Beyond the Hidden Sky

~~Ideas for Lesson Plans & Discussion Topics~~

Star Trails contains various lessons which are likely to be missed by casual readers. If used as part of a learning module those lessons can be pointed out and used as discussion points. Everyone makes mistakes, even adults, and it is much more effective to learn vicariously from those made by others, particularly fictitious characters, than make the same mistake yourself. This is also an opportunity to explore the science aspects in greater detail as part of science class curriculum or even explore the world of metaphysics. What follows is a summary of lessons contained in various chapters with suggested discussion topics that can prompt assignment ideas.

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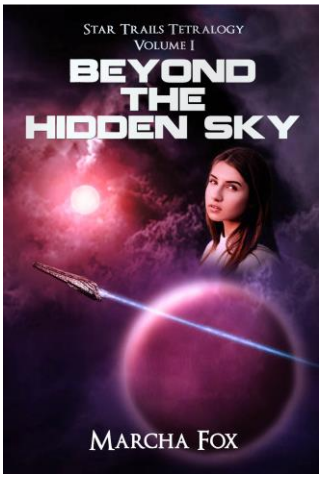
Volume I: <u>Beyond the Hidden Sky</u>



- **Family dynamics: How sibling quarrels can produce dire consequences, *i.e.* be careful what you wish for.**
- **Right-brain or left-brain, logic versus intuition and its affect on learning style and communications.**
- **Consequences of impulsive behavior.**
- **Assumptions can bring considerable risks when not backed by facts.**
- **Being responsible for one's choices as well as their affect on others.**
- **Basics of Kepler's Laws of orbital dynamics and Newton's Laws of motion.**
- **Einstein's Special and General Relativity theories and their application to space travel including time dilation and theory behind warp drive technology.**
- **Effects of zero gravity, need for countermeasures to maintain physical strength.**
- **Metaphysical speculations, *e.g.* thoughts become things, consciousness' effects on reality, telepathy.**

Chapters 1 - 2

1. Creena and Dirck clearly don't get along. What are their basic differences? (Creena is driven by feelings, emotion and intuition while Dirck prides himself on being logical.) Is one approach better than the other? Why?

2. Creena is upset and frustrated by the conditions onboard the *Aquarius*. There is no privacy which is part of the problem but in addition the technology on Mira III helped mitigate feelings

through "holographix" which offered soothing colors and sounds as well as other environmental effects to keep people calm. Do you think that such technologies would help control emotions? What is the difference between controlling and suppressing?
3. Creena wants to get away from everyone. Some individuals need solitude to "recharge" and others seek out friends or activities. Which one are you?

4. What was the first mistake that Creena made? Did she know it was wrong? How did she rationalize her decision? When you have to talk yourself into doing something is it usually right or wrong? How much was driven by logic and how much by emotion?

5. Once inside the escape pod did she immediately know what it was? Why not? (It looked like a mini-learning module) What additional mistakes did she make? What had her father told her that would have kept her from activating the pod if she had followed his advice?

6. The INTEGRATOR notes that "Mirans were so very easy to deceive." Why? (They are predictable in their actions.)

Chapter 3

1. Why didn't a word for "panic" exist on Mira III? Would it be possible to create such a world? Why or why not?

2. What was one thing Dirck liked about Mira III? (All choices were made for him; everything was predictable; they had luxurious living conditions.)

3. Dirck's view of life was binary in nature, i.e. "black and white." When does this strategy work and when does it fail to yield accurate information? Why?

4. Why does Dirck have trouble speculating where Creena might be? (In a black and white world there are fewer options. He's not used to thinking in terms of numerous choices and outcomes.)

5. Dirck starts to feel guilty for provoking Creena. Why? Whose fault is it, his or hers?

6. What does his father mean when he says "To start your off-world education?"

7. Creena experiences stronger emotions than she's ever had when she realizes what has happened. What was the cause? (Adrenaline triggering a "fight or flight" reaction.) Can such a reaction be controlled? Why or why not?

