Sound check

Present-day Practicals webinar series ’25/’26

PRESENT-DAY PRACTICALS

Welcome to webinar 3:

“Refocusing labs: from cookbook to open inquiry”

Dr. Forrest Bradbury[1], Julia Burzyńska[1,2], Eva Steultjens[2], Noor Schrofer[2]

[1]Amsterdam University College
[2]University of Amsterdam

We often talk about preparing students for “real research”, yet many lab assignments feel more like recipes than investigations. What if students could take charge of their own experiments – from the first question to the final conclusion?

We encourage you to **turn on your camera** to help create a more personal and interactive atmosphere.

This webinar will **not be recorded** to help create an open, interactive atmosphere where everyone feels comfortable to share ideas and ask questions. Instead, we’ll share a **recap** afterwards

PRESENT-DAY PRACTICALS

Who are we?

Marjo de Graauw

Janine Geerling

Carolien Koppejan

Charita Furumaya

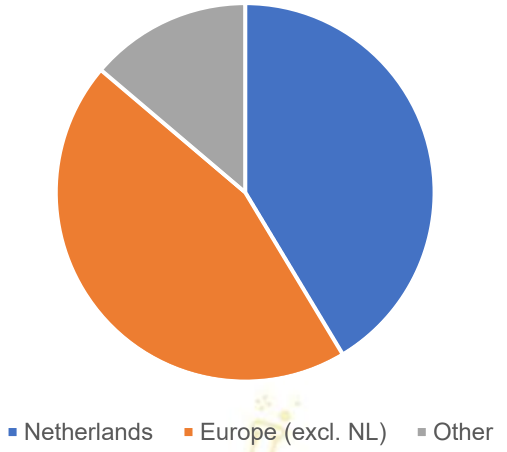
Bianca Bakker

Who are you?

63 registrations, 20 different countries:

- Aruba
- Austria
- Belgium
- Denmark
- Germany
- Greece
- Hungary
- Israel
- Jordan
- Latvia
- Norway
- Slovakia
- Slovenia
- South Africa
- Sweden
- Switzerland
- The Netherlands
- Turkey
- United Kingdom
- United States of America

Regional distribution PDP webinar 3



PRESENT-DAY PRACTICALS

We encourage you to **turn on your camera** to help create a more personal and interactive atmosphere.

Use the **chat** to post your questions and share your ideas

After the webinar, we'll share a **recap** containing slides, lessons learned, and additional information and resources

Refocusing Labs:
from cookbook to open inquiry

Dr. Forrest Bradbury[1]
Julia Burzyńska[1,2]
Eva Steultjens[2]
Noor Schrofer[2]

[1]Amsterdam University College
[2]University of Amsterdam

inter-institution project
funded by a
SURF Open Education grant

SURF

S³OIL

SUPPORTING STUDENTS' SCIENTIFIC OPEN INQUIRIES IN LABS

Universiteit Leiden

Amsterdam university college
AUC

UNIVERSITY OF AMSTERDAM

Instituut voor Interdisciplinaire Studies
Het expertisecentrum voor interdisciplinair leren en doceren

Swammerdam Institute for Life Sciences
A multidisciplinary research institute with a systems biology approach to the life sciences

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

ESoE
TU/e

Outline

- Define Open Inquiry Labs
- Motivations for Open Inquiry
- Challenges for Open Inquiry
- S^3OIL team & courses
- Eva, Noor, Julia:
  - MolNeuroBio & Maker Lab courses
  - Student & TA experiences of Open Inquiry
- Break-out discussions: Open Inquiry Labs in your program's specific context
- S^3OIL team findings (requirements & best practices)
- Acknowledgements

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Refocusing Labs: from cookbook to open inquiry

Definitions

“open inquiry” in science lab education

open:

students have agency in all phases of the research process

authentic research/inquiry:

students engage in knowledge creation processes (from “start” to “finish”)

Definitions

“open inquiry” in science lab education

open:

students have agency in all phases of the research process

Inquiry/Enquiry = Research !

- *though “Research” implies adding to the body of scientific knowledge…*
- *while “Inquiry” has a more accessible and even playful connotation*

authentic research/inquiry:

students engage in knowledge creation processes (from “start” to “finish”)

Definitions

Levels of openness

	Research question	Research methods	Conclusion
1. Confirmation	Given	Given	Given
2. Structured inquiry	Given	Given	Open
3. Guided inquiry	Given	Open	Open
4. Open inquiry	Open	Open	Open

open:

students have agency in all phases of the research process

authentic research/inquiry:

students engage in knowledge creation processes (from "start" to "finish")

An inquiry's openness is determined by how much of its components are given or specified by the instructor.

J.J. Schwab, "Inquiry, the Science Teacher, and the Educator", The School Review, Vol. 68, No. 2, p. 176 (1960).

Definitions

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According to these definitions:

What inquiry openness level do your lab courses reach?

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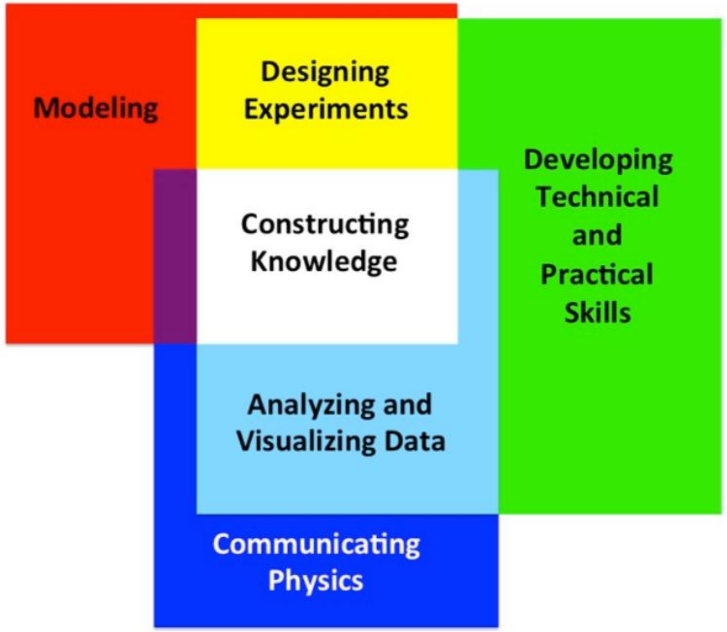
S^3OIL motivations for Open Inquiry

Q: What should labs seek to teach?

- Empirical research skills!

research processes



Empirical (physics) research skills, as defined by the American Association of Physics Teacher's special report on lab education, 2014

research understandings

- Nature of science
  - What am I doing?
- Self-efficacy
  - Can ***I*** do it?
- Critical thinking
  - How to do it successfully?
- Creativity
  - How to do it even better?

S^{3}OIL motivations for Open Inquiry

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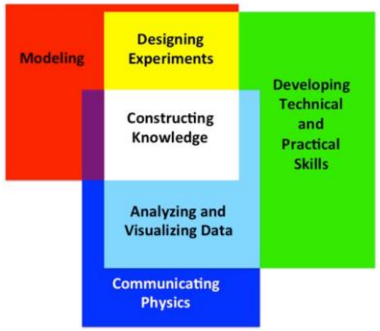

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A: Higher-order & integrative skills for research practices

Q: How?

A? constructive alignment suggests open inquiry:

engaging students in empirical science processes & decision-making in authentic† contexts

†authentic from student perspective

S³OIL motivations for Open Inquiry

Q: Is open inquiry in labs effective ***in practice***?

(i.e. Can students handle full cycles of scientific agency?)

YES	NO
Problem-Based Learning: What and How Do Students Learn? January 2004 · Educational Psychology Review 16(3):235-266 DOI:10.1023/B:EDPR.0000034022.16470.f3 Cindy E. Hmelo-Silver **Scaffolding and Achievement in Problem-Based and Inquiry Learning: A Response to Kirschner, Sweller, and Clark (2006)** CINDY E. HMELO-SILVER, RAVIT GOLAN DUNCAN & CLARK A. CHINN Pages 99-107 | Published online: 05 Dec 2007 Cite this article https://doi.org/10.1080/00461520701263368 Review **Let's talk evidence – The case for combining inquiry-based and direct instruction** Ton de Jong[a], Ard W. Lazonder[b], Clark A. Chinn[c], Frank Fischer[d], Janice Gobert[c e], Cindy E. Hmelo-Silver[f], Ken R. Koedinger[g], Joseph S. Krajcik[h], Eleni A. Kyza[i], Marcia C. Linn[j], Margus Pedaste[k], Katharina Scheiter[l], Zacharias C. Zacharia[m] Review **Beyond inquiry or direct instruction: Pressing issues for designing impactful science learning opportunities** Ton de Jong[a], Ard W. Lazonder[b], Clark A. Chinn[c], Frank Fischer[d], Janice Gobert[c], Cindy E. Hmelo-Silver[f], Ken R. Koedinger[g], Joseph S. Krajcik[h], Eleni A. Kyza[i], Marcia C. Linn[j], Margus Pedaste[k], Katharina Scheiter[l], Zacharias C. Zacharia[m]	**Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching** By Kirschner, PA (Kirschner, Paul A.) ; Sweller, J (Sweller, John) ; Clark, RE (Clark, Richard E.) View Web of Science ResearcherID and ORCID (provided by Clarivate) Source EDUCATIONAL PSYCHOLOGIST ssue: 2 Page: 75-86 5326985ep4102_1 **There Is an Evidence Crisis in Science Educational Policy** Zhang, Lin; Kirschner, Paul A.; Cobern, William W.; Sweller, John Educational Psychology Review, v34 n2 p1157-1176 Jun 2022 Review **Response to De Jong et al.'s (2023) paper "Let's talk evidence – The case for combining inquiry-based and direct instruction"** John Sweller[a], Lin Zhang[b], Greg Ashman[c d], William Cobern[e], Paul A. Kirschner[f g] **Putting Students on the Path to Learning: The Case for Fully Guided Instruction** Clark, Richard E.; Kirschner, Paul A.; Sweller, John American Educator, v36 n1 p6-11 Spr 2012

While educational psychologists fought, lab teachers experimented!

