

Enhanced TPACK Lesson Exemplar in Physical Science



PHILIPPINE NORMAL UNIVERSITY
The National Center for Teacher Education
&
COMMISSION ON HIGHER EDUCATION (CHED)



CAPABILITY BUILDING PROGRAM FOR STEAM EDUCATION

March 19-21, 2019 | Philippine Normal University - Manila

“Capability Building Program for STEAM Education”

Your Name: PHYSICAL SCIENCES GROUP

Program: BSE – Science

Subject/Course: Thermodynamics / BSE – Science 3rd Year

Topic: Thermodynamics

Lesson Title: The Laws of Thermodynamics

Level: 3rd Year ; 2nd Semester

Lesson Duration: 3 hours

#	LAW [condensed form]
0 th	The EQUILIBRIUM Principle
1 st	The ENERGY Principle
2 nd	The ENTROPY Principle
3 rd	The TEMPERATURE Principle

Learning Outcomes

Demonstrate understanding of the principles and laws of thermal physics with microscopic and macroscopic point of views.

Lesson Objectives

At the end of an interactive metadisciplinary lesson, the learners are expected to attain the following:

- a. state the laws of thermodynamics operationally;
- b. apply the laws to analyze different thermodynamic processes; and
- c. relate the laws of thermodynamics to the different societal issues (thermal pollution, global warming and energy resources).

Target Audience



Target Audience

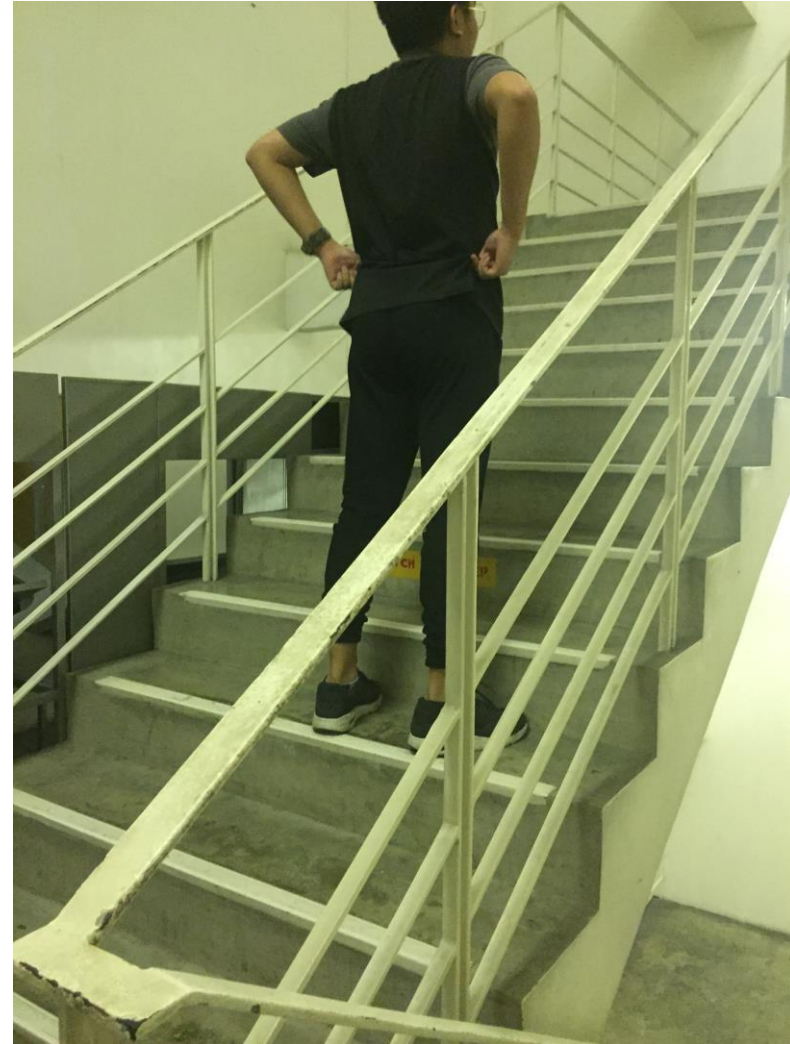
The students in the pilot study were digital 21st Century learners mainly manipulative, visual, tech savvy, interactive, creative, reflective, diverse, innovative and confident to understand the value of collaboration and the relationship of effort to results, and the need to continually grow.

Pedagogies

This lesson shall be presented using constructionism and neurocognitive – based teaching model wherein the students will be the one to develop their own understanding of the concepts.

Pedagogies

A simple activity of going up and down in the stairs. The student was asked to share his experience.



Pedagogies

In the motivation part and in the cognitive assessment, an interactive online presentation will be used. In the lesson development, powerpoint presentation, video, and an interactive online laboratory (virtual reality using Physlets) using problem – based learning and inquiry approach will be utilized.

Pedagogies

The exposure to the different technologies allow the students to boost attention, gather information, understanding of concepts, organization of thoughts, idea clarification or looking for something new and students' re – engineering of concepts learned.

