

## Lesson 3

### An Awkward Homecoming

Elijah awoke to the soft thrush of the car stopping underneath his numb thighs and the stale taste of French fries on his tongue. He groaned inwardly; he'd always hated to be caught unawares and waking up right as they were supposedly pulling in to wherever James lived was not his idea of being prepared. He rubbed a hand across his face, left hand reaching for his white cane and feeling the momentary but trivial panic at not immediately feeling it but finding it instead on the floorboard at his sneakers. He pulled his cane up to rest underneath his chin, listening to James mumbling to himself in his quiet, ineffectual tenor, and opened his ears to the sound of the outside world as his car door was opened for him. Judging by the tittering of the birds and the slow whir of traffic somewhere beyond the snappy A.M. cold, it was somewhere around 7 in the morning, perhaps a little before. James's shoes crunched in leaves which he'd apparently never raked up from the autumn just passed, and Elijah could imagine the mouth which had talked so furiously for a good two hours of the long drive breathing out woolen bundles of steam.

The cold air hit Elijah in the face as he explored the ground with a foot and pushed his body out of the car, supporting himself with his cane, swaying a little with the sudden movement and the sleepiness still clinging around his slack body. "My house isn't very much you understand," came James's voice, fuzzy and sleepy, "but it was given to me by an uncle that sadly passed on a few years back and so I have managed to live pretty comfortably. There's a little guest room, which is where you'll be if you've a mind, with a bath attached and some little bits of furniture here and there. Like I said, it's all fairly small but cozy enough and I hope you like it." The smile snuck into his voice again as his warm hand came to rest next to Elijah's, carrying the suitcase with him as he guided him gently towards what Elijah could only guess was the door.

"Now, I unfortunately have a class that I shall have to leave to teach around noon, but I am going to try and catch a few hours' sleep until then and shall briefly show you about the place so you won't be lost or something when you wake up." Elijah stood sullenly, feeling suddenly very tired despite having just woken up, and listened to the jangle of keys being sorted out. "I'm dreadfully sorry that I can't stick around on your first day, but it's nearing midterm week and if I bailed now, even for one class, I'd have a mutiny on my hands."

"Whatever, that's fine," Elijah said, more to silence him than anything else, and was guided through the door after a creaking rush of warmth stroked his cheeks from the interior of James's self-described hole in the wall. He stepped into the foyer and was surprised to smell the strong aroma of Earl Grey tea. He could tell nothing else about the house, other than the wooden floor echoing beneath his feet and the warmth from vents, in the sides of the walls judging by the way it hit him from either side.

"Come this way and I'll show you the kitchen in transit," James said after yawning, and Elijah was guided along what felt like a hallway. They stopped mid-step and James turned Elijah slightly to the right; being guided by bony hands wasn't exactly what Elijah had been expecting

but he swallowed a snappy remark and tried not to flinch, feeling James very near him but grateful the professor let go as soon as he oriented his new charge. “That’s the kitchen, you may raid it whenever you feel like it only do shut the fridge door as I sometimes forget to do, the bills will go up horribly if you don’t. And turn right around straight once more and I’ll show you to the guest room, I’m right across the hall so if you need anything you can just give me a shout.”

Elijah felt along the hallway with his cane as James guided him into the hallway with both bedrooms facing one another, and turned him to the right once more into the guest room. Elijah felt the empty space of what must be a sparse room and his cane snuck along a wooden floor until he felt the bump of a bureau drawer and heard the clank of brass handles. “The bed is directly in front of you like five paces, the bath to the left of that.” Elijah nodded and stood, saying nothing, looking around even though he could see only blackness. James heaved a brisk sigh as if to finish off matters and Elijah did him the tiny courtesy of turning in his direction, feeling the gravity of his big hand leave his suitcase handle.

“I’ll let you settle in. Like I said, I’m just across the hall and shall be until like 11 or so, then I shall have to catch the metro bus to the college and will be there until 3.” There was a long pause. “What do you like for food? I can pick up something special for supper for our first evening as two old bachelors.”

If Elijah hadn’t been so sleepy, he would have smiled at the reference, but he just shrugged a shoulder. “Chinese is cool by me,” he said grudgingly. If he was going to stay here and free food was being offered, he might as well be honest.

“Very cool,” James reiterated, but the words sounded modern on his tongue. “Alright then, I’ll leave you to get some rest.” There was a slight hesitation. “I’m very glad you’re here, Elijah.”