<u>empirical results suggest:</u>

- ***more agency addresses more (and higher-order) learning objectives,***
- ***but open inquiry requires scaffolding & guidance***

S^3OIL motivations for Open Inquiry

E CLASS scores

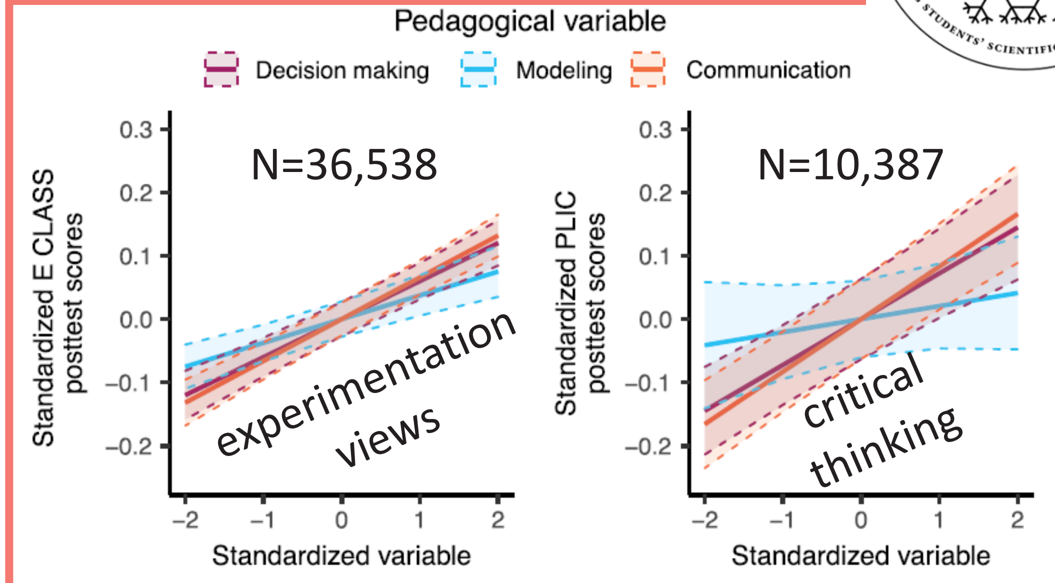
Level		Open-ended*	Guided*
	N	592	3487
FY	Pre	15.4	16.0
	Post	15.5	14.1
	N	553	279
BFY	Pre	18.6	18.1
	Post	19.7	17.2

increases! ☺

decreases! ☹

Overly-structured* lab courses harm students' understandings of the nature of science and their self-efficacy for empirical science… *see their definitions of "open-ended" & "guided"

(Wilcox, Lewandowski; 2016)
DOI: 10.1103/PhysRevPhysEducRes.12.020132



Labs aiming to teach scientific skills outperformed labs aimed at concepts due to their greater student agency (decision-making, communication).

(Walsh, Lewandowski, Holmes; 2022)
DOI: 10.1103/PhysRevPhysEducRes.18.010128

empirical results suggest:

- ***more agency addresses more (and higher-order) learning objectives,***
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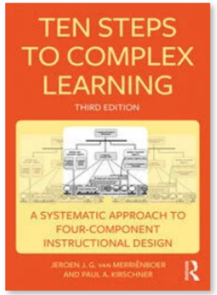
S³OIL motivations for Open Inquiry

Contradictio in terminis?

teacher guidance is needed to support student agency



Book

Ten Steps to Complex Learning

A Systematic Approach to Four-Component Instructional Design

By Jeroen J. G. van Merriënboer, Paul A. Kirschner

diminishing levels of guidance (content/skills and procedural) leads to integrative, authentic, whole-task experiences based on real-life tasks.

What guidance do **you** find necessary for open-ended labs?

empirical results suggest:

- ***more agency addresses more (and higher-order) learning objectives,***
- ***but open inquiry requires scaffolding & guidance***

S³OIL motivations for Open Inquiry

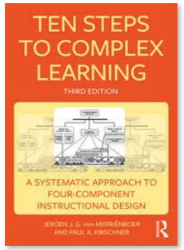
Q: Is open inquiry in labs effective ***in practice***?

(i.e. Can students handle full cycles of scientific agency?)

A: Yes! Our own findings agree:

- **labs can support effective student open inquiry**
- **if: prior "first-order scaffolding"**
  - ➢ of domain-specific content & skills
- **if: simultaneous "second-order scaffolding"**
  - ➢ of self-directed learning skills
  - ➢ aka process-focused guidance

terms used in the 4C/ID model:
https://www.4cid.org



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Refocusing Labs: from cookbook to open inquiry

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Challenges for Open Inquiry in Labs

What is the process of **doing** empirical scientific research?

1. *Establishing research goal: What are the goal(s) and question(s) of the research?**
   a. Deciding if the goal is interesting, timely, worthwhile, etc.
   b. Predicting if the goal is sufficiently ahead of current knowledge to be interesting but not so far ahead that it might have too high a risk of failing or be ignored.
   c. Evaluating whether the research question is consistent with the constraints on funding, time, equipment, and laboratory capacity, including personnel.
2. *Defining criteria for suitable evidence: Deciding what will constitute suitable evidence to achieve the goal by developing and/or utilizing existent criteria:*
   a. What data would be convincing given the state of the field?
   b. What variables are important and how might they be measured and controlled?
   c. What types of experimental controls and checks would need to be in place?
3. *Determining feasibility of experiment*
   a. Predicting whether or not it is realistically possible to carry out the experiment, and, if it is, analyzing the scale of time and money required and deciding if these are reasonable. (This involves a more detailed reiteration of 1.c.)
   b. The researcher must also analyze contingency options, if the results of the experiment are not what is hoped for. Will the data produced still provide novel publishable information? Will the results show how to improve the apparatus to achieve conditions needed to obtain hoped-for results?
4. *Experimental design*
   a. Exploration of many possible preliminary designs (requires clear definition of the optimum depth of analysis of the alternative designs).
   b. Analyzing relevant variables that may lead to systematic errors in results and interpretation. This requires having complex cause and effect models for the experiment. (Will be repeated after measuring performance of the apparatus.)
   c. Finalizing the design, taking into account construction details and performance requirements of each component. Often requires bringing in additional expertise.
   d. Developing detailed data acquisition strategy: How much data to take and over what parameter ranges, how long to accumulate data in each measurement, in what order are things measured, which measurements do you repeat and how often? Deciding on required precision and accuracy: This includes deciding which quantities need not be measured. This must take into account constraints on time, clarity of results, all potential statistical and systematic uncertainties, and the importance and requirements for distinguishing between different potential interpretations of results. (This step is repeated/revised after performance of apparatus has been measured.)
5. *Construction and testing of apparatus*,***
   a. Deciding who should build the various parts and on what schedule (in-house, purchase standard parts, special construction by outside companies, etc.). Requires evaluation and application of trade-offs of cost, construction expertise, time, degree of confidence as to specific design details.
   b. Developing criteria and test procedures for evaluation of the apparatus components as they are completed.
   c. Collecting data on performance of specific components and full apparatus.
   d. Developing procedures for tracking down the source of malfunction when the individual components or the assembled apparatus do not perform as designed. This necessarily involves deep familiarity with the respective hardware and a repertoire of troubleshooting regimes that are highly specific to the field, the apparatus, and the approach being used.**
   e. Figuring how to modify particular parts, or overall apparatus, as needed according to test results.
   f. Reiterate data acquisition strategy 4.d., taking into account actual performance of finished apparatus.
   g. After completion, collecting experimental data.
6. *Analyzing data*
   a. Modeling the data by suitable mathematical forms, including deciding which approximations are justified and which are not.
   b. Deciding on what statistical analysis methods and procedures are appropriate.
   c. Calculating the statistical uncertainty.
   d. Calculating the systematic uncertainties as needed (often already done as part of the data acquisition strategy).
7. *Evaluating results*,***
   a. Checking the results, when they come out differently than expected. This involves calling on complex mental models incorporating a web of cause and effect relationships, strategies for separating relevant and irrelevant information, complex pattern recognition and search algorithms. (Also usually involves extensive additional data collection, and possible modification of apparatus and redoing data collection.)
   b. Testing data that come out as expected. Identify redundant tests for possible systematic errors, being particularly sensitive to experimenter biases.
8. *Analyzing implications if results are novel and/or unexpected and confirmed*
   a. What are plausible interpretations or new theoretical or experimental directions implied by these results?*
9. *Presenting the work*
   a. Follow standard data display procedures or, as needed, develop new procedures that highlight critical features of methods or results.
   b. Explain the work so the broader context and uniqueness of the work, the apparatus, the procedures, and the conclusions are easily understood, and the audience/readers perceive it to be of maximum interest and significance.