Technology

Technology Being Used by Students	Technology Being Used by Teacher
Smartphones, laptops, internet connection, online apps, worksheets, 10 coins per two students, millimeter paper, graphing software or <u>graphoscope</u>	LCD Projector, Laptop, internet connection, online apps, worksheets, graphing software or <u>graphoscope</u>

Technology



NATSC14 DGE01 (20182)



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Course Schedule

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Introduction to Physics

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Physics of Directions

Heat and Thermo ▼



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Bulk Edit

⋮ [Laws of Thermodynamics](#) ▼

📺 Video



⋮ [Chapter20](#) ▼

📺 PowerPoint Presentation



⋮ [Thermo Experiment](#) ▼

📺 Video

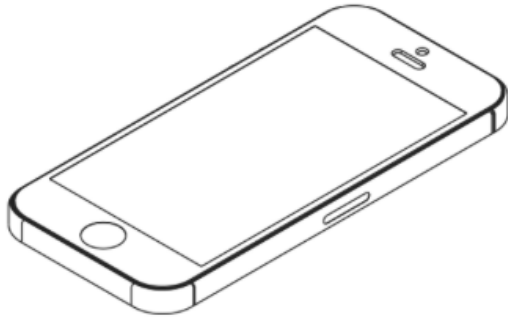


Lesson Strategy and Required Materials

After the motivation part, we will use the mentimeter, an open interactive presentation to elicit students' understanding of terms related to thermodynamics forming a word cloud. Each student, using their smartphone will give a word associated to "Thermodynamics" to this online link <https://www.mentimeter.com/s/993da57b41f2995bfe976def727c50b0/0191e0394276>.

Technology Use

Go to www.menti.com and use the code **47 09 32**



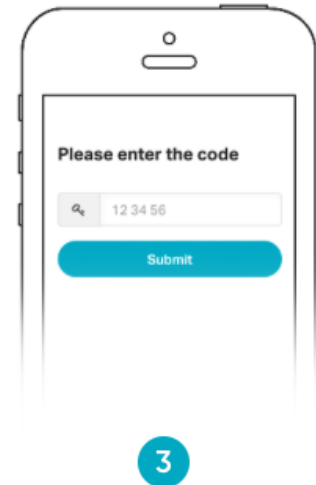
1

Grab your phone

www.menti.com

2

Go to www.menti.com



3

Enter the code **47 09 32** and vote!

Video Clip

- https://www.youtube.com/watch?v=mWFcg_Mgw7U

Lesson Strategy and Required Materials

Students will be grouped into 8 with 5 members each. Then, allow the students to deduce laws of thermodynamics in the following systems using a 3 – minute video clips presented by the teacher.

- Heat engine (car engine)
- Heat pump (air condition/refrigerator)
- Human being as thermodynamic system
- A rock falling on the ground
- Earth as a thermodynamic system
- Perfect crystals

Lesson Strategy and Required Materials

Students will answer the guide questions that would elicit their conclusion about the laws of thermodynamics. Further, the students will answer the following questions, based on the assignment given:

Prior to the viewing, the questions will be projected on screen.

Lesson Strategy and Required Materials

The teacher process the students' understanding on thermal equilibrium, the first law in terms of conservation of energy, irreversibility of natural processes and entropy. Then students will write the deduced statements of the laws of thermodynamics.

Lesson Strategy and Required Materials

Students will give practical activities or daily activities, which are considered as thermodynamic involving the laws of thermodynamics. The teacher demonstrate also to the class using PheT simulations and allow the students to analyze the situation what law of thermodynamics is applicable to the situation.

Inquiry - Based

The students will collaborate in a laboratory activity on the *statistical interpretation of entropy*.

Statistical Interpretation of Entropy

Coin Tosses

What are the possible outcomes of tossing 5 coins?

- The following possibilities exist: (Macrostate)

5 heads, 0 tails

4 heads, 1 tail

3 heads, 2 tails

2 heads, 3 tails

1 head, 4 tails

0 head, 5 tails

Microstate

5-Coin Toss

	Individual microstates	Number of microstates
5 heads, 0 tails	HHHHH	1
4 heads, 1 tail	HHHHT, HHHTH, HHTHH, HTHHH, THHHH	5
3 heads, 2 tails	HTHTH, THTHH, HTHHT, THHTH, THHHT HTHHT, THTHH, THHHT	10
2 heads, 3 tails	TTHHH, TTHHT, THHTT, HHTTT, TTHTH, THTHT, HTHTT, THTTH, HTTHT, HTTTH	10
1 head, 4 tails	TTTTH, TTTHT, TTHTT, THTTT, HTTTT	5
0 heads, 5 tails	TTTTT	1
		Total: 32

Lesson Strategy and Required Materials

The teacher will present the different societal issues (thermal pollution, global warming and energy resources) case study, which has been previously distributed. A class argumentation activity or SSI (Socioscientific Issues) within 15 minutes will be conducted.

Assessment

Assessment for Learning	
<p style="text-align: center;">Assessment Strategy</p> <p>In the motivation part, the students construct their own terms related to thermodynamics.</p> <p>Students' answers to the worksheets and their participation in the group activities.</p>	<p style="text-align: center;">Feedback Strategy</p> <p>The teacher will confirm the word cloud generated from the online answers.</p> <p>Teacher will process the answers provided by the students in the guide questions.</p>

Assessment



Edit Folder - Introductory Concepts of the Laws of Thermodynamics

Properties

Restrictions

Objectives

Name *

Introductory Concepts of the Laws of Thermodynamics

Instructions



Paragraph



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Short Quiz

1. State the Law of Thermodynamics in terms of irreversibility of natural processes to a common activity you do everyday.
2. Give situations of thermodynamic processes and state what law of thermodynamics is applied to particular situation.

Reflection

The teacher and students should strictly follow the specified time in each activity. In each of the processing of the lesson, the teacher should be aware of the existence of misconceptions.

Enrichments

The learners will present a 5 – minute role play depicting the mitigating factors for the different societal issues related to the laws of thermodynamics (thermal pollution, global warming and energy resources), each group will post it in their own social media account, reflect on the comments of the viewers. The students will submit a reflection paper based on their experiences in the set of activities. Rubrics will be used to grade the students' output, both in the role playing and the reflection paper.

Thank You