“Shut the door on the way out,” Elijah replied, and found the bed with his cane as he heard the gentle thump of the bedroom door closing behind his new caregiver.

The bed was soft and bouncy underneath his legs as he tangled them inside coarse sheets, grateful for the chance to lie still and horizontal and not even bothering to take off his sneakers, feeling himself drifting off as soon as his head met the pillow.

James sleepily gathered his papers in the next room, leaving his door open a crack in case Elijah should have an uncharacteristic need for which he would call from across the hall. There was a lot for James to digest, but at the moment all he wanted was to get his things for his class together and sleep for as long as he was able before venturing back out into the cold and riding the grimy metro bus to the college. The weight of taking in Elijah was beginning to creep about the fringe of his mind, but he refused to let worry have its way and drag him into a sense of being cut adrift. What did he know about raising a teenager, a hermit-like bachelor living in the middle of practically nowhere, with no motherly influence for the child and nothing much besides a strong faith cultivated over the years since his father died and his mother moved in with his sister in Arizona. James had recognized the need to fortify himself with his study of the Bible, in order to not only as the verse stated study to show himself approved but also to combat a challenging classroom atmosphere. Even if he was only teaching about the concept of time and the ways of telling it, both ancient and modern, as a last-minute cram before midterms, it was his duty to

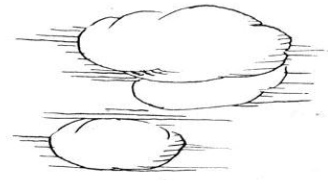
present the material in a way that would please God, since all work was to be for His glory. However, the added pressure of raising his estranged and blind cousin was something for which James felt inadequately prepared.

Sitting on the springy edge of his bed, the sheets tossed back from jumping out late that evening after a quick nap to go and get his new charge, James put both hands to his face after removing his glasses, and rubbed his cheeks as if to wake himself. “God, I have no idea what I am doing,” he muttered into his palms. “You have seen fit to give me this new responsibility and while I thank You for it, since I know You have a plan, I also have to ask...why did You give me this on top of everything else, unless You thought I could handle it? I admit to having no idea of Your plan and can only hope and fervently pray that it aligns with what will I may have on my own to be a faithful servant for You.” Head heavily cradled in his hands, James sat in silence for a long moment, letting his thoughts wear themselves out like waves against rocks, splashing and rolling over one another as one concern quickly followed its predecessor, but finally he pulled himself to his full towering height and began collecting things for his class amid the deluge of papers and articles strewn all across his floor. If there was one thing James was not when it came to research, it was tidy.

Most of his materials for the upcoming day were scattered around the sundial he’d been examining to get a feel for the subject on that he would be teaching. It was his first time teaching this particular class, having had more research or writing experience than teaching even as a teacher’s assistant while pursuing his Master’s, but he knew enough to lecture from the top of his head and the materials he crammed into his briefcase morning after morning were mainly extra credit articles for the students to read and report on in class or things to which he could refer should he get stuck. Being more an astronomer than a physicist, he often had to keep notes with him while teaching in case a student asked a mathematically-oriented question. In the classroom that day, he was going to be lecturing on the concept of time, what it was and where it came from, in what ways it could be measured as in a day, or a season, and how people had come to keep track of time. The sundial was one of the oldest methods for keeping track of time, having been around for thousands of years, and measured the passage of the sun with a gnomon or pointer attached to the surface of a dial, using latitude as a reference point. The earliest documented use of a sundial was in the Bible, in the time of King Hezekiah and Isaiah around 700 B.C. Timekeeping started out as being wholly dependent upon the sun and its movement, but modern mechanical inventions had come to tell time more efficiently. The middle of the day, when the sun reached its zenith, was when it reached an imaginary line called the meridian. The sun shone continually on the earth but because of the earth’s movement, only half of the globe experienced light while the other half experienced darkness. The border between day and night, the light and dark on the surface of the globe, called the terminator, determined the sunrises and sunsets and their visibility. James looked out the window and blinked, listening to the chirping of the birds despite the lateness of the season; the birdseed he kept outside spewed across the front lawn seemed to have been sufficient in bringing birds and uninvited squirrels to his yard. Now that he had a charge to take care of, however, birds wouldn’t be the only thing he would feel obligated to watch. It was a shame he couldn’t skip at least one class to get to know the mysterious cousin better; so far Elijah was like a stone tower, unable to be penetrated nor climbed, but James was hardly daunted. It was an interesting challenge and something deep in his bones told him that Elijah was not quite as skeptical and set in his ways as he appeared to be.