Cognitive Task Analysis Elements

1. Establishing research goals
2. Defining criteria for suitable evidence
3. Determining feasibility of experiment
4. Experimental design
5. Construction and testing of apparatus/code
6. Analyzing data
7. Evaluating results and analyzing implications
8. Presenting the work

open:

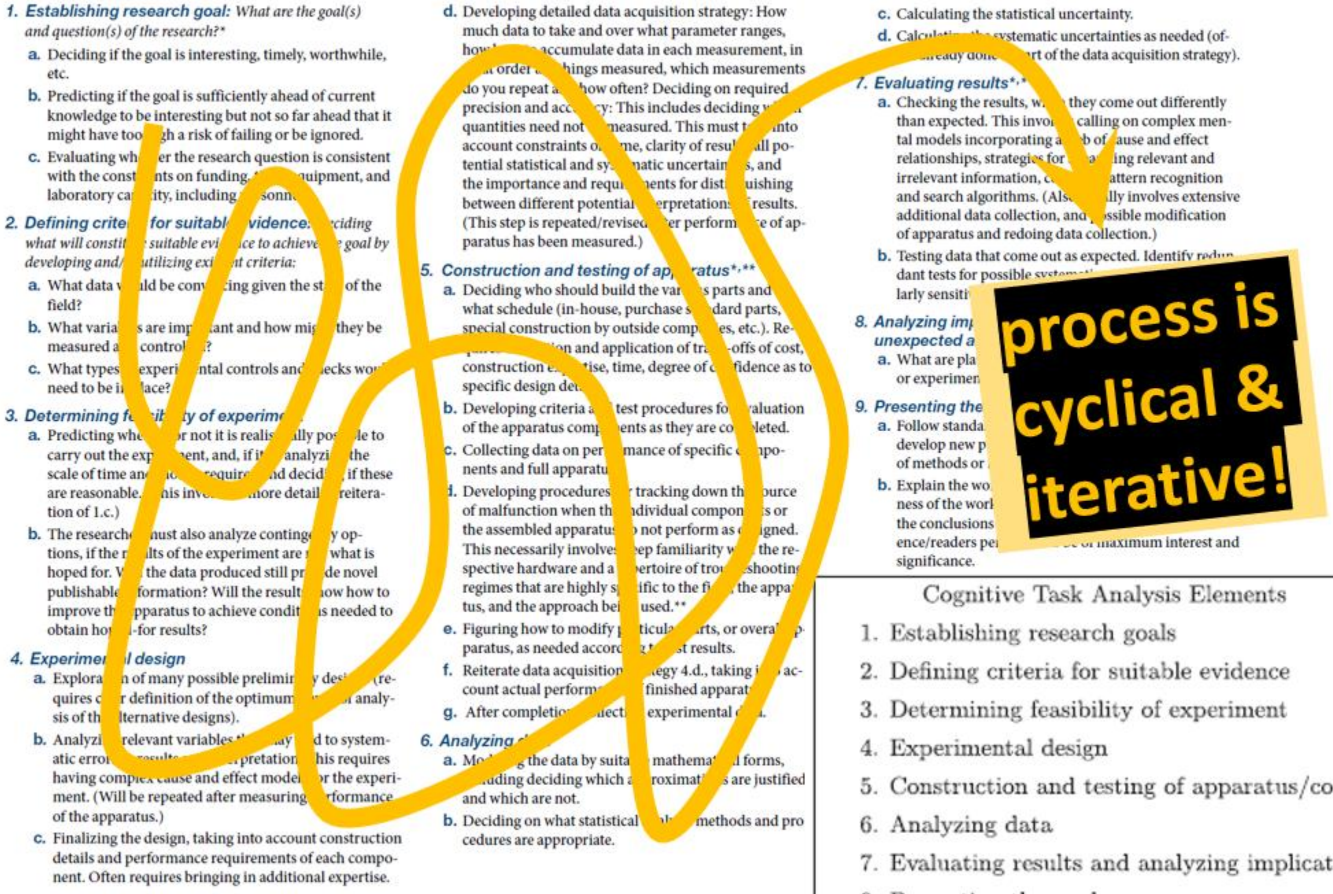
students have agency in **all** phases of the research process

Wieman, The Physics Teacher 53, p349 (2015), Holmes & Wieman, Phys. Rev. Phys. Educ. Res. 12, 020103 (2016).

Challenges for Open Inquiry in Labs

S³OIL — Supporting Students' Scientific Open Inquiries in Labs

What is the process of **doing** empirical scientific research?



Cognitive Task Analysis Elements

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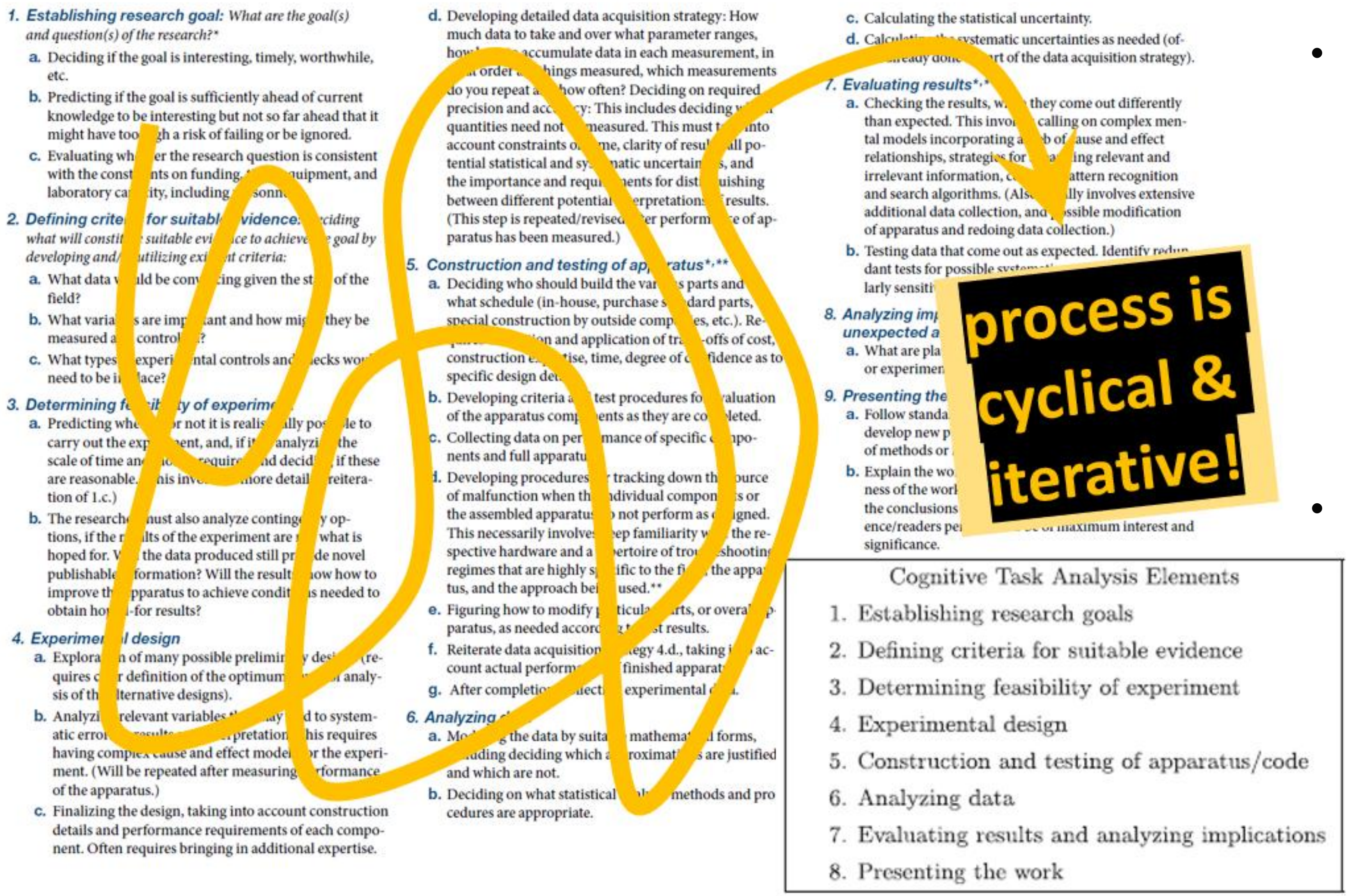
Challenges for Open Inquiry in Labs

<u>What is the process of **guiding** empirical scientific research?</u>



- **prior "first-order scaffolding"**
  - ➢ of domain-specific content & skills

What do students need to know before working on higher-order and integrative skills in labs?

- **simultaneous "second-order scaffolding"**
  - ➢ of self-directed learning skills
  - ➢ aka process-focused guidance

How to guide the inquiry process while preserving student agency?

Wieman, The Physics Teacher 53, p349 (2015), Holmes & Wieman, Phys. Rev. Phys. Educ. Res. 12, 020103 (2016).

