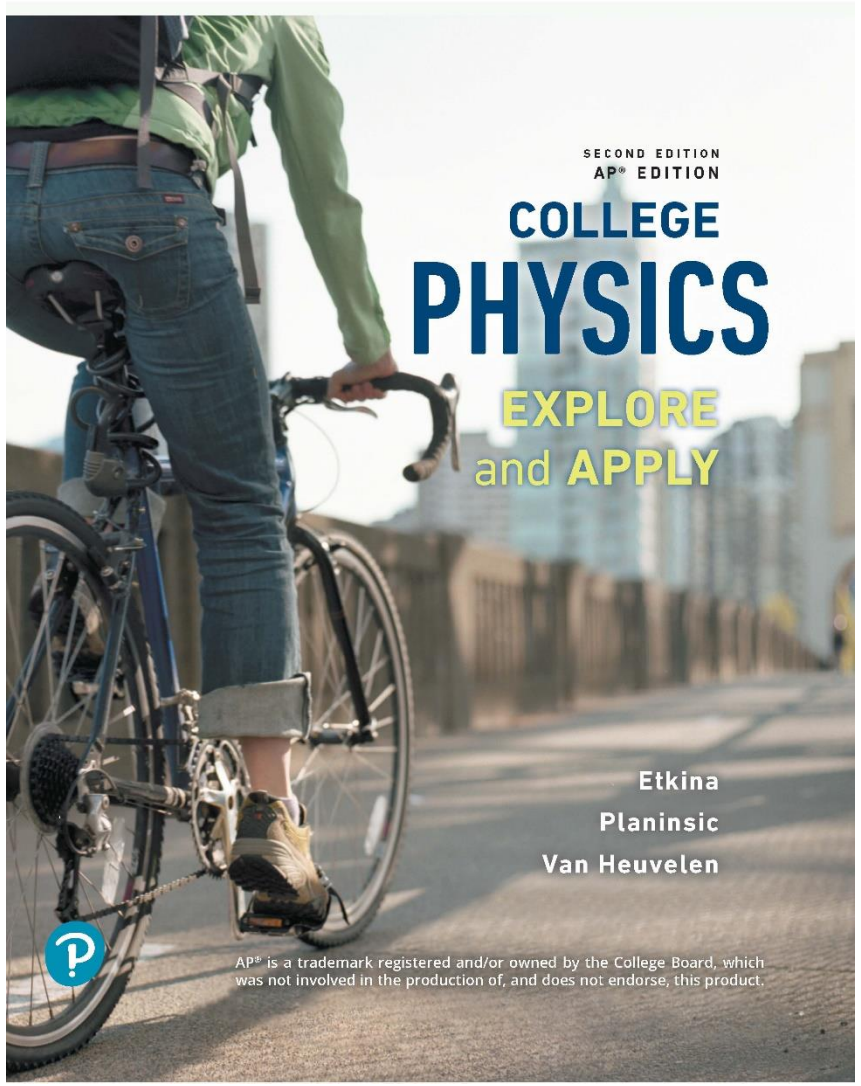


STUDENTS WORK IN SMALL GROUPS

OPPORTUNITES TO IMPROVE WORK

Etkina and Van Heuvelen, 2007
Etkina, 2015
Etkina *et al,* 2019



Etkina, Planinsic, Van Heuvelen, *College Physics*, *2nd Ed*. Pearson (2019)

+ Active Learning Guide (ALG)
+ On-line (ALG)
+ Instructor's Manual

+ About 200 Free Videos

Project Laboratory at FMF UL (since 2000)

Planinšič G, 2007

Project Laboratory at FMF UL (since 2000)

- Optional course for 1st year & 2nd year students
- The only course where students work in small groups (typically 4) on open ended experimental problems, with minimum help.
- Each group gets *a new* project task, assigned by course leaders (about 200 projects so far)
- Time to complete the whole project: typically 2-3 months (preparation, practical work, completing a web report, final presentation)

  http://projlab.fmf.uni-lj.si/
- Grading: pass/fail

1963 1998 2003 2015 2021

Renovation of Project lab course 2014-2015 (sabbatical E Etkina, Rutgers Univ.)