“Only You know,” James murmured in a final prayer as he rubbed his face and crammed the last couple reference pages into his old-fashioned leather briefcase, then pulled the sheets over his fully-clothed frame, and tried to sleep across the hall from a fifteen-year old boy doing the exact same thing, even down to the shoes.

**Lesson 3**



**What are luminaries?**

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**How does the Bible define day and night? Or does it?**

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**Does the Bible provide a clear distinction in the creation account for how long a 'day' was? Why or why not?**

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**What problems might arise in claiming a day lasted longer than twenty-four hours?**

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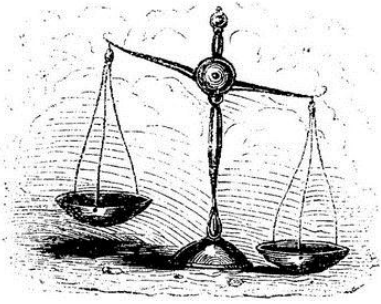
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**Looking Higher:** Does the study of time and measuring time relate to a study of physics? Why or why not? How do the two correlate with one another? What is meant by the term space-time?



### Lesson 3

**How does a study of mathematics relate to a study of physics or astronomy? What sorts of math might be used in either of these sciences?**

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**What is meant by the word space? How is it defined as a measurement? As an abstraction? Can space be measured?**

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**What about time? Define time as a measurement or an abstraction. Does time exist? How does God view time? Does time exist for God? If so, why does the Bible lay out specific time references for the creation, prophecies being fulfilled, or specific times of the day and night for battles to be fought?**

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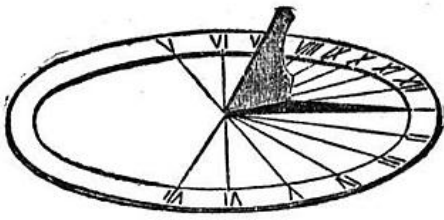
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**Looking Higher:** What is meant by dimensions of time? How many dimensions are there? Is there a possibility of more dimensions than we might now know about?

(We will cover dimensions in more depth in a later week.)





### Lesson 3 Part 1

**Who invented the sundial? Which cultures made them popular?**

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**What was the account in the book of Isaiah that makes mention of a sundial?** Look up this account and provide a brief summation below.

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### Lesson 3 Part 1

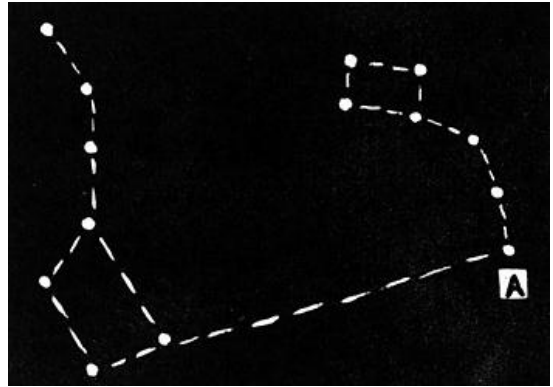
Making your own sundial is an easy project, so we will dig a bit deeper with this project. After you make your sundial, you must tell time with it at least twenty-four hours after making it and be able to explain to a family member how latitude affects the efficiency of the sundial.

Depending on your latitude, the sun's shadow will cast differently on your dial than it would in another state. Latitude is coordinates of the north-south position of a point, any point somewhere on the earth's surface. So depending on your location, the latitude coordinates will shift.

Find out your latitude so that you can fashion your sundial specifically for that latitude. Ultimately it will not affect the look of the sundial, rather sharpen the efficiency of your project. Looking up your latitude on the Internet takes about three seconds! Be sure you can explain to someone else how latitude affects your sundial before proceeding to make your project.

Use a disk of heavy cardboard or wood and carefully draw a horizontal line across the center of the disk. Choose an object for your gnomon, or hand, of your sundial; a pencil or nail (for wooden disks) work well. Insert the end of your gnomon into the disk, at its center. The angle of the gnomon relative to the surface of the disk should equal your latitude angle. Use a protractor and make sure that the gnomon is at the correct angle to the disk. Now draw radiating vertical lines out from the center of the disk, to represent each hour. (There are different methods for marking the hours, so look up some pictures of different sundials and choose the one you like the best.) Take your sundial outside and point the gnomon due north. The shadow that is created on your dial should be the correct hour line.