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from cookbook to open inquiry

S^3OIL team members:

(collaboration: SURF* Open Education grant)

Universiteit Leiden

Leiden Institute of Physics

Paul Logman
logman@physics.leidenuniv.nl

EINDHOVEN UNIVERSITY OF TECHNOLOGY TU/e

ESoE LERAREN-OPLEIDING TU/e

Lesley de Putter
l.g.a.d.putter@tue.nl

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UNIVERSITY OF AMSTERDAM

AUC

Forrest Bradbury
f.r.bradbury@auc.nl

Swammerdam Institute for Life Sciences

Simone Mesman
s.mesman@uva.nl

Martijs Jonker
m.j.jonker@uva.nl

Instituut voor Interdisciplinaire Studies

Morten Strømme
m.h.stromme@uva.nl

*SURF (the Netherlands' collaborative organization for IT in education and research: www.surf.nl)

SURF

S^{3}OIL team members:
(collaboration: SURF* Open Education grant)

Lesley de Putter
l.g.a.d.putter@tue.nl

Project roles:

- education research
- coaching our collaborative development
- dissemination

S^{3}OIL team members:

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Universiteit Leiden

Leiden Institute of Physics

Paul Logman
logman@physics.leidenuniv.nl

EINDHOVEN UNIVERSITY OF TECHNOLOGY TU/e

ESoE TU/e

Lesley de Putter
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UNIVERSITY OF AMSTERDAM

AUC

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f.r.bradbury@auc.nl

Swammerdam Institute for Life Sciences

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s.mesman@uva.nl

Martijs Jonker
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m.h.stromme@uva.nl

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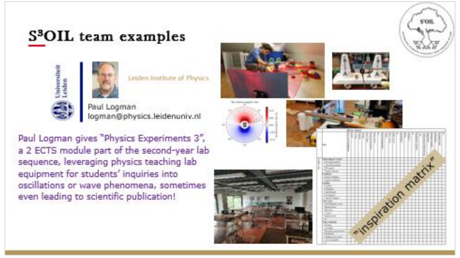
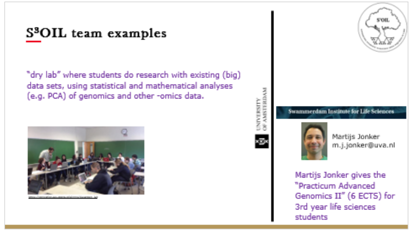
Paul's, Martijs' & Morten's open inquiry courses:

Paul Logman

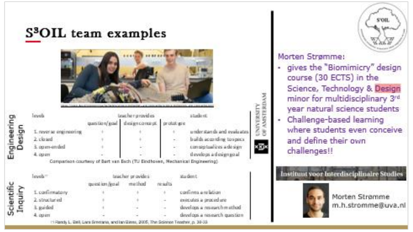
second year physics lab:
wave phenomena and oscillations





third year life sciences dry lab:
genomics & (big) data analyses

Martijs Jonker



applied science design lab:
bio-mimicry & robotics (30 ECTS)

Morten Strømme

Eva, Noor, and Julia's student experiences

Courses and their developers were part of the S^3OIL project:

Dr. Simone Mesman

Molecular Neurobiology Lab

&

Dr. Forrest Bradbury

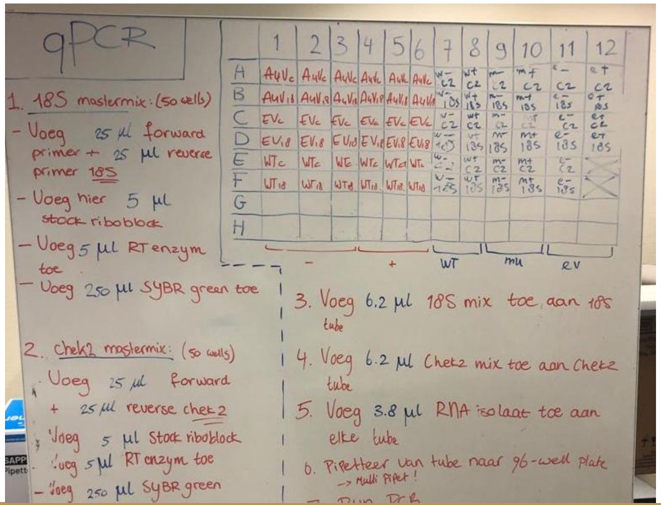
Maker Lab

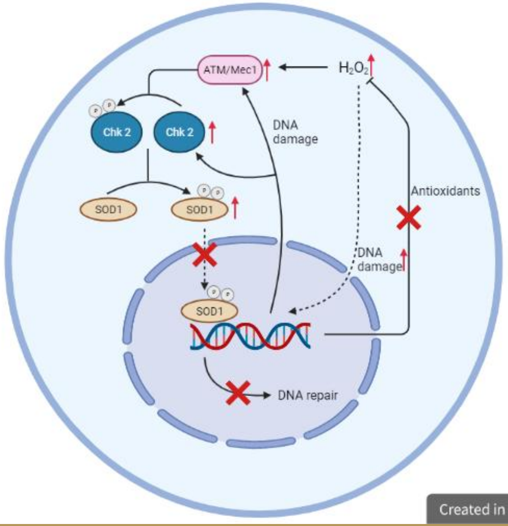
- Upper-level undergraduate lab courses
- 6 ECTS (168 total hours of student work)

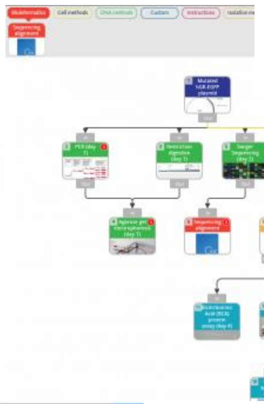
Noor & Eva: "Molecular Neurobiology Lab"

- University of Amsterdam, BSc Psychobiology
- Teams of ~10, organized as a research group with TA as "PI"
- Fixed: subject + methods (cell-line) | Open: questions + planning

1: guided inquiry → 2&3: open inquiry → 4: exam, report, presentation, attitude







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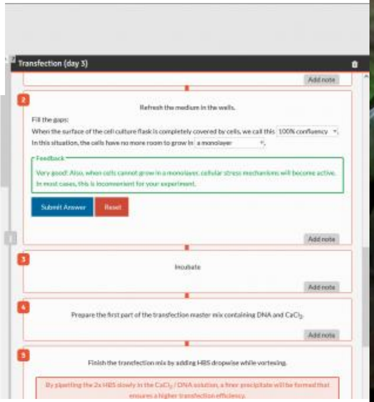
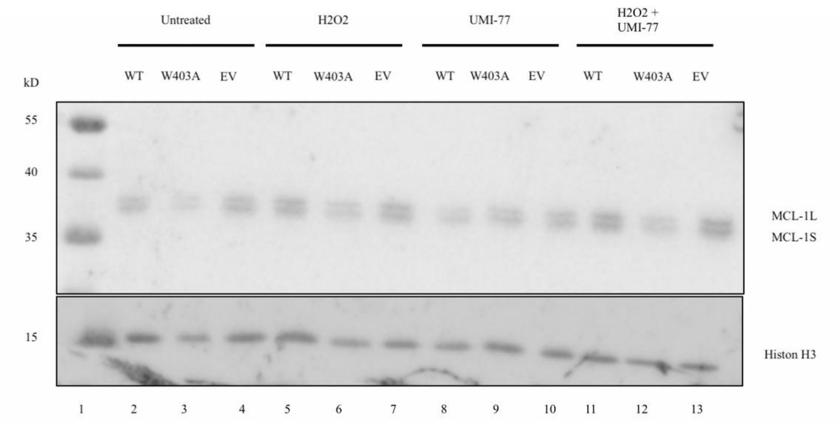
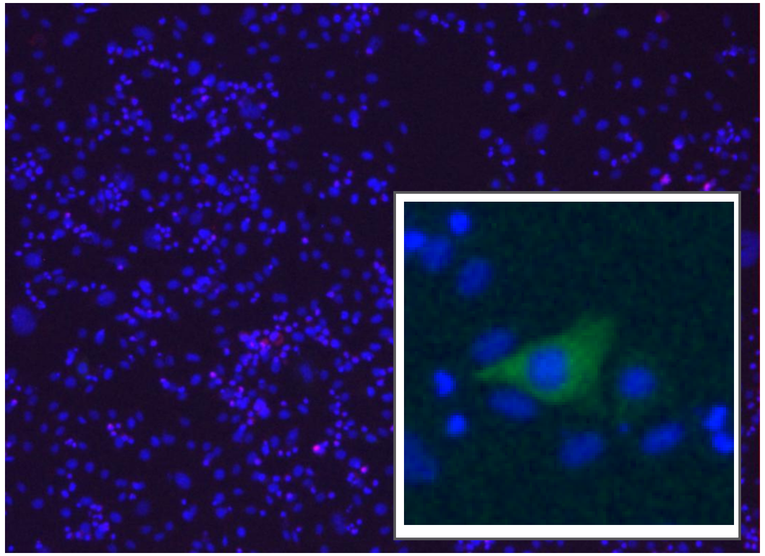