8. It doesn't feel as if the pod is moving. Why? (When something is moving in a straight line at constant speed you can't tell it's moving. This relates to Newton's 1st Law of motion or the principle of inertia which states that an object will remain in a state of rest or constant velocity unless acted upon by unbalanced forces. Newton's 2nd Law is best described by the equation Force = mass x acceleration or F = ma. In other words, the force exerted on an object depends on its mass and how fast it is changing speed or accelerating. Newton's 3rd Law relates to opposing forces, that whenever a force is applied to something, an equal and opposite force is generated, such as the kickback on a rifle or pushing off the side of a swimming pool.

9. Why is Creena weightless in the pod? (It doesn't have a "gravity simulator." Mass such as that of a planet creates gravity which is proportional to how big it is. Scientists still don't understand exactly how or why gravity works but they can predict its strength based on the mass of an object or planet.)

10. Mira III had a very ordered way of life which included specific "zones" for each activity. Everything was organized and happened according to plan. What would it be like to live on such a planet? Would you like it or not? Why?

Chapters 4 - 5

1. Why is Dirck upset by his father's reaction to Captain Troy?

2. Who is on the offensive and who is on the defensive in this encounter? (Both Troy and Laren are on the offensive but Troy's case is stronger. He's in a position of authority and using it to full advantage.

3. Why is Laren so frustrated? Is there more to it than Creena's disappearance? (He had promised his bondling (wife) they would stay on Mira III where she had always lived and everything was predictable. He knew she would be very upset and blame him because they'd had to leave, thus violating his *Promises*.

4. Why would they need "inertial time adjustments?" (According to Einstein's Theory of Special Relativity time moves at a different rate for objects moving extremely fast, such as near the speed of light which is 186,000 miles per second. In theory, nothing can move faster than the speed of light but time will "dilate" or stretch and expand when something is moving close to that speed. In other words, time progresses at a different rate in a spacecraft traveling near the speed of light. "Inertial time adjustments" would assure arriving in the same dimension of time from which they left as opposed to one in the far future or past.

The fictitious "warp harmonics" referred to in the story relate to Einstein's Theory of General Relativity which states that space can be folded, thus shortening the distance which decreases the time required to reach a given destination.

The physics equation for how far you will go at a certain speed in a certain amount of time is velocity multiplied by time = distance [vt=d] or velocity = distance divided by time [v=d/t]. Distance divided by time is expressed in the common expression "miles per hour." A "base-ten logarithmic scale" refers to a system where each step adds an order of magnitude by multiplying a number by 10, 100, 1000, 10,000, etc.)

5. What is one of the primary motivations Laren has to rescue Creena other than the fact she's his daughter? (He made vows "to protect and shield from harm of any kind.")

6. Why is Dirck so confused by what happened in Troy's office? (Unquestioned compliance or obedience was of primary importance on Mira III. There were no other options. Now they have a dilemma because the "authority figure" (Troy) has denied any help in finding his sister which violates his father's ability to fulfill his father's *Promises*.)

7. What does Laren mean that "higher laws" govern his *Promises?* (Basic human rights to freedom and safety are in the category of "inalienable rights" and thus at a different level that civil or governmental law which should first and foremost protect those it serves, not jeopardize them.)

8. When faced with a problem why is it important to identify a "primary objective?" (It helps measure all actions in terms of achieving a specific goal and prevents diversions.)

Chapter 6

1. Can you see the stars where you live? If so, how do they make you feel? What would it be like to live on a planet where you never see the sky?

2. Why would it be difficult to have a luxurious life and then suddenly lose it?

3. How does Laren turn the tables on Troy? (Troy's original premise was that the starship was a military craft under military rule. Laren points out that when it's being used as a civilian craft it falls under different laws and regulations related to passenger safety. Since safety requirements were violated, at least part of Creena's disappearance is Troy's fault. This relates also to the responsibility of manufacturers to provide a safe product and liability if someone is hurt by it.)

4. Why does Troy initially refuse and then agree to provide Laren with a ship to look for Creena? (He has an ulterior motive.)

5. On one hand Laren is trying to teach Dirck to think and make choices, then tells him he needs to follow orders. Why this discrepancy? (There are some conditions where someone needs to be in charge for the good of all concerned, particularly when a wrong action by one person could harm the others.)

6. Why is Sharra so confident they'll find Creena and bring her home? (Her Miran upbringing has conditioned her to expect a positive outcome with no other options.)

