

## Remote Learning Packet

Please submit scans of written work in Google Classroom at the end of the week.

### Week 8: May 18-22, 2020

**Course:** Nature of Science

**Teacher(s):** Mr. Brandolini ([david.brandolini@greatheartsirving.org](mailto:david.brandolini@greatheartsirving.org)); Mr. Mooney ([sean.mooney@greatheartsirving.org](mailto:sean.mooney@greatheartsirving.org)); Mr. Schuler ([david.schuler@greatheartsirving.org](mailto:david.schuler@greatheartsirving.org))

#### Weekly Plan:

Monday, May 18

- Read the introduction lecture and pg. 143, then pg. 141 and the very top of 142.
- Complete the questions

Tuesday, May 19

- Read pp. 142, 144-146
- Complete the questions

Wednesday, May 20

- Read p.148, “The Four Causes of Locomotion According to the Ancients” and “The Final Cause of Locomotion.”
- Read from the middle of p.150 to the end of p.152, “The Efficient Cause of Locomotion.”
- Complete the questions

Thursday, May 21

- Read pp. 149-150, “The Material Cause of Locomotion” and “The Formal Cause of Locomotion.”
- Read the first and third paragraph on p. 147 in *Nature of Science*
- Complete the questions

Friday, May 22

- Attend optional office hours at 11:30
- Catch-up or review the week’s work

#### Statement of Academic Honesty

I affirm that the work completed from the packet is mine and that I completed it independently.

I affirm that, to the best of my knowledge, my child completed this work independently

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Student Signature

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Parent Signature

## Monday, May 18

Today's instructions:

1. Read the lecture below and *Nature of Science* pg. 143
2. Read *Nature of Science* pg. 141 through the very top of 142.
3. Complete the questions below

For the past few weeks, we've observed how the modern scientists built off of the discoveries of the ancient Pre-Socratics, using thorough measurements and experimentation to achieve some incredible discoveries about the material causes of ultimate substances. We also saw, however, that these moderns had narrowed their focus of chemistry down to *purely* the material and efficient causes: in general, the modern emphasis in science is on mathematical, measurable principles that hold true in every possible situation. We saw this in chemistry as scientists sought to understand the ultimate substance that defined all material, and much of the same emphasis can be found in the study of physics as well.

In modern science, "physics" refers specifically to the study of *the motion of bodies in space*. The speed of a moving object, the many different forces that act upon a given object<sup>1</sup>, the amount of force required to overcome inertia (resistance to being pushed), are a few examples of the sorts of things that modern physics seeks to calculate and understand on a mathematical level.

It's important, however, to remember the etymology of that word "physics": way back in Quarter 1, we discussed how the Greek word φύσις (or, physis) meant *nature*, and it's from this word that we get the word physics. In Quarter 1, we also saw how in his *Physics*, Aristotle defines nature as "a principle of moving and of resting" (pg. 21). Technically speaking, the modern understanding of "physics" agrees with Aristotle, since it also studies how objects "move and rest (stop moving)". We mustn't forget, however, the second part of Aristotle's definition, which was that the principle of natural things is "an inborn impulse to change". The ancient understanding of motion is far broader than the modern emphasis (it even has a specific Greek name for it!). Aristotle shows that there are **four** kinds of motion:

- Locomotion, or Change of Place
- Increase and Decrease, or Change of Quantity
- Alteration, or Change of Quality
- Substantial Change, or Change of Substance

The study of modern physics only focuses on the first one: **locomotion**, or something's change of *place*. The other three kinds of motion are motions as well, in that they involve *moving* from one kind of state of being to another. We observed changes of Quantity and Quality in Biology, and Chemistry studies both changes of Quality and of Substance.

For the purposes of this week, we are going to focus on understanding what makes Aristotle's four kinds of motion distinct from each other and will particularly begin to build a deeper understanding of locomotion. As you continue to study physics in the years to come, you should always keep in mind how the ancient understanding of motion provides a much more complete look at the ways in which a natural thing can change according to its inborn impulse!