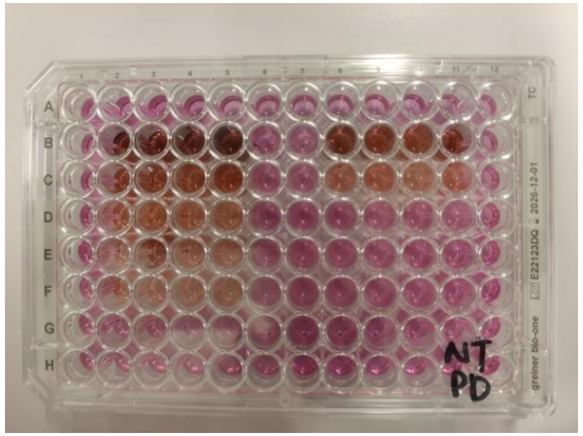
Noor & Eva: "Molecular Neurobiology Lab"

Difficulties/Advantages

- As a student:
  - "Pressure cooker"
  - Experiments take time and fail
  - Working in a team
- As a TA:
  - Balance

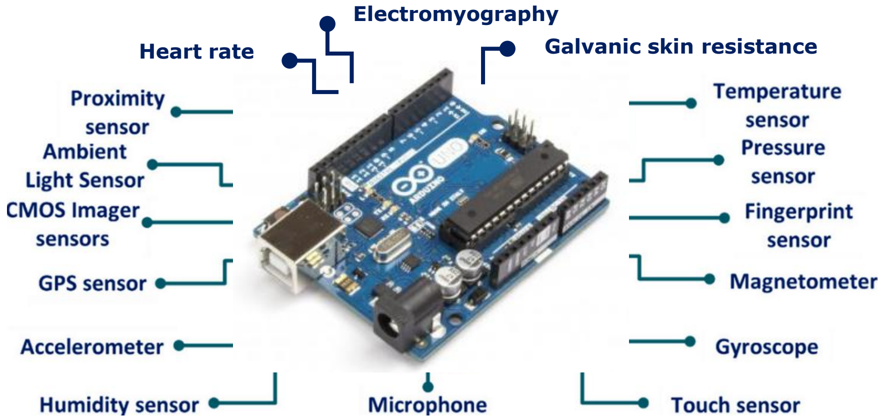






Julia: "Maker Lab"

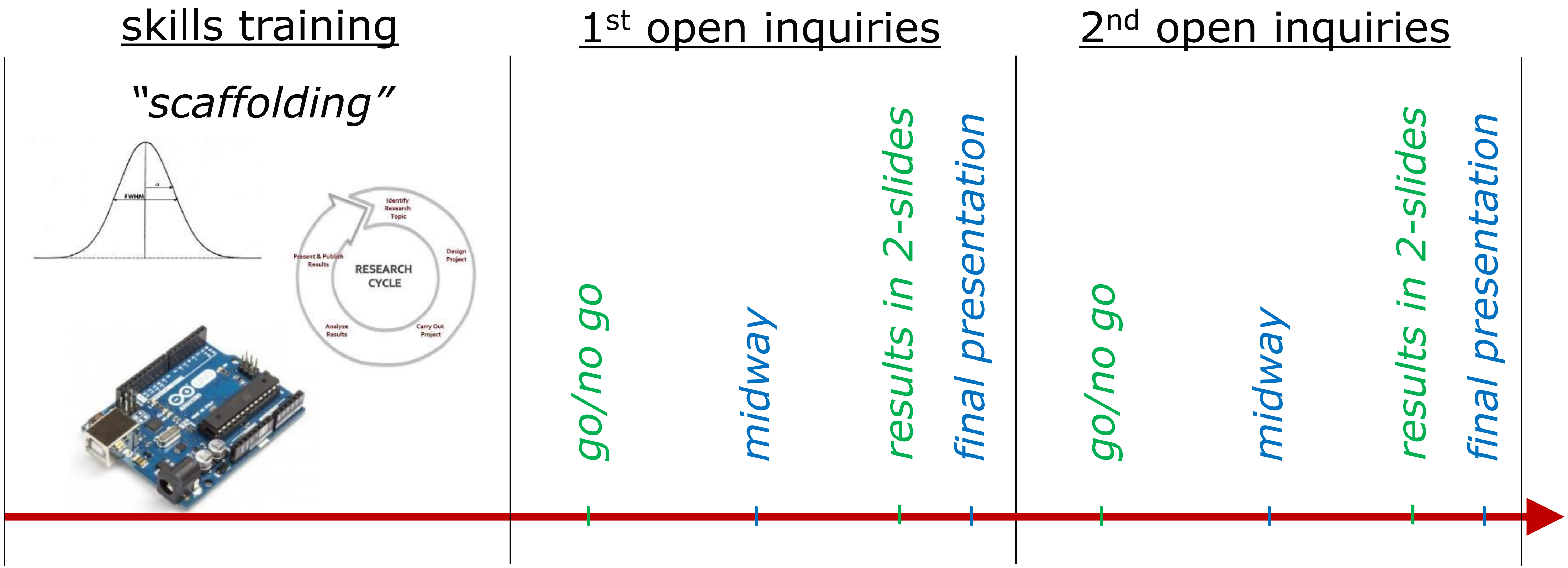
- for Amsterdam University College's natural & exact science majors
- students choose sensors controlled by self-programmed Arduinos, and leverage available online resources of the "Maker Community"



- teams of 2-3, take home a "toolbox" of supplies:

Julia: "Maker Lab"

- Rough schedule of the 14-week course:

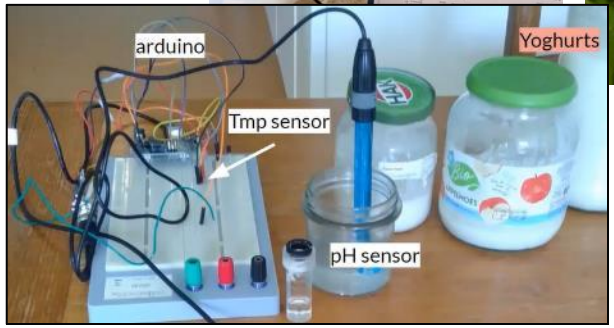


S^{3}OIL
SUPPORTING STUDENTS' SCIENTIFIC OPEN INQUIRIES IN LABS

Julia: “Maker Lab”

From following instructions to solving problems

- Defining your own research question
- Becoming your own supervisor
- Difficulties of a ”simple” experiment
- Mistakes as the biggest lessons



Julia: "Maker Lab"

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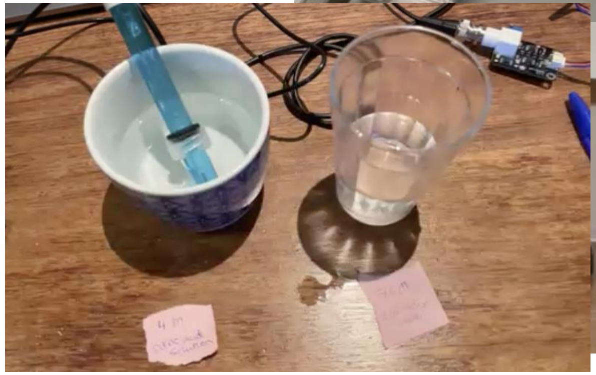
SUPPORTING STUDENTS' SCIENTIFIC OPEN INQUIRIES IN LABS

Additional remarks from the TA perspective

- TA = bridge between a teacher and student
- ! Supporting group collaboration
- Guidance not instructions



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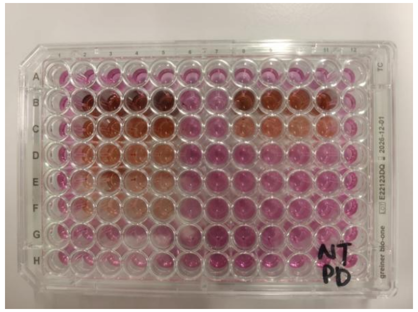
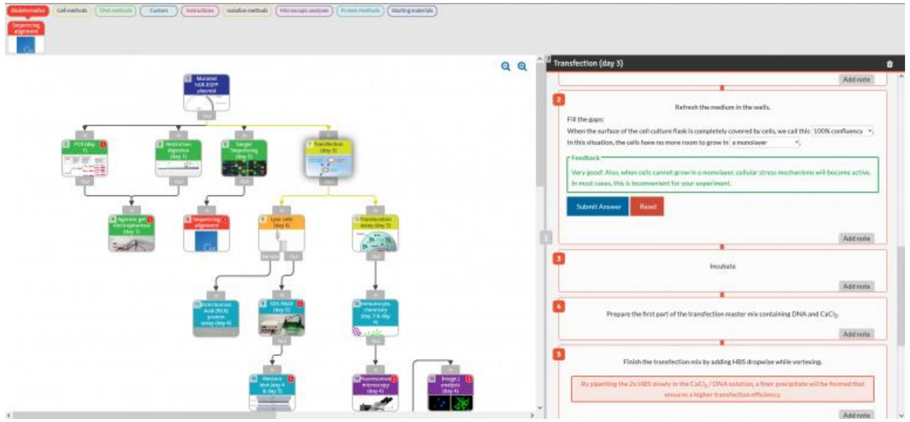
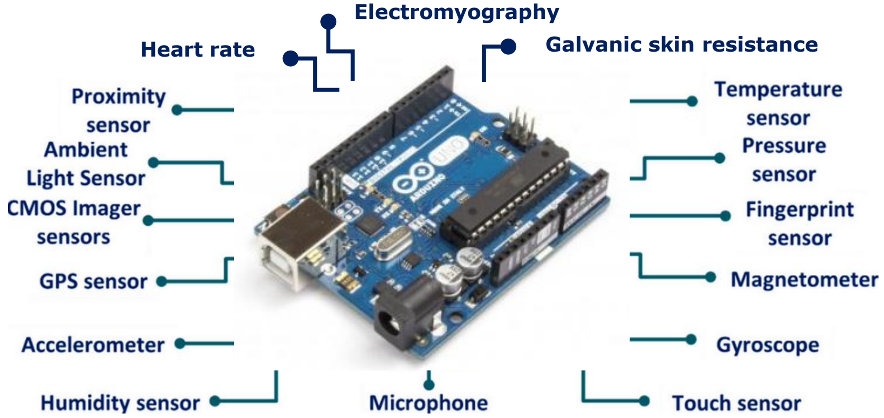
Eva, Noor, and Julia's student experiences

Molecular Neurobiology Lab: & Maker Lab:







Questions about courses and student/TA experiences?