Chapters 7- 8

1. Creena's determination to find food and other facilities onboard the pod drive her to do things that a "typical Miran" probably would not. Why? (Mirans always wait to be told what to do. Initiative and original thought were discouraged. What are the pros and cons of such a culture?)

2. Why is life in a weightless state different than on Earth? (Gravity forces our bodies to continually compensate for it by building additional strength. Without it muscles weaken, including the heart, which is also a muscle, which needs to pump blood against it. "Orthostatic intolerance" is the technical term for not being able to stand up without holding onto something. Astronauts in space exercise to maintain their strength so that when they return to Earth they are not too weak to walk. Some astronauts who have returned from long-duration

space flight have not been able to walk without assistance. Gravity is something we take for granted. For example, pouring a glass of water requires gravity to deliver the liquid to the container. In space the liquid would spill out into the air and float around in a glob. Think about things you do that you can't do upside down and you will discover various "gravity assisted functions." Astronauts often suffer from space sickness, similar to motion sickness, because gravity is not helping keep food and liquids in the stomach.)

3. The brain is divided into two parts called "hemispheres," one right, one left. The right side is associated with creativity while the left side is associated with logic and linear thinking. Most people are prone to use one side more than the other. Some believe that people who are left-handed are right-brained while those who are right-handed are left-brained since each side of the brain relates to the opposite side of the body. However, this is not always the case even though those who are left-handed seem more likely to be right-brained.)

4. Why would engineers design important systems so that they are "two-fault tolerant?" (So if two fail the other one will still work and not cause a problem.)

5. Was Laren's intent in taking Dirck along really a punishment? (Not entirely. However, it would show him the consequences of Creena's loss, in which he played a part.)

6. Was Creena doing anything wrong when she tried to figure out where the pod was going? Why did she think it might be? Why was her behavior being observed? (On Mira III initiative and unique questions were punished because they disrupted the status quo. Her behavior was being observed to determine how intelligent and creative she was in addressing problems.)

7. Why is it difficult for Dirck to think about what might happen when the arrive on Verdaris? (Everything was predictable on Mira III.)

Chapters 9 - 11

1. Is there a reason the pod's systems are not working properly? (Yes. The people observing Creena's behavior want to see how she'll react to surprises, whether she'll try to fix them, be as compliant as possible without them, or simply do what she wants.)

2. What are the different types of learning styles? (Visual, auditory, and kinesthetic. A visual learner absorbs the most from what they see; an auditory learner does best from listening to others; a kinesthetic learner does best by doing and participating in an activity. It's important to know your primary learning style even though you may not always have a choice on how information is presented. You can still seek out supplemental information in your preferred format to reinforce the data through more efficient means.)

3. Why did the inside of the pod get hot when it entered the Verdarian atmosphere? (The air created drag and friction against the surface generated heat. The faster an object is going the more air particles it encounters in less time, increasing the effects. Something going slowly, such as a car, doesn't notice it as much, but this is why windshields are slanted into what is known as an "aerodynamic" shape so there is less air resistance which constitutes a force holding the car back, even if it's small. Race cars are always designed for as little wind resistance as possible, including having a clean, shiny surface. The insulation and reflective

properties of the pod were not sufficient to compensate so the inside heated up. Spacecraft that re-enter an atmosphere require insulation or some other method to keep them from burning up. This is partly why the Space Shuttle, Columbia, was destroyed on February 1, 2003. When it launched a piece of foam from the external tank broke off and cracked the protective material on the leading edge of the wing. When Columbia entered Earth's atmosphere the hot gases entered the inside of the wing, melted the metal frame and caused it to fall off with the entire vehicle eventually breaking up.)

Chapters 12 - 14

1. Are "timebumps" possible? (Theoretically, yes. When technologies are developed that allow for travel at relativistic speeds if malfunctions occur it's possible that time could be disturbed. A "Time Adjustment Station" or TAS could likewise use these technologies to send a vehicle or object to a specific point in time.)

2. Why would anyone want to control time? (If you could go backward and forward in time you could determine what was going to happen in the future and then go back and work it to your advantage, such as finding out what number would be drawn in a lotto and then choose that number. However, there are various paradoxes associated with time travel. The most common one is going back in time and killing your grandfather which would mean you would never be born. Some physics theories such as the "many worlds" or "multiverse" theory state that doing so creates another possibility and therefore another dimension where the new chain of events play out. Some believe that every possible choice anyone can make is active in another dimension.)