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<sup>1</sup> For instance, you have gravity pushing down on you at all times, while the chair you are sitting on is "pushing" AGAINST gravity and your mass to keep you suspended at a certain height!

Name: \_\_\_\_\_  
 Section & Course: \_\_\_\_\_  
 Teacher: \_\_\_\_\_  
 Date: \_\_\_\_\_

**Monday May 18: Aristotle’s *Physics* I.7 and “The Kinds of Motion”**

1. In the table below, list the name of each kind of motion, the type of change, and then one example that you can think of (this cannot be an example from page 143, although you should look at those examples to give you a sense of the type of change).

Kind of Motion	Type of Change	Example of Change

2. Another name for the idea of motion and change that Aristotle introduces is \_\_\_\_.

- a. “Being”
- b. “Becoming”
- c. “Coming to be”
- d. a. and b.
- e. b. and c.

3. The Greek word for a broader reality, which means “change” or “motion”, is \_\_\_\_\_.

4. What are the two most basic and broad categories of change? To which category do the **first three** kinds of motion belong? (Complete sentence)

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5. At the start of page 141, Aristotle says that when talking about a thing undergoing a change, the thing can either be...
- a. simple or complex.
  - b. old or new.
  - c. rational or irrational.
  - d. being or becoming.

6. Aristotle says that in every example of change or motion, there must always be an \_\_\_\_\_ that will “survive” the change.

7. In 2-3 sentences, briefly explain the difference between the ancient and modern understanding of physics as a science.

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**Tuesday, May 19**

Name: \_\_\_\_\_

Section & Course: \_\_\_\_\_

Teacher: \_\_\_\_\_

Date: \_\_\_\_\_

***Physics I.7 continued and “Three Principles of Motion”***

Instructions for today:

1. Read pg. 142 (finish *Physics I.7*)
2. Read pp. 144-146 “Three Principles of Motion”
3. Complete the questions below

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***Physics I.7***

1. Which of the different ways of “coming to be” do so *in the unqualified sense*? What does the book say “unqualified sense” means? (Complete sentences)

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2. List the five ways which Aristotle says things “generally come to be” on page 142.

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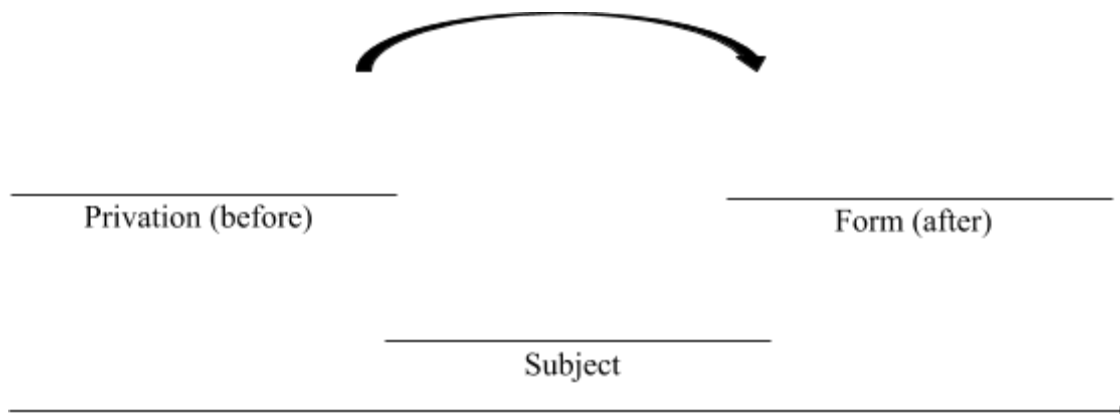
**“Three Principles of Motion”**