Outline

- Define Open Inquiry Labs
- Motivations for Open Inquiry
- Challenges for Open Inquiry
- S^3OIL team & courses
- Eva, Noor, Julia:
    - MolNeuroBio & Maker Lab courses
    - Student & TA experiences of Open Inquiry
- Break-out discussions: Open Inquiry Labs in your program's specific context
- S^3OIL team findings (requirements & best practices)
- Acknowledgements

Refocusing Labs:
from cookbook to open inquiry

S^3OIL

SUPPORTING STUDENTS' SCIENTIFIC OPEN INQUIRIES IN LABS

Break-out questions & discussions

Questions for speakers?

Discuss: What **opportunities** and **challenges** do you see for making lab inquiries fully open?

(in your program's specific context)

Breakout room first option: **molecular life sciences (with Eva and Noor)**

Breakout room second option: **"Maker" labs (with Julia)**

Main room (stay here): **open inquiry labs in other contexts (with Forrest)**

Refocusing Labs:
from cookbook to open inquiry

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Our findings

Centrality of Open Inquiry

our courses are centered around enabling it,
and targeting the related higher-order learning outcomes

Contexts different, but our challenges similar:

1. **giving students time and agency for full open inquiry**
2. **prior "first-order scaffolding"**
   - of domain-specific content & skills
3. **simultaneous "second-order scaffolding"**
   - of self-directed learning skills
   - aka process-focused guidance

Our findings

1. giving students time and agency

To experience full and authentic empirical research cycles, students must:

- define the question they want to answer,
- design and carry out experiments to reach their goal,
- interpret and report results,

	Research question	Research methods	Conclusion
1. Confirmation	Given	Given	Given
2. Structured inquiry	Given	Given	Open
3. Guided inquiry	Given	Open	Open
4. Open inquiry	Open	Open	Open

- search for information,
- continually communicate ideas, needs & results with others; integrating feedback,
- iterate: test assumptions; refine questions; adapt models, measurements & analyses,

! One open inquiry often takes as much time as 2-3 guided or 5-8 structured inquiries, as students need time to reflect & iterate and recognize & learn from failures.

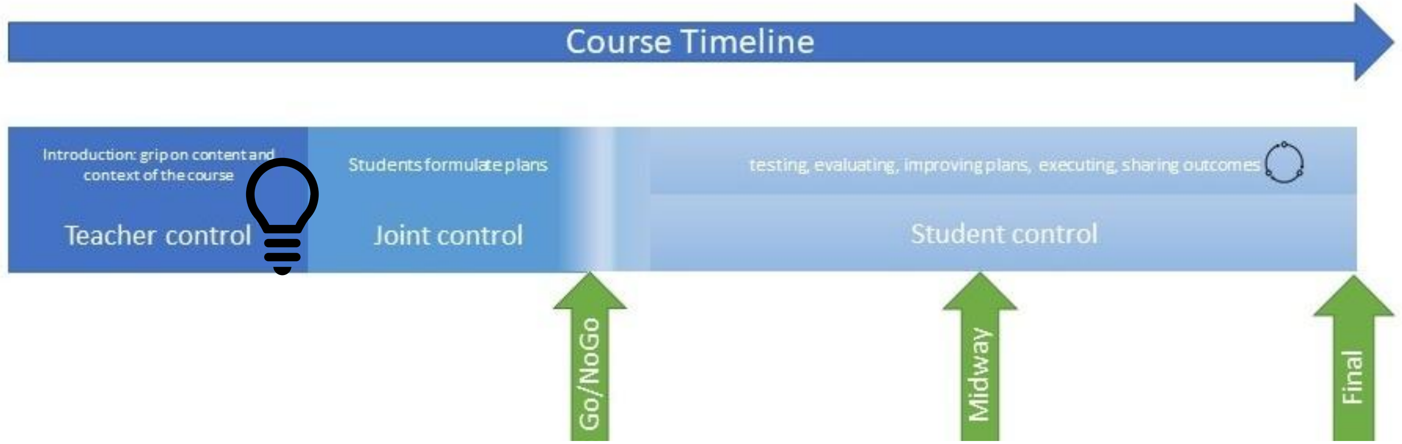
Our findings

2. prior "first-order scaffolding"

To enable agency and independence, students must already have:

- *working knowledge of* relevant scientific concepts/models
- *experience with* experimental, analysis, and communication methods (skills)
- *examples of* feasible research questions & projects ("inspiration scaffolding")

All provided in pre-requisite courses and the lab course's "teacher control" phase:



Our findings

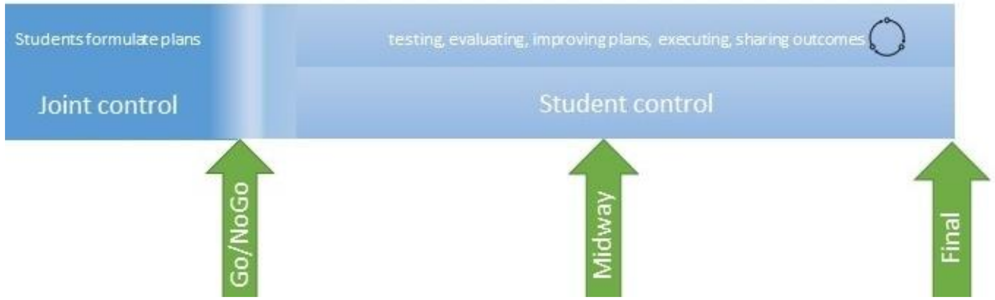
3. simultaneous "second-order scaffolding": (open inquiries involve structure & guidance!)

a. Teachers/technicians/TAs regularly available for student questions

b. Teachers/technicians/TAs plan discussions with students on higher-order questions !

- support for lower-order questions is partially:
  - pre-empted: learning outcomes from previous assignments or courses
  - outsourced: e.g. Maker movement resources
  - anticipated and asynchronized: e.g. LabBuddy

c. Student decision-making is regularly prompted and feedback moments built-in:



Our findings

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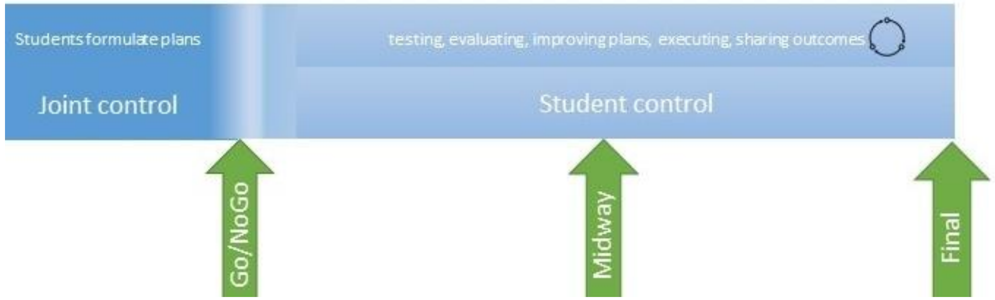


- Go/NoGo moment: student plans discussed in context of safety, ethics, feasibility, and scientific motivation,
- Midway assignment: critical assessment moment!, providing feedback on progress and plans,
- Communication: in authentic context: students' scientific questions, plans, and findings must be accessibly shared with and reviewed (and celebrated!) by a non-expert audience of their peers,
- Reflection and growth mindset: extra time and support for learning from mistakes, whereby failures are recognized as expected occurrences and important learning opportunities,
- Rubrics explicitly grade inquiry ***process***: published in advance, students prioritize reflection & iteration

!

