Student Teaching Practicum in Physics at Leominster High School

An Interactive Qualifying Project

Submitted to the Faculty of

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in partial fulfillment of the requirements for the

DEGREE OF BACHELOR OF SCIENCE

By:

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Abstract

In the Spring of 2020, I started a student-teaching practicum at Leominster High School. During this experience, I prepared and delivered physics lessons to 11th and 12th grade students. In order to obtain my Initial Massachusetts Educator's License, I adhered to the Massachusetts Candidate Assessment Performance (CAP) cycle with the assistance of a Supervising Practitioner and Practicum Supervisor. To provide evidence of my proficiency in each of the six essential elements recognized by the Massachusetts Department of Elementary and Secondary Education and to detail my student teaching experience, I have created an online portfolio. The portfolio also includes background information pertaining to my educational experience, the culture of Leominster High School and the Massachusetts public school system, and many of my pedagogical beliefs.

Acknowledgments

I would like to thank all of those who made my extraordinary student teaching experience possible, including Thomas Noviello (Supervising Practitioner), Dr. Irene Plonczak (Practicum Supervisor), and Shari Weaver (Director, Teacher Preparation Program). I would also like to acknowledge WPI's STEM Education Center and Leominster Public Schools for their support.

Table of Contents

Below is a Table of Contents describing each page of my ePortfolio, which can be found at https://wpi.digication.com/tom-young-tpp

Lesson Plan

Lesson Plan Title: Introduction to Gravitational Force

Teacher's Name: Tom Young **Subject/Course:** Physics

Unit: Gravitational Forces **Grade Level:** Junior

Overview of and Motivation for Lesson:

Students will be introduced to Newton's Law of Universal Gravitation. They will then use this Law to determine the effects of a planet's mass and radius on its gravitational Field

Stage 1-Desired Results	
Standard(s): **Next Gen** HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. HS-ESS1-4 Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.	
Aim/Essential Question: • Why do different planets have different accelerations due to gravity?	
Understanding(s): *Students will understand that . . .* • All particles in the universe exert gravitational forces on one another. • The gravitational forces attracting two objects is proportional to the product of objects' masses and indirectly proportional to the square of the distance between them. • The gravitational acceleration on a planet is related to the mass of the planet as well as its radius	
Content Objectives:	**Language Objectives:**

Students will be able to . . .	ELD Level 3 *Students will be able to read a sentence describing the relation between variables in an equation and recognize the important words in that sentence in English.* ELD Level 4 *Students will be able to listen to a question about the relationship between two variables in an equation and answer the question verbally in English.*
• Use the equation $F_G = G\frac{m_1 m_2}{r^2}$ to calculate the attractive forces acting on a pair of objects due to gravity • Describe the relation between a planet's local acceleration due to gravity and the universal gravitational constant	

Key Vocabulary

- Universal Gravitational Constant
- Inverse Square Law

Stage 2-Assessment Evidence

Performance Task or Key Evidence

- Determine how gravity changes an object's motion on different planets

Key Criteria to measure Performance Task or Key Evidence

- Students can correctly determine their vertical on different planets

Stage 3- Learning Plan

Learning Activities:

Warm-Up: QOTD (10 minutes):

Students will answer the following questions individually in writing before the class discusses their answers as a whole:

1. What types of objects can apply gravitational forces? Identify one object exerting a gravitational force on you right now.
2. Would your weight be the same on a planet with the same mass as Earth but with a larger volume? How about on a planet with the same volume but a larger mass?
3. List at least three different ways in which you think gravity might affect our bodies.

Learning Activity 1: Introducing the Law of Universal Gravitation (15 minutes)

The teacher will write down the following notes on the board for the students to copy into their notebooks:

Newton's Law of Universal Gravitation

$$F_G = G\frac{m_1 m_2}{r^2}$$

Where G = 6.67 x 10^{-11} $m^3/kg*s^2$

The teacher will then ask students to work in partners or small groups to find

(a) The gravitational force between two 70 kg people standing one meter apart

(b) The gravitational force between two 70 kg people standing two meters apart

(c) The gravitational force between two 70 kg people standing three meters apart

Learning Activity 2: Vertical on Another Planet (30 minutes)

Students will now determine what their vertical would be on another planet or moon. They will measure their vertical on Earth and use kinematics to find the speed at which they can leave the ground, then calculate g on another planet and find their new verticals.

Application

- Astronautics
- Structural Design
- Life Sciences

Summary/Closing: Surprising Findings (5 minutes)

Students will share their adjusted verticals on other planets. Then, the teacher will ask what variables affect the gravitational acceleration on other planets.

Multiple Intelligences Addressed:

☐ Linguistic	☒ Logical-Mathematical	☐ Musical	☒Bodily-kinesthetic
☒ Spatial	☒ Interpersonal	☐Intrapersonal	☐Naturalistic

Student Grouping

☒ Whole Class ☒ Small Group ☒ Pairs ☐ Individual

Instructional Delivery Methods

☒ Teacher Modeling/Demonstration ☒ Lecture ☒ Discussion

☐ Cooperative Learning ☐ Centers ☒ Problem Solving

☐ Independent Projects

Accommodations	**Modifications**
n/a	n/a

Homework/Extension Activities:

None

Materials and Equipment Needed:

- Masking tape
- Meter sticks

Adapted from Grant Wiggins and Jay McTighe-*Understanding by Design*

References

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