### Lesson 3



Tonight you will begin to identify simple stars and constellations. As you progress in your study of astronomy, as well as how it relates to physics as a subset of the scientific topic, you will be able to rely on your star map less and less as the constellations become familiar to you. However, as you are just beginning your study and observations, don't get discouraged if you cannot immediately find something on your star map. Use this observation day as a time for fellowship with your family, a time to look back on the week and talk about what you have learned.

Using your star map, try to find Polaris, the north star.

Find and be able to recognize the Milky Way.

**What is the Milky Way? Who discovered it?**

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**Why would it be important to recognize Polaris?**

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Use the space below to draw what you observe in the night sky, which stars are visible, and the orientation of the moon, if visible. You may also use the lines to write about this.

A series of horizontal lines spanning the width of the page, intended for writing.

## Lesson 4

### Laws of Suspicion

James adjusted his glasses and looked over the notes he'd prepared for the class that stared back at him from their desks, rummaging in their backpacks for blank sheets of paper and fresh pens or pencils as they prepped themselves mentally for the promised midterm review. This was the second hour of the 3-credit college course on the basics of non-mathematical physics and its subset astronomy. Many of the students who'd been dozing in their seats for most of the first half of the semester were alert and hoping to compensate for whatever they had missed. Their bloodshot eyes and the ink stains on their fingers told James that many of them had been preparing the night before in case he gave the rumored pop quiz or should ask them questions instead of merely giving them the answers, drawing the words from them and making them think instead of regurgitating whatever they might have learned all that semester.

"Alright, pencils at the ready?" he said in a jokingly formal manner, making every head turn to him. "Now that I have your attention, no I will not be giving a pop quiz but—" and he spoke over the heavy sighs of relief "—you will be expected to answer questions if I ask them so hopefully you all have been listening this semester and have been taking good notes, and if you study and prepare yourselves then I am certain the midterm will be nothing to worry about." A blast of chilly autumn wind hit the windows of the little classroom as he finished off the sentence as if it was a doleful reminder and a couple of the students who'd done the homework and taken notes felt at ease enough to chuckle. James smiled inwardly and cleared his throat, then picked up a piece of chalk from the holder at the computer desk and began looping cursive letters across the top left hand corner of the blackboard.

"Okay, so what do we know? We know that ancient people groups made observations about movement on the earth and the way the stars aligned themselves and seemed to change with the seasons and so forth, and based on these assumptions they began to develop the idea of physics." He wrote the word across the board in large lettering. "Now where does this word come from, who invented this word?" He turned around as the mumble broke out across the classroom. "That's right, it came from the word *physika*, meaning natural, or physical, and it's Greek. So it's safe to assume then even from that little bit of information that the Greeks played a big part in ordaining the knowledge we now hold to be evident as we study physics in our modern times. Now physics investigates what about the world?"

"Sort of like the basic laws and stuff that govern it?" piped up one girl sitting in the front, chewing on the end of her blond hair.

"Not sort of, that's exactly why," James threw back. "For example Newton's law of gravity is beyond arguing now, because it has been proven to be a fact, and a law is..."

"Something that has been accepted with like proof and experiments and stuff," said a boy in the middle, with his boots propped underneath the desk in front of him.

"Okay, good, so you all remember things from this first half of the semester." James looked over his notes, things jotted down to trigger their memories about after having created

most of the midterm the previous week, as a soft laugh jiggled the silence in the room. “So scientists, even ancient ones, whether they knew it or not began a series of investigative tactics known as what in order to prove their theories and transform them into accepted laws?”

“Scientific method,” chimed in another student.

“Right, so this consists of observation, formulation of a hypothesis, experimentation, the results of the previous step, and your conclusion. Repetitions of the scientific method would be good grounds for creating a law that explains how the natural world is governed. So the most famous fellow perhaps in the early history of science accredited with putting the scientific method was Galileo Galilei, and he did what? When did he live, what did he do?”

“He was an Italian,” said one person, and James nodded but kept his silence. “Who was born in Pisa and he threw lead balls off the side of the Leaning Tower.”

“Okay, and why did he do that?”

“He wanted to figure out whether different sized balls would hit the ground at the same time,” the student finished, and smacked his pencil on his notebook. One of the all-nighter studiers, James noted to himself, and decided to move on.

