

# Changing attitudes to learning physics through participation in the Victorian Young Physicists Tournament

Scott Daniel, Pam Mulhall, Dan O’Keeffe

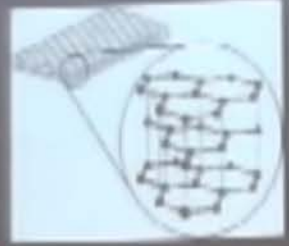
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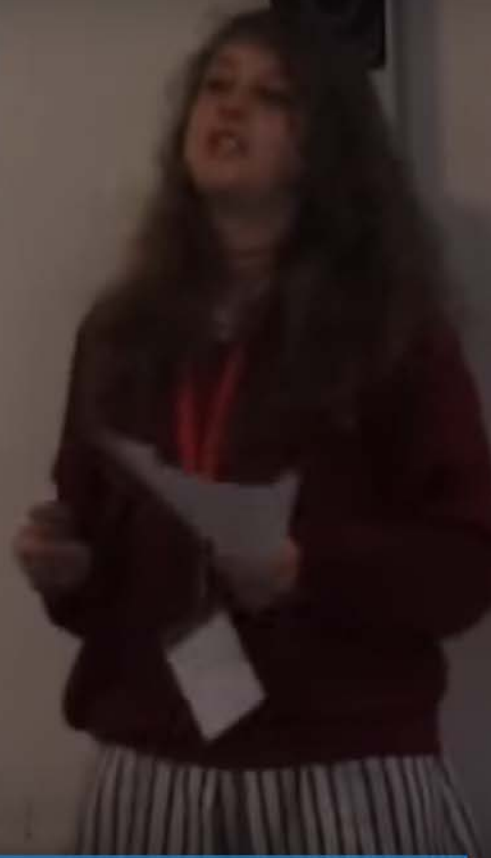


# BASIS OF EXPERIMENT

The lines, drawn by so called "lead" pencils, conduct electricity. Investigate the factors\* that determine the resistance of the line.



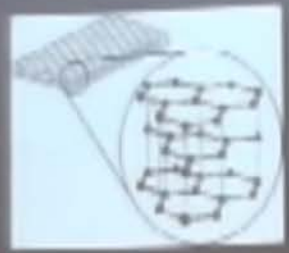
\*TYPE OF PENCIL, LENGTH OF LINE, AND CROSS-SECTIONAL AREA OF LINE



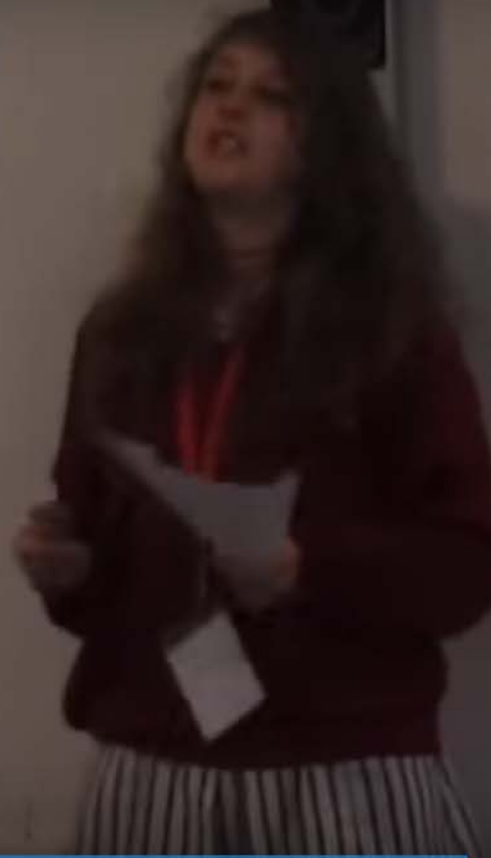
**Investigate the conductivity of a graphite pencil line.**

