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Student Perception of a Visual Novel for Fostering Science Process Skills

ABSTRACT

In undergraduate science education, emphasis is often placed on teaching subject matter rather than science process skills (e.g., critical thinking, problem solving). Although important to scientific training, these skills are often not taught because they are challenging to teach. We therefore present a case-scenario activity that aims to facilitate the development of science process skills. This activity, which takes the form of a visual novel, asks students to generate hypotheses for the seemingly odd events that are described in the story. We implemented this activity in a science-process-focused course. Our aim in this exploratory study was to assess whether students would make meaningful connections between the visual novel and science process skills. To do this, upon the completion of the activity, we asked students to submit a written response to the prompt: "What are you taking away from the activity?" We conducted a qualitative analysis of these written responses to ascertain whether meaningful codes and themes related to science process would arise from this open-ended prompt. Based on student responses, four main themes emerged: scientific inquiry, student satisfaction, flexibility, and collaboration. These results demonstrated the activity was both enjoyable, and it successfully enabled students to apply science process skills. We offer this activity in anticipation that it will provide educators with a tool to include these skills in their classes.

KEYWORDS

science process skills, active learning, problem-based learning, fiction, student engagement

INTRODUCTION

Science process skills—making observations, generating hypotheses, critical thinking, problem solving, collaboration, and communication to name a few—are the cornerstones of scientific training, yet these skills are seldom taught in undergraduate science programs. Although many educators recognize science process skills are crucial to scientific training, they perceive these skills as too difficult or too time consuming to teach and educators opt instead to teach subject matter (Coil et al. 2010). More concerning, Stains et al. (2018) recently reported that the majority of college science-related classes in Canada and the United States are taught didactically (i.e., lectures), despite accumulating evidence of the ineffectiveness of lectures (Bunce, Flens, and Neiles 2010; Cleary-Holdforth 2007; DiCarlo 2009; Freeman et al. 2014; Gilboy, Heinerichs, and Pazzaglia 2015; Mann and Robinson 2009).

Unfortunately, much of science education resembles what science is not, a mechanical process that focuses on the correct answer. This is contrary to what we do in science; as scientists, we seek answers to difficult questions, and we never know with certainty what the answer may be. The focus on a single expected answer stifles creativity and critical thinking, as students become fixated on memorizing facts they will soon forget (Amabile 1998; Bacon and Stewart 2006; Custers 2010; Voice and Stirton 2020). Science advances through exploration, curiosity, and risk-taking, and it is with these principles in mind that the activity presented here was developed.

Our case scenario activity, named "Hill Valley," has been implemented into upper-level university courses aimed at helping students develop science process skills. Presented digitally, this activity consists of a visual novel—an interactive, fictional storybook. In groups, students are asked to generate a scientific explanation for the seemingly "odd" behaviors of the characters described in the story. Students are encouraged to use a host of science process skills including generating hypotheses, making observations, and thinking creatively and critically. Our case scenario activity is both easily implemented and takes a collaborative, active learning approach to challenge students to think like scientists.

The activity was largely informed by the teaching literature. We decided to present the case scenario in the form of a visual novel (similar to an interactive storybook; see Figure 1), as studies have suggested that digital media (e.g., games, videos) and fiction increase student motivation and engagement with learning (Blatch et al. 2017; Cookson, Kim, and Hartsell 2020; Ketelhut 2007; Kiran et al. 2016). Additionally, the scenario was designed with no correct answer in mind, which encourages students to take risks. Students also worked in groups and were encouraged to consider various scientific disciplines when completing the activity. Collaboration, interdisciplinary thinking, and particularly risk-taking are suggested to promote exploration and experimentation (Amabile 1998; Ashby and Exter 2019; Cowden and Santiago 2016; Ivanitskaya et al. 2002; Laal and Ghodsi 2012). This activity prompts discussion and active reflection, learning tools that have been shown to foster metacognition and deeper-level learning (Sabel, Dauer, and Forbes 2017; Selmo and Orsenigo 2014; Wain 2017). The format of our case scenario activity also benefits and caters to Generation Z students, who currently comprise the majority of undergraduate students in post-secondary education. According to Seemiller and Grace (2017), Generation Z students prefer active and applied learning and learning through digital formats (e.g., watching videos), components that are embedded within this activity. In addition to catering to the learning preferences and interests of Generation Z students, our case scenario activity also targets important science