“Good. Okay so when talking of physics, just the basics, let us examine some basic tenets. These are things which have been experimented upon and have been proven as to be governed by laws, have they not?” He turned and wrote across the chalkboard once more. “Energy. What is it, how is it defined?”

There was a shuffling silence and James finally turned around to help them along. “Energy is the ability to do...what?”

“Work,” they chimed in finally. James nodded and scribbled this underneath the underlined word energy.

“And work is what happens when an object is moved by force. Okay, what is force?”

“Force is something that changes stuff like the speed an object is moving at, the shape of it, the position of where the object is,” said one of James’s more competent students, and James nodded to encourage them along.

“Great. What is the most famous type of force?”

“Gravity, found out by Newton,” said a girl with a bit too much lip gloss.

“Good, and this affects the way the earth orbits around the sun. And what is the equation for work?”

“Work equals distance times force,” said a young-looking boy with thick rims on his glasses.

“Alright, so can we say that the amount of work expended is proportional to the distance traveled by the object?” The class nodded, a few students looking around to the brains of the class who talked more than anyone else before they nodded as well.

The review carried on for the remainder of the class, and James wrote busily until nearly his entire chalkboard was filled up and the last ten minutes were hailed by the rushing sound of zipping backpacks and the beeps of electronic watches flipping the time to 3 in the afternoon. James put down his nub of chalk and dusted off his hands, calling a few last-minute instructions to the class who would take a midterm the next time he saw them file in. James began erasing his chalkboard, white dust floating out and being caught for a few seconds in the weak gray sunlight looking in through the windows. A quiet knock on the door snagged his attention and James turned to find the dean, Joe Chamberlin, standing in the entrance.

“Good afternoon,” James said, putting down his eraser and dusting off his hands enough for a handshake. Joe smiled cordially, his wrinkles showing beneath a cloud of Einstein-like hair.

“Busy day? Class just let out?” he asked, in his typical fragment-affectionate way. James nodded and shrugged with a laugh.

“Well they’re as prepared for the midterm as they can be, it shouldn’t be too bad and we reviewed for an hour, mainly the physics and such, the astronomy they seem to have down pretty well.” Joe nodded and listened but his was a polite silence so James let his words trail off.

“Listen, James, it came to my attention that you’ve taken on a charge or something,” he said, cutting to the quick. James absently dusted his hands a few more times and nodded.

“Yes, you heard rightly so,” he replied.

“What is the nature of this? I guess I found it a bit odd. A bachelor like yourself taking on a kid when you already have a busy schedule.”

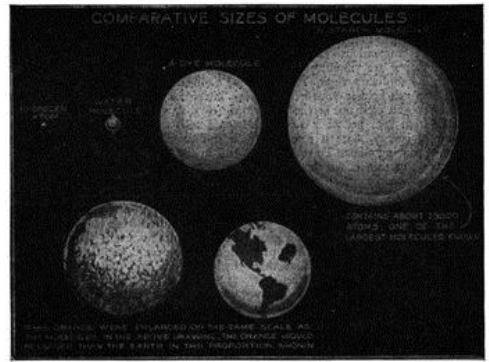
James felt the hairs on the back of his neck raise slightly, wondering at the intrusive nature of a man whose conversation had always been pleasant if not aloof. Joe wasn’t his favorite person at the school but they’d managed to get along unlike some teachers with their deans. James pushed his glasses further up his nose and looked about the empty classroom.

“Well he was in foster care, he has been for some time, and I didn’t really know too much about him until I filed to be his guardian after having been hunted up by his agency...we’re cousins, he’s fifteen and soon to be enrolled in the local school if that’s your concern.”

Joe cut him off with a raised hand. “Nope, nope, not concerned not worried at all. Good thing. Your taking in a kid and all. I’m just looking out for you, James. You’re a fine teacher. I want to keep it that way.” His meaty hand clapped James on the shoulder and before anything more could be said, Joe was ambling out of the classroom, leaving James and his thoughts lingering beside the smeared chalkboard.

**Lesson 4 Part 1**

**Give your own definition of physics.**



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**What is a theory? What is a law? What is the difference between the two? Give examples of each.**

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**What is the scientific method? Who first used it? Who else has used it in order to create a viable law?**

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**Looking Higher:** How have Galileo's experiments affected our modern world? Do we still use his ideas?



## Lesson 4 Part 2

The scientific method is widely used today to prove facts and research unknown patterns and occurrences. Today, you will prove a simple fact using the scientific method.