3. List all three principles of motion.

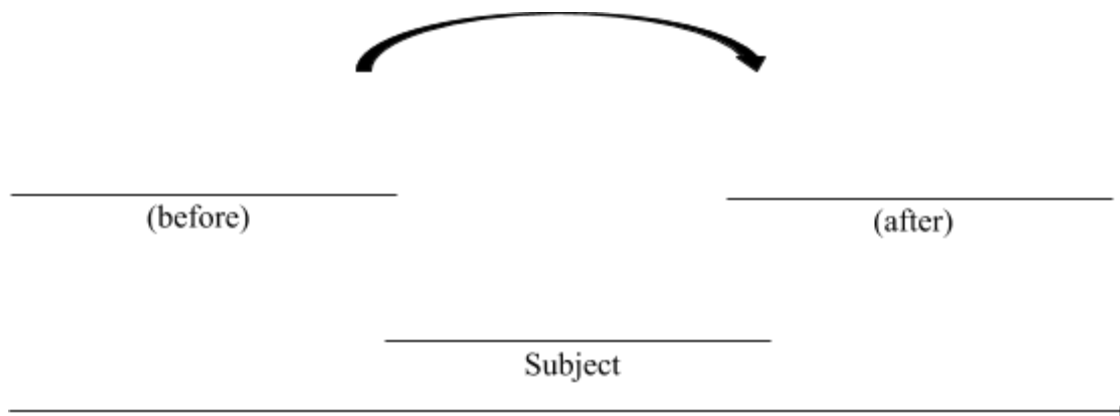
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4. Which principle is the *underlying* thing that endures the change? \_\_\_\_\_

5. Fill in the model below according to the model on page 145.



6. Now, fill in the same model choosing your *own subject, form (quality after the change), and privation (lack of the new form before the change)*.



7. Circle correct answer: The models above are examples of ( accidental / substantial ) change.

8. According to page 146, what is the *subject* of a substantial change? What is the *form* of a substantial change?

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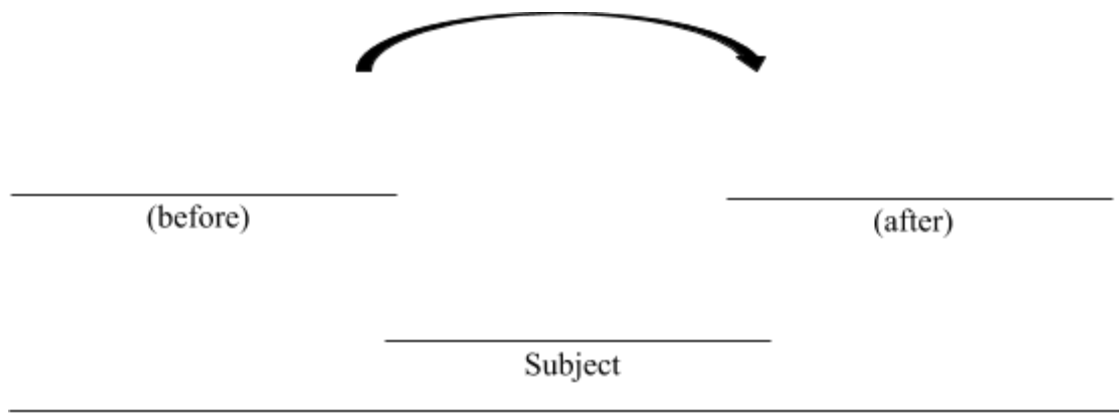
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*One more on the next page →*

9. Based on what you now know from all of the above questions, attempt to identify the three principles of motion of a *substantial change*. Read the following sentence, then use the terms in the wordbank below to fill out the model:

*Faraday split the water into hydrogen and oxygen gases.*

Hydrogen and Oxygen (material)	Water	Gases
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**Wednesday, May 20**

Name: \_\_\_\_\_

Section & Course: \_\_\_\_\_

Teacher: \_\_\_\_\_

Date: \_\_\_\_\_

### **The Final and Efficient Causes of Locomotion**

Instructions for today:

1. Read p.148, “The Four Causes of Locomotion According to the Ancients” and “The Final Cause of Locomotion.”
  2. Read from the middle of p.150 to the end of p.152, “The Efficient Cause of Locomotion.”
  3. Answer the questions below.
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### **The Four Causes of Locomotion According to the Ancients**

1. Why is *locomotion* the most “foundational” kind of motion?
  - a. Because *locomotion* is the only way to get from one place to another.
  - b. Because *locomotion* is the most common kind of motion.
  - c. Because *locomotion* is a change of place.
  - d. Because the other two kinds of accidental motion--*alteration* and *change in size*--are both dependent on *locomotion*, and would be impossible without it.
2. As the ancients did, we will study *locomotion* according to \_\_\_\_.
  - a. The Material Cause
  - b. The Formal Cause
  - c. The Efficient Cause
  - d. The Final Cause
  - e. All of the above (all four causes)

### **The FINAL CAUSE of Locomotion**

3. What are *natural motions*, according to Aristotle?
  - a. The growth of plants and animals
  - b. The motions of natural things
  - c. The motion of the five elements towards their natural places
  - d. The most common or ordinary kinds of motions



4. Match each element to its natural place:

- |            |  |
|------------|--|
| ___ Water  | A. <i>towards the center of the earth</i>          |
| ___ Earth  | B. <i>away from the center</i>                     |
| ___ Air    | C. <i>in a circular motion in the lunar sphere</i> |
| ___ Water  | D. <i>towards the center, but above earth</i>      |
| ___ Aether | E. <i>away from the center and above air</i>       |

5. What is the *telos* (the Final Cause) of every element's natural motion?

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6. If you drop a rock off of a cliff, what is the final cause of its motion *downward*?

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7. If you light a match, what is the final cause of its motion *upward*?

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### The EFFICIENT CAUSE of Locomotion

8. In the last section, on the Final Cause, we looked at *natural motions*. What is the other kind of motion?

- a. violent motions
- b. unnatural motions
- c. strange motions

9. For each of the following, identify whether it is a natural or a violent motion. Write either N for *natural motion* or V for *violent motions*.

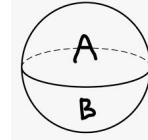
- \_\_\_ A boulder falls down off a cliff.
- \_\_\_ A rock flies high into the air because someone threw it.
- \_\_\_ Rain falls to the ground.
- \_\_\_ A balloon full of air is submerged beneath the water in a swimming pool.

10. Some cases of *efficient causes* of locomotion are very obvious. When you pick a ball up off the ground, the efficient cause of the ball's movement is \_\_\_\_\_.

11. In the second paragraph of "The Efficient Cause of Locomotion" reading, on p.150, it says that there is a universal principle about the efficient cause of locomotion. It says that: "*Everything moving is \_\_\_\_\_.*"

12. Aristotle proves that this must be true using a proof called a \_\_\_\_.
- direct proof
  - reductio ad absurdam* proof
  - ad infinitum* proof

13. If we imagine some whole object moving, like a tennis ball or a planet, we know that if one part of it stops, the rest of it will stop too. For example: If the tennis ball is bouncing up and down and then suddenly the top half (A) stops moving, then the bottom part (B) would also have to stop moving.



In his proof, Aristotle shows it is therefore evident that *it is impossible for a body to* \_\_\_\_.