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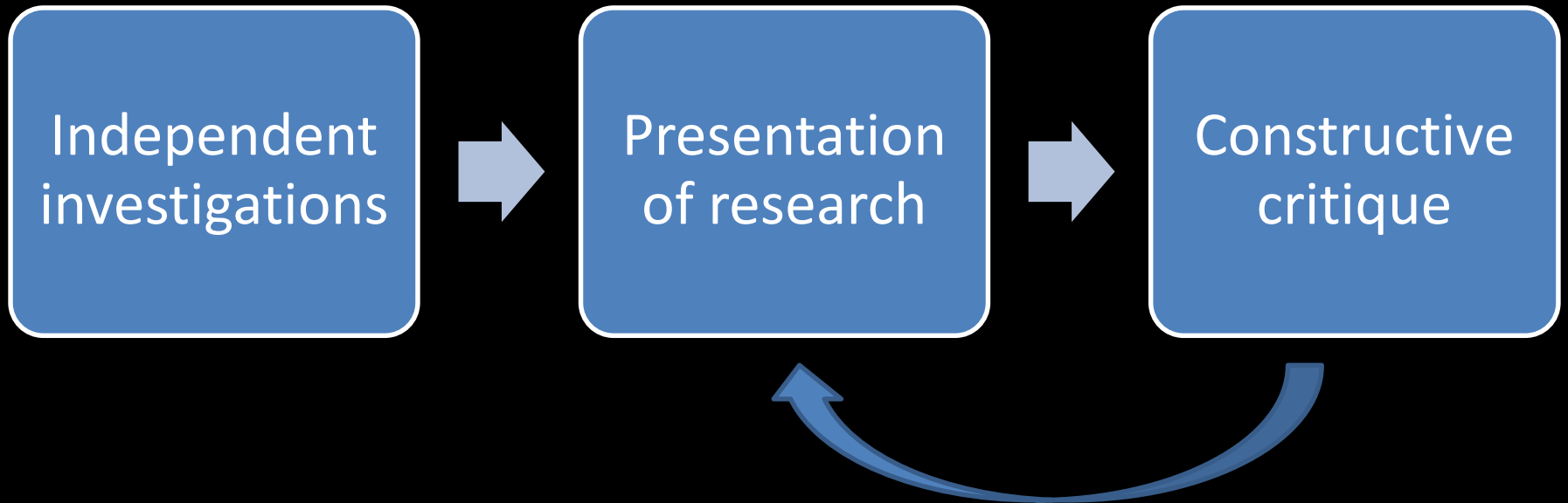
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**Investigate the conductivity of a graphite pencil line.**

**Investigate the properties of the radiation emitted from a TV remote control.**

# Physics Phytes



## Judging Criteria

- *Presentation*
- *Research*
- *Defence*

- *Recognising strengths*
- *Insight*

- **Student-lead, open-ended investigation**
- **Constructive and collegial exchange**

# Research questions

1. Does participation in the Young Physicists' Tournament affect students' attitudes towards learning physics?
2. Are any changes in students' attitudes sustained over time?
3. How are students' attitudes related to their teachers' attitudes?

# Survey instruments about attitudes

- **“Derived Chemistry Anxiety Rating Scale”**
  - *Lecturing leads to greater anxiety about learning chemistry*
    - *Listening to a chemistry lecture*
    - *Reading the word ‘chemistry’*
- **Maryland Physics Expectations Survey (MPEX)**
  - Pre-conceived categories that correlate poorly
- **EBAPS, Views of NOS, VASS, etc.**
- **Colorado Learning Attitudes about Science Survey**

# Colorado Learning Attitudes about Science Survey (CLASS)

*3. I think about the physics I experience in everyday life.*

**Personal  
interest**

*28. Learning physics changes my ideas about how the world works.*

**Real-world  
connection**

*35. The subject of physics has little relation to what I experience in the real world.*

- Uses language appropriate “to a wide variety of physics courses and to be meaningful for students who have not taken physics” (Otero & Gray, 2008)
- Each question has “only one interpretation for both novices and experts” (Sawtelle et al., 2009)
- Validated with >5000 students

# Colorado Learning Attitudes about Science Survey (CLASS)

- Scored as % 'favourable' and % 'non-favourable'
- Learning introductory physics leads to more novice-like attitudes
  - Some research-based teaching strategies reverse this (but only some!)
- University-physics-bound high-school students have more expert-like views than their peers
- Women score differently to men in some categories