Our findings

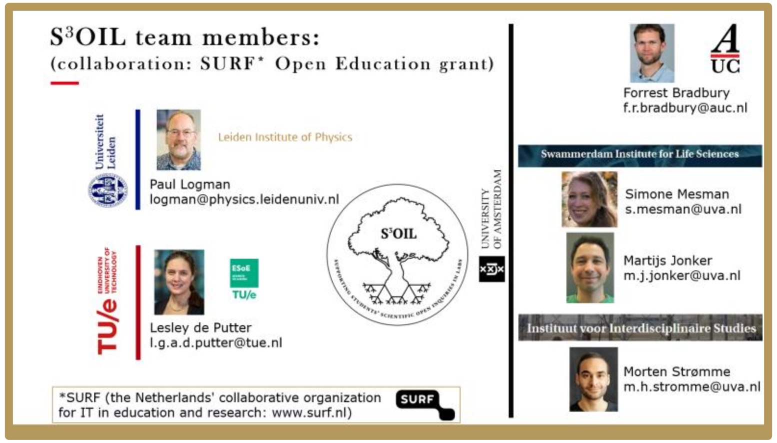
When we succeed in doing these:

1. **giving students time and agency for fully open inquiries**
2. **prior "first-order scaffolding"**
3. **simultaneous "second-order scaffolding"**

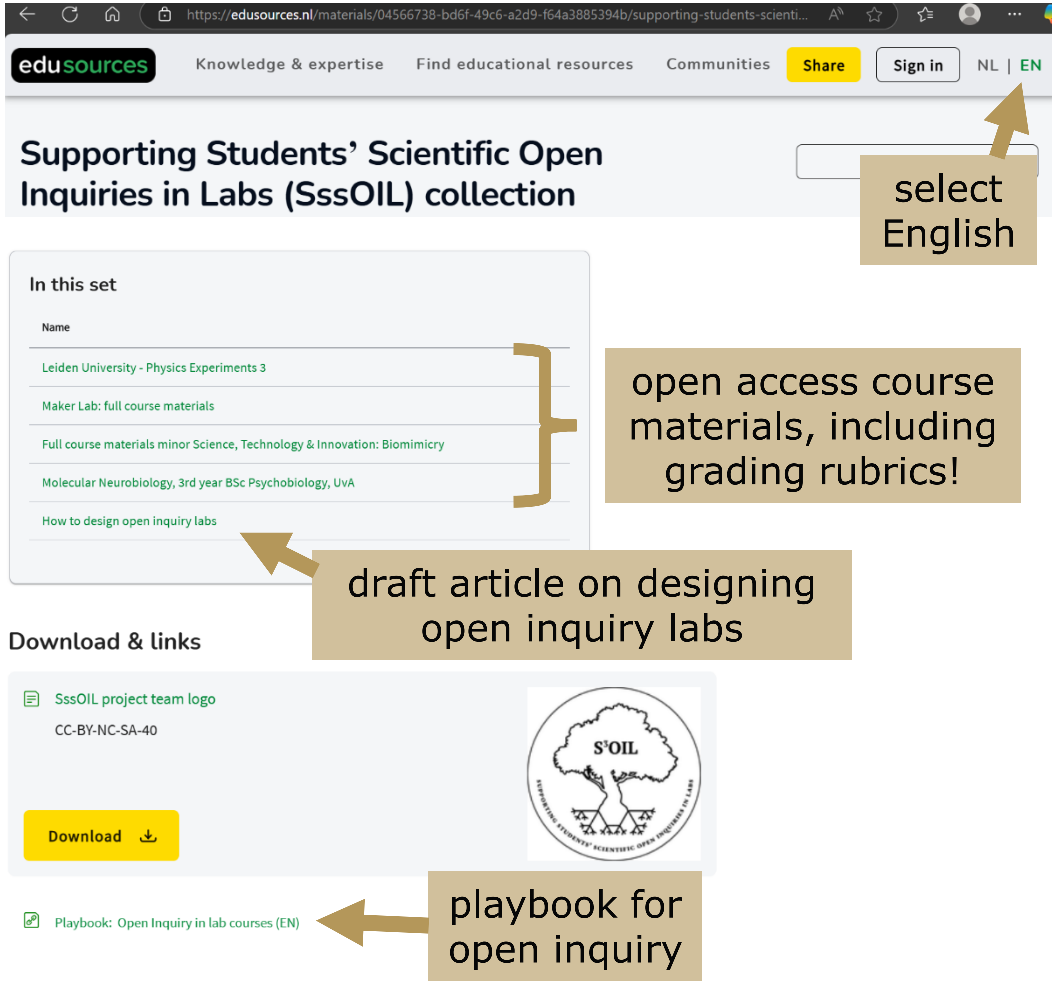
Then our students can spend time on these:

- situating knowledge,
- integrating diverse skills,
- critical thinking,
- reconciling the scientific method with real-world complexities,
- practicing science communication in authentic contexts,
- building self-efficacy for empirical science.

S³OIL team's open access course materials



https://edusources.nl/materials/04566738-bd6f-49c6-a2d9-f64a3885394b



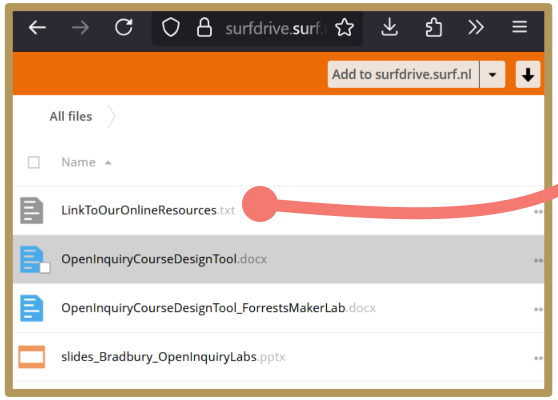
select English

open access course materials, including grading rubrics!

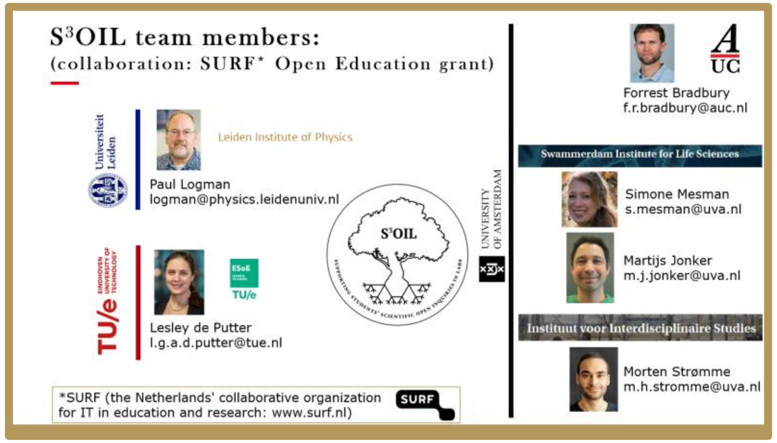
draft article on designing open inquiry labs

playbook for open inquiry

https://surfdrive.surf.nl/s/LPoysxEH87T99QY



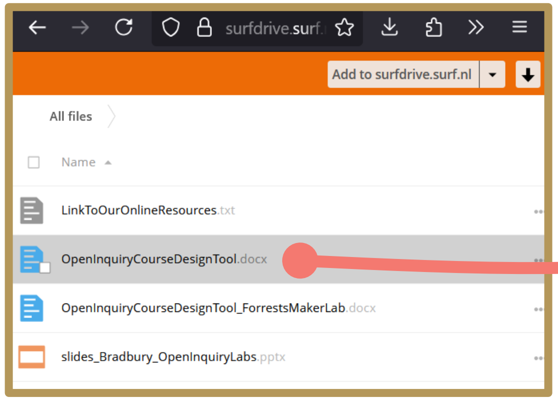
Course design tool

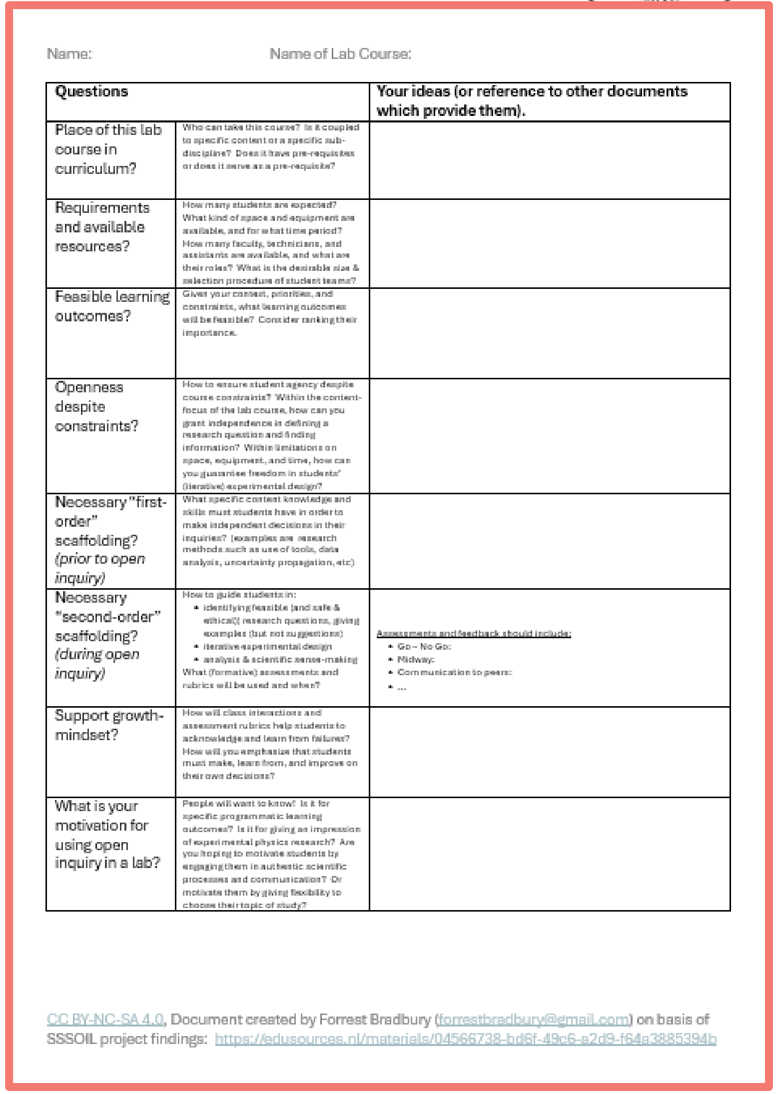


Realization:

- local conditions define unique sets of course boundary conditions
- new faculty users of open inquiry will be ***adapters*** and ***not adopters***

https://surfdrive.surf.nl/s/LPoysxEH87T99QY





Name: Name of Lab Course:

Questions		Your ideas (or reference to other documents which provide them).
Place of this lab course in curriculum?	Who can take this course? Is it coupled to specific content or a specific sub-discipline? Does it have pre-requisites or does it serve as a pre-requisite?	
Requirements and available resources?	How many students are expected? What kind of space and equipment are available, and for what time period? How many faculty, technicians, and assistants are available, and what are their roles? What is the desirable size & selection procedure of student teams?	
Feasible learning outcomes?	Given your context, priorities, and constraints, what learning outcomes will be feasible? Consider ranking their importance.	
Openness despite constraints?	How to ensure student agency despite course constraints? Within the content-focus of the lab course, how can you grant independence in defining a research question and finding information? Within limitations on space, equipment, and time, how can you guarantee freedom in students' (iterative) experimental design?	
Necessary "first-order" scaffolding? *(prior to open inquiry)*	What specific content knowledge and skills must students have in order to make independent decisions in their inquiries? (examples are research methods such as use of tools, data analysis, uncertainty propagation, etc)	
Necessary "second-order" scaffolding? *(during open inquiry)*	How to guide students in: • identifying feasible (and safe & ethical) research questions, giving examples (but not suggestions) • iterative experimental design • analysis & scientific sense-making What (formative) assessments and rubrics will be used and when?	<u>Assessments and feedback should include:</u> • Go – No Go: • Midway: • Communication to peers: • ...
Support growth-mindset?	How will class interactions and assessment rubrics help students to acknowledge and learn from failures? How will you emphasize that students must make, learn from, and improve on their own decisions?	
What is your motivation for using open inquiry in a lab?	People will want to know! Is it for specific programmatic learning outcomes? Is it for giving an impression of experimental physics research? Are you hoping to motivate students by engaging them in authentic scientific processes and communication? Or motivate them by giving flexibility to choose their topic of study?	

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Refocusing Labs: from cookbook to open inquiry

S^3OIL

SUPPORTING STUDENTS' SCIENTIFIC OPEN INQUIRIES IN LABS

Thanks!

- Amsterdam University College for support and flexibility
- other S^{3}OIL team members: Lesley, Paul, Simone, Morten & Martijs
- SURF's Open Education grant program
- all the students and teaching assistants of our courses
- and especially Julia, Eva, and Noor for helping to present!
- and the Present-Day Practicals team,
  - especially Charita, Marjo & Janine for mentoring us in preparing this webinar!

Next slides were not used, but were prepared to answer any questions about Paul’s, Martijs’, and Morten’s lab courses

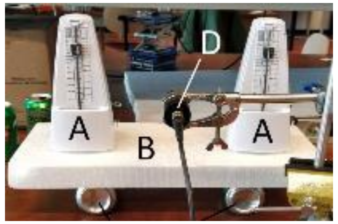
S^{3}OIL team examples

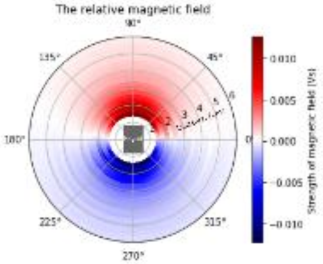
Universiteit Leiden

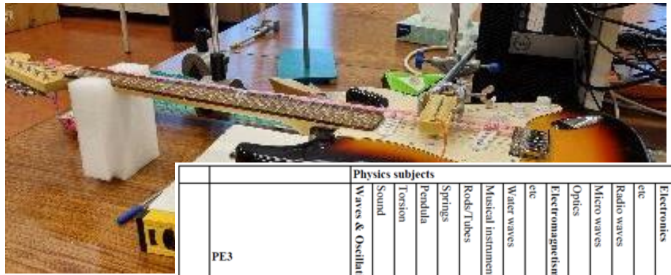
Leiden Institute of Physics

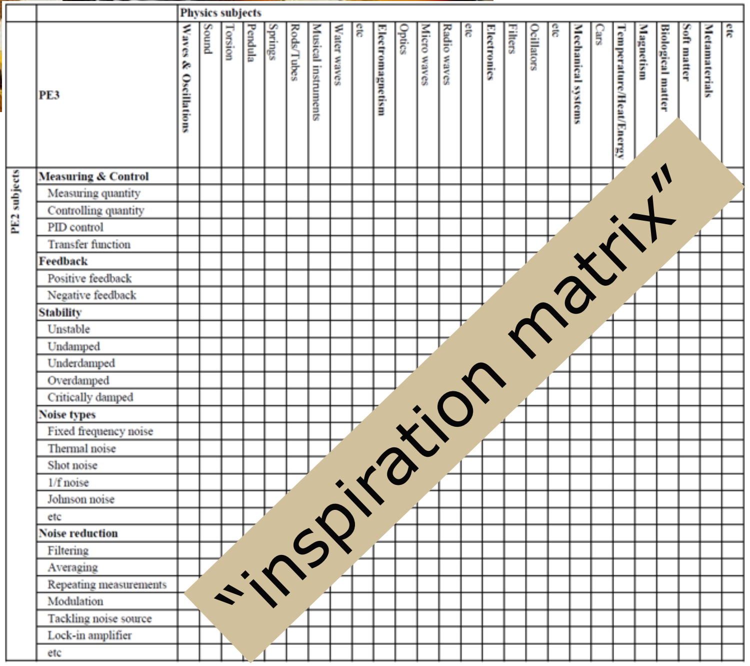
Paul Logman
logman@physics.leidenuniv.nl

Paul Logman gives "Physics Experiments 3", a 2 ECTS module part of the second-year lab sequence, leveraging physics teaching lab equipment for students' inquiries into oscillations or wave phenomena, sometimes even leading to scientific publication!









S^{3}OIL team examples

S^{3}OIL
SUPPORTING STUDENTS' SCIENTIFIC OPEN INQUIRIES IN LABS

"dry lab" where students do research with existing (big) data sets, using statistical and mathematical analyses (e.g. PCA) of genomics and other -omics data.

https://computing.sas.upenn.edu/mms/classroom_lab

UNIVERSITY OF AMSTERDAM

Swammerdam Institute for Life Sciences

Martijs Jonker
m.j.jonker@uva.nl

Martijs Jonker gives the "Practicum Advanced Genomics II" (6 ECTS) for 3rd year life sciences students

S³OIL team examples

https://www.uva.nl/programmas/bachelors/science-technology-and-innovation/science-technology-and-innovation.html

Engineering Design

levels	teacher provides			student
	question/goal	design concept	prototype	
1. reverse engineering	+	+	+	understands and evaluates
2. closed	+	+	-	builds according to specs
3. open-ended	+	-	-	conceptualizes a design
4. open	-	-	-	develops a design goal

Comparison courtesy of Bart van Esch (TU Eindhoven, Mechanical Engineering)

Scientific Inquiry

levels(*)	teacher provides			student
	question/goal	method	results	
1. confirmatory	+	+	+	confirms a relation
2. structured	+	+	-	executes a procedure
3. guided	+	-	-	develops a research method
4. open	-	-	-	develops a research question

(*) Randy L. Bell, Lara Smetana, and Ian Binns, 2005, The Science Teacher, p. 30-33

UNIVERSITY OF AMSTERDAM

Morten Strømme:

- gives the "Biomimicry" design course (30 ECTS) in the Science, Technology & Design minor for multidisciplinary 3rd year natural science students
- Challenge-based learning where students even conceive and define their own challenges!!

Morten Strømme
m.h.stromme@uva.nl

Thank you for your participation!

PRESENT-DAY PRACTICALS

Upcoming webinars

Present-day Practicals webinar series '25/'26

1.	How do students truly learn in the lab?	Thu 06/11/'25
2.	Extended reality in lab education	Thu 20/11/'25
3.	Refocusing labs: from cookbook to open inquiry	Tue 02/12/'25
4.	Fostering sustainability in lab education	Tue 13/01/'26
5.	Artificial intelligence in lab education	Thu 29/01/'26
6.	TBA	Tue 17/02/'26

Enhancing lab education with **LabBuddy** — Thu 19/03/'26

Link to evaluation

info@presentdaypracticals.nl

THANK YOU

for attending this webinar

PRESENT-DAY PRACTICALS