Choose something you would like to prove. Don't try to prove something too abstract or broad, rather choose a narrow fact that you would like to prove by putting it through the scientific method. Some examples are that water freezes at a certain temperature, a ball pushed down a hill will roll down, if a bike is pushed out of balance it will fall over, etc. Pick something that you can experiment and then record your method below.

### **Observation:**

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### **Hypothesis:**

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### **Experimentation:**

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**Results:**

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**Conclusion:**

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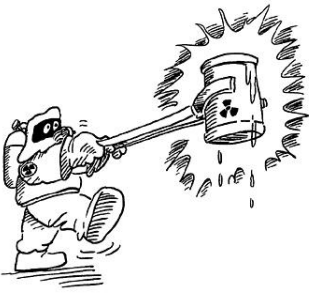
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Lesson 4



**What is energy? Why is it important to understand energy when studying physics?**

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**What is work? How is it different from energy? How does it relate to distance?**

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**What is force?**

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**What is gravity?**

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**Explain the difference between balanced and unbalanced force.**

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**Looking Higher:** What is acceleration? How does it relate to force? Give some examples of acceleration.

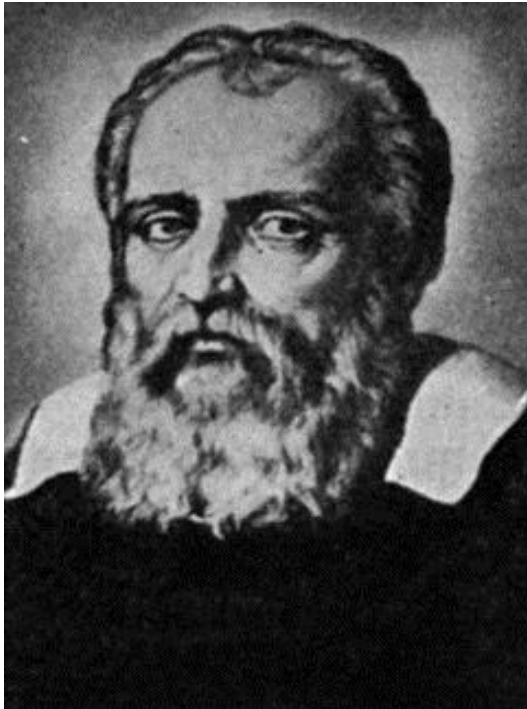
## Lesson 4

Part of studying any topic, be it scientific or otherwise, will involve the necessity of knowing the material well enough to write about it. If you can condense a complex subject to explain it to a layman, someone who does not know about the topic or is unfamiliar with the particulars, then you are well-equipped to comprehending it yourself. It is said that if you can explain it to a child, you have it down!

In order to understand something, being able to write about it truly comes in handy. Writing about a subject and explaining to the reader, working under the assumption that the reader is being first introduced to your subject, will let you have a better grasp on it yourself.

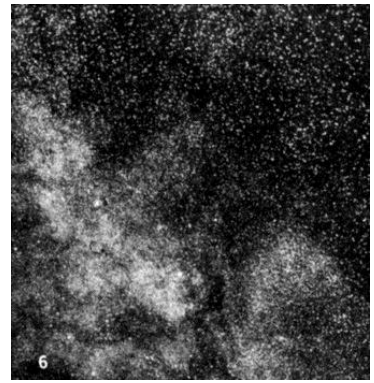
You will be given topics for essays from time to time throughout the course of this year. Research your topic and write a short essay, no less than a full page and no more than two pages unless you are compelled to write a longer essay, and present it to your family or teacher. Explain your topic well enough so that your reader can understand, and be sure to double-check any facts you present to maintain accuracy.

This week, you will write an essay comparing the scientific facts proven by Galileo Galilei and Isaac Newton. What were their methods, how were they similar, are their ideas still used today, have their ideas been proved to be laws or merely theories? Have fun!



## Lesson 4

This should be your fourth time observing the heavens. This week, focus on the patterns you might have been observing and how the shape of the moon has changed since your first week.



Tonight will mark your first month of stargazing; what things have you noticed? What things about your weekly trips do you like? What still needs to be worked on? Are you beginning to recognize constellations? Can you find Polaris or the Milky Way without the aid of your star map?

Look up cycles of the moon and record whether the lunar observations you have made are accurate.

Use the space below to draw what you observe in the night sky, which stars are visible, and the orientation of the moon, if visible. You may also use the lines to write about this.

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