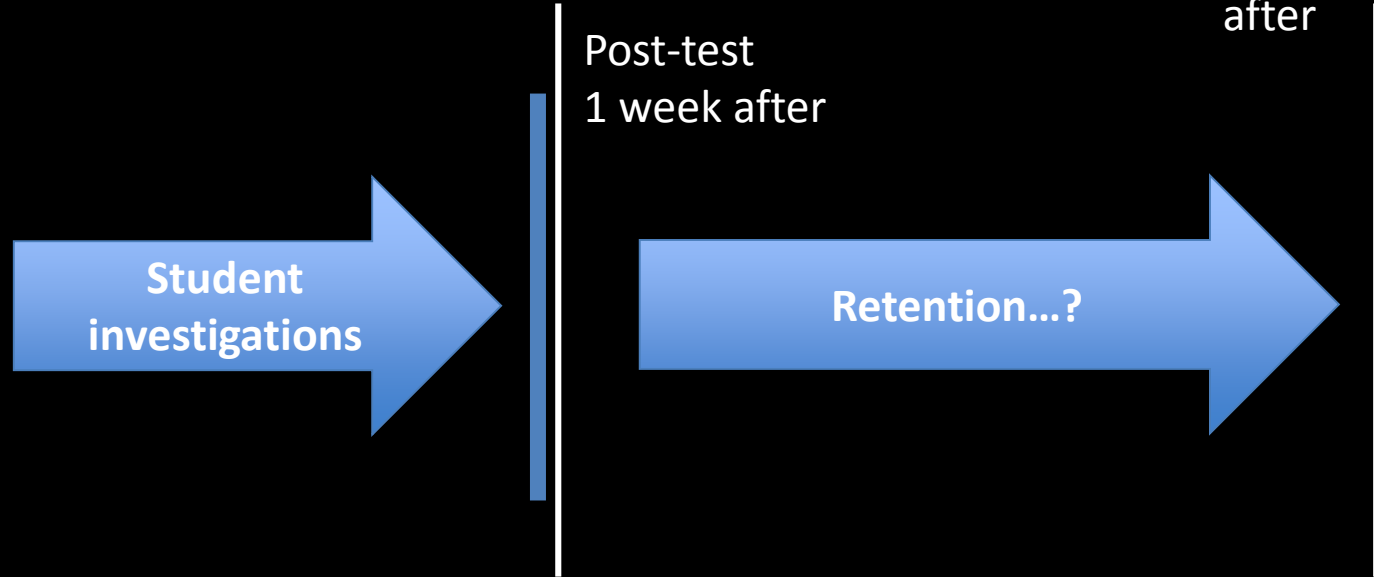


# Study design – pre/post/retention

Pre-test  
Sept: 3 months  
before

Dec: VYPT  
tournament

Retention  
June: 6 months  
after



Post-test  
1 week after

Student  
investigations

Retention...?

Longitudinal Study

Students

6

19

17

Teachers

1

7

4

25

17

8

4

Response Rate

~ 40%

Completion Rate

~ 30% [max. 67%]

**How to  
improve?**

# Findings

- High reliability

	Number	Pre-post correlation
Students	10	0.96
Teachers	4	1.0

# Findings

- **Convergence between students and teachers?**

**–Student-teacher correlation:**

<b>Pre-test (N=21)</b>	<b>Post-test (N=7)</b>
<b>0.68</b>	<b>0.83</b>

# Findings

- VYPT students are exceptional

Cohort	% favourable
Pre-test (N=25)	89
Post-test (N=17)	91
<i>Teachers pre-test (N=8)</i>	97
<i>1<sup>st</sup> yr physics students (Adams et al. 2006)</i>	65
<i>Top decile of 1<sup>st</sup> yr students (Gray et al., 2008)</i>	80
<i>1<sup>st</sup> yr Canadian physics students (Milner-Bolotin, 2011)</i>	56

Strongly Disagree		Neutral	Strongly Agree	
1	2	3	4	5

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Strongly Disagree		Neutral	Strongly Agree	
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<b>273</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>418</b>

# Findings

- **Completion as proxy for confidence?**

Matched responses	Pre-test		Post-test	
	% favourable	Completion rate	% favourable	Completion rate
Students (N=10)	<b>88.7%</b>	<b>27.0%</b>	<b>90.7%</b>	<b>24.1%</b>
Teachers (N=4)	<b>96.5%</b>	<b>33.6%</b>	<b>95.4%</b>	<b>38.7%</b>

Pooled responses	Pre-test		Post-test	
	% favourable	Completion rate	% favourable	Completion rate
Boys (N=14, 8)	<b>86.6%</b>	<b>26.7%</b>	<b>90.6%</b>	<b>31.5%</b>
Girls (N=10, 8)	<b>92.7%</b>	<b>29.3%</b>	<b>87.2%</b>	<b>14.0%</b>

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# Conclusions

- Improving response and completion rates is a challenge
- CLASS can provide interesting insights into student attitudes

<http://www.colorado.edu/sei/class/>

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# VYPT Topics

- Investigate the conductivity of a graphite pencil line.
- Place a sheet of paper on a horizontal table and put a cylindrical object (e.g. a pencil) on the paper. Pull the paper out. Observe and investigate the motion of the cylinder until it comes to rest.
- A TV controller emits infrared radiation that controls the TV. What are the properties of



**Diagram showing experimental design**

**Then overlain with poor response rate and poor completion rate statistics**

**Then prime audience about discussion about how to attract and engage research collaborations with schools.**

**[maybe do think-pair-share later**