3. Why would Verdaris have a purple sky? (It's composed of a different combination of gases than Earth, where the predominance of nitrogen causes it to appear blue. A planet's atmosphere reflects light, the color dependent on its wavelength, which in turn relates to the specific type of gas molecule reflecting the light. If a space object doesn't have an atmosphere then the sky would be black, like it is at night, even if it were close to a star like our Sun.)

Chapters 15 - 17

1. What is a "tachyonic transmission?" (Some physicists believe that the speed of light is a barrier of sorts for physical material but it's possible that something can actually move faster than light. This is the world of tachyons. If they exist, future technologies could determine how to use it to transmit data in what could be an instantaneous manner. Most data on Earth, particularly what you see, is conveyed through tiny light particles known as photons, which move at the speed of light. For example, the light from the Sun, which is 93 million miles away, takes approximately 8 minutes to arrive on Earth. In other words, if the Sun were to suddenly die, it would be 8 minutes before those of us on Earth would know.)

2. What is wrong with Verdaris? (The fictitious planet is being bombarded by huge pieces of a comet. When huge pieces of space rock or ice enter the atmosphere they heat up from friction like the pod and often explode from rapid expansion, causing significant damage on the planet's surface. It was such a collision which is believed to have wiped out the dinosaurs 63 million years ago.)

3. Is there such a thing as warp gullies? (They are possible based on Einstein's Theory of General Relativity. Such a gravitational effect that warps time and space could be caused by a very massive but small object such as a black hole or neutron star. All physical matter is made of atoms which are so small they cannot be seen with the naked eye. However, there is a lot of empty space within an atom. If a hydrogen atom were made big enough that the nucleus was the size of a softball, its single electron would be 6 miles away. Thus, an atom can be compressed if there is enough gravity involved, making it much heavier for the amount of space taken up. Thus, blackholes and neutron stars can be relatively small yet have stronger gravity than Earth.)

4. Can objects be moved or controlled by your thoughts alone? (Yes. Your entire body is electrical and your brain emits electrical impulses. Scientists and engineers today are learning how to use these brainwaves to control such things as prosthetic limbs i.e. artificial arms, legs, hands, etc. Control of some electronic devices is also being developed based on the same principle. Many people believe that "thoughts are things" which have a specific type of energy which can be harnessed. In this story this is the basis of holographix, which react based on a person's thoughts.)

Chapters 18 - 19

1. The electroid or 'troid, Aggie, is an example of linear thinking. Why? (Most robotic devices are driven by computer code which progresses one line at a time. When it reaches a decision point then it will proceed through another set of commands. A computer can process information very quickly but it will typically do so one step at a time. Humans, however, can process information in a more holistic manner, comprehending many things at once and drawing from experience. Computer programs are limited to what they include. They cannot learn. A computer that can learn is known as "Artificial Intelligence." Computer scientists are beginning to develop such devices.)

2. What are the specific steps you take to do something such as make a sandwich? Do you think of them as sequential steps or simply a single process?

3. Free will allows you to think whatever you want. Does that mean you can do anything you want?

4. Do you think it is possible to control other people's thoughts? Would this be good or bad?

5. Do you think that "thoughts become things?" First, consider that nothing comes into existence without first being a thought. What power does a thought possess? How is it limited?

Chapters 20 - 23

1. Do you think you are right-brained or left-brained? Why?

2. Would an inclination to be right or left-brained be inherited or acquired from your environment? (While both have an influence, the inclination is mostly inherited, indicating the genes inherited from your parents and grandparents play an important role. These physical

characteristics then contribute to how you think and behave even though this is where your environment also has a strong influence.)

3. Do different cultures show more of a propensity for one or the other? (Yes. Some revere creativity while others discourage it. If you were born with a strong sense of creativity but in a culture that discouraged it then it would never develop to its fullest capacity and you would probably be frustrated, even if you didn't understand why.)
4. Sharra is gradually gaining courage and learning to make decisions. When she converses with Zahra she doesn't understand much of what she's told. Why not? Why do you think that Deven *does* understand? (Sharra's Miran roots discouraged creative thinking and making decisions. What Zahra tells her is based on intuition and abilities she has not developed. However, Deven has inherited strong intuitive genes from his father and can grasp what she is saying. To some degree everyone is programmed a certain way, making it easier to comprehend some things better than others. This is why some people are better at spelling or math than others, because their brain operates differently. Learning something you are not naturally designed to do is possible but more difficult.)