- stop moving*
- split in half*
- be its own efficient cause*
- cause another body to move*

14. The second-to-last paragraph says that, in light of this principle (from the previous question), our earlier examples of *violent motions* should make sense. To see that this is true, identify the *efficient cause* of each of the following violent motions:

- A tractor moves a large mound of dirt. \_\_\_\_\_
- A catapult launches a boulder through the air. \_\_\_\_\_
- You force a balloon full of air underwater. \_\_\_\_\_

15. With *natural motions*, however, it is much harder to tell! Try to identify the *efficient causes* of the following natural motions, keeping in mind the principle that Aristotle proved: *a body cannot be its own efficient cause!*

- Water flows downhill. \_\_\_\_\_
- A stone sinks to the bottom of a pond. \_\_\_\_\_
- Flames rise from the wood. \_\_\_\_\_

**Thursday, May 21**

Name: \_\_\_\_\_

Section & Course: \_\_\_\_\_

Teacher: \_\_\_\_\_

Date: \_\_\_\_\_

**The Material and Formal Causes of Locomotion**

Instructions for today:

1. Read pp. 149-150, “The Material Cause of Locomotion” and “The Formal Cause of Locomotion.”
  2. Read the first and third paragraph on p. 147 in *Nature of Science*
  3. Answer the questions below.
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**The Material Cause of Locomotion (p. 149)**

1. What is the material cause of your own locomotion?
  - a. Your soul
  - b. Your form
  - c. Your parents
  - d. Your body
  - e. Your legs
  
2. What is necessary in order to actually be *somewhere*?
  - a. A body
  - b. A motion
  - c. A thought
  - d. A soul

**The Formal Cause of Locomotion (pp. 149-150)**

3. Copy the three definitions indicated in the reading (Note: The first is a definition of motion in general and the second two are definitions of one specific type of motion - locomotion):

- a. Motion is \_\_\_\_\_  
\_\_\_\_\_
  
- b. \_\_\_\_\_  
\_\_\_\_\_
  
- c. \_\_\_\_\_  
\_\_\_\_\_

4. Recall from Tuesday’s lesson when you read about the Three Principles of Motion on pp. 144-145. The three principles were *subject*, *form*, and *privation*. These three principles are foundational to all four types of motion! We want to see how these principles apply to the one type called “Locomotion”.

See the table below for how these three principles are reflected with the particular type of motion called “Locomotion”.

<b>Principle of Motion</b>	<b>Example with Locomotion</b>
Subject	Your body
Form	Being outside
Privation	Not being outside

These are the three principles of the locomotion of you going outside. To help us understand, let’s look at it a little more carefully.

When you are *inside* you have the *privation* (the lack) of being outside, but you are an embodied creature and so have the potential to be *outside*. Locomotion comes into play when you go from the privation (inside) to the actuality of being outside (form).

Repeat the table correctly with this example:

*A little bird has been foraging for materials to make its nest and is planning to return. In this instance, what are the three principles of the locomotion of the bird to its nest?*

<b>Principle of Motion</b>	<b>Example with Locomotion</b>
Subject	a. The bird’s _____
Form	b. _____
Privation	c. _____

5. Who is the follower of Parmenides who denied the possibility of real locomotion?

\_\_\_\_\_

*(Worksheet continues on the next page)*

6. Describe this person's argument that motion does not exist.

You must use the following words:

Word	Place a check when you have used it
arrow	
time	
moment	
instant	
at rest	

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7. What is necessary in order for locomotion to take place?

- a. Time must pass
- b. Space must move
- c. The object must be able to move itself
- d. The substance must have a rational soul

8. What else *also* requires time in order to take place?

- a. Existence
- b. Rest
- c. Potential
- d. Form

9. What else *also* requires time in order to take place?

- a. Existence
- b. Rest
- c. Potential
- d. Form

10. The follower of Parmenides who denied the possibility of motion made two fundamental errors. Circle the two errors:
- a. He misunderstood the nature of time, thinking (incorrectly) that time is made up of many different points
  - b. He misunderstood bodies, thinking they must move themselves in order for there to be motion; since the arrow was launched by a person, it was not really in motion
  - c. He misunderstood substances and thought (incorrectly) that they did not necessarily have to have bodies in order to have locomotion
  - d. He misunderstood the nature of rest and thought (incorrectly) that something could be at rest even though time did not move

**Friday, May 22**

- Attend optional office hours at 11:30
- Catch-up or review the week's work