- Reconceptualization of the types of project tasks
- Introduction of Self-assessment rubrics

Faletič S and Planinšič G (2020)

Reconceptualization of the types of project tasks

New Project task types resemble the roles of the experiments in physics:

- **Observational experiments**
- **Testing experiments**
- **Application experiments**

(Etkina et al 2002)

Reconceptualization of the types of project tasks

New Project task types resemble the roles of the experiments in physics:

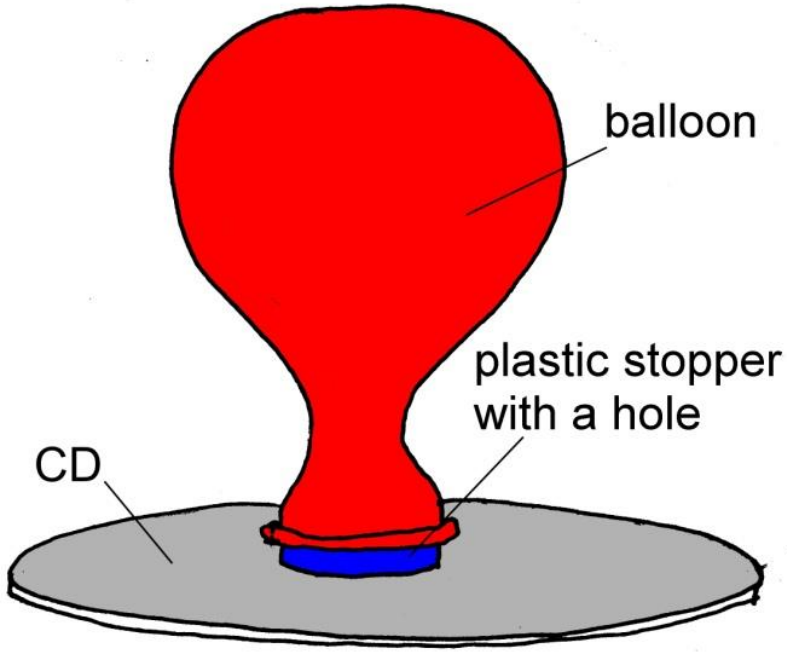
- **Observational experiments** (observe phenomena, collect relevant data, identify patterns, propose explanations)
- **Testing experiments** (test different explanations, reject the explanation)
- **Application experiments** (apply acquired knowledge to solve practical problem /measure a quantity, design a device/).

(Etkina et al 2002)

PROJECT BASED ON OBSERVATIONAL EXPERIMENTS

Hovercraft

Simple hovercraft can be made of used CD, plastic stopper with a hole and the balloon (see figure). Investigate how relevant parameters affect hovercraft motion and time spent levitating.



PROJECT BASED ON TESTING EXPERIMENTS:

Disappearing water

Jan and Ana observe how water slowly disappears from an open container. They notice that drying is faster in the presence of wind. Each of them proposes an explanation:

Jan: Fresh air from wind sucks water vapor by binding water molecules to air molecules.

Ana: Wind makes more space for water molecules so they can leave the liquid.

Design experiments that will allow you to test the explanations and choose the one that explains the observed phenomenon best.

PROJECT BASED ON APPLICATION EXPERIMENTS

Energy stored in a battery

Design two independent methods to determine energy stored in an AA battery and compare the results.

References

E. Etkina and A. Van Heuvelen (2007) Investigative Science Learning Environment–A Science Process Approach to Learning Physics, in Research-Based Reform of University Physics, Vol. 1, edited by E. F. Redish and P. J. Cooney.

Etkina, E. (2015). Millikan award lecture: Students of physics - listeners, observers, or collaborative participants in physics scientific practices? American Journal of Physics, 83(8), 669–679. https://doi.org/10.1119/1.4923432.

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