5. Is Creena acting like a typical Miran when she proposes they find or build a ship to leave Verdaris? (No, a typical Miran would probably sit and wait to be rescued regardless of what was going on around them.)

6. Why is Creena nervous about the ship landing? Which information is logical or left-brained and which information is intuitive or right-brained? (The fact there's a ship coming to a planet where everyone has evacuated is logical, the bad feeling she has is intuition.)

7. Why would a "quantum paralysis device" be better than a refrigerator? (Because this fictitious device actually stops chemical reactions while a refrigerator simply slows them down since reactions occur more slowly in a colder environment.)

8. What is "acoustical cooling?" How can sound waves make something colder? (Sound is a form of energy and energy is always conserved, meaning it cannot be destroyed or created. However, energy can be converted from one form to another. One measure of the amount of energy present is heat, which if used to create a different type of energy, such as sound, will be reduced and therefore cooled.)

Chapters 24 - 26

1. How can a spacecraft use gravity to save power? (This is another example of converting one form of energy to another. A spacecraft can use the gravity of a planet which tends to pull it closer (centripetal or center-seeking force) to give it extra velocity. NASA interplanetary spacecraft use this method to speed up without having to use additional fuel. Most spacecraft exploring the solar system do not have propulsion systems. Rather they operate based on Newton's 1st Law which states that an object will remain in a state of rest or a state of constant velocity unless acted upon by an outside, unbalanced force. A rocket is used to take it outside Earth's atmosphere and send it in a certain direction. The rocket is left behind and the spacecraft proceeds forward at the speed attained from the rocket. When the spacecraft gets near a planet, particularly a large one like Jupiter or Saturn, it is drawn toward it, speeding it up. If it is on the correct trajectory or path, it can use the gravity to sling it off in another

direction or what is known as a hyperbolic orbit, which is an open arc, not a closed one which would put the spacecraft in orbit around the planet.)

2. Why can't Aggie hear Thyron? (Thyron communicates through telepathy or brain waves, sometimes also called psi waves. Aggie's receivers are not naturally tuned to receive and interpret them. Not all humans can hear them, either, something that would also depend on heredity as well as the environment in which they were raised. Think about whether you have ever felt as if you could read someone else's mind or s/he could read yours. Was it truly telepathy or were you reading different indicators, such as body language and facial expressions?)

3. What are Sharra's choices? Is there anything she hasn't thought of? What would you do?

Chapter 27 - 28

1. What skill is Dirck gradually developing from the ship's datalogs? (He is learning to tie seemingly unrelated facts together, a process known as synthesis. He is also becoming curious, something that was discouraged on his homeworld.)

2. What effect could "transcription errors" have on a person? (Transcription errors are theoretical mistakes in reassembling a person's body based on their DNA coding after their body has been dissociated by a transfer beam or, in this case, the timebump experiences. Depending on which errors occur and the part of the body affected it could result in physical or mental disease, disabilities, or even death.)

3. What would life on Earth be like if it orbited two stars like a figure-eight? (The tilt of the Earth's axis is 23 degrees, which is what causes our existing seasons. The primary difference would be during the time when our planet was between the two stars, placing the entire planet in a "summer" mode that also lacked a diurnal cycle, i.e. night and day. In other words, it would be extremely hot with constant daylight. This concept is explored in detail in volume II, "A Dark of Endless Days.")

Chapter 29 - 33

1. Think about the things you care about most and what it would be like if everything was suddenly gone. Would you accept the situation and give into your new circumstances or figure out how to get everything back? How?

2. Give an example of a time when you have used both logic and intuition to solve a problem.

3. Do you think Creena did the right thing insisting on going to Cyraria? Why or why not?

4. Have you ever known something without knowing why or how? For example, has someone ever called you and you knew who it was without even looking at the caller ID? What do you think it was?

5. How much risk would you be willing to take for something you absolutely had to have? What kind of situation would it take for you to be that determined? Do you feel that way about anything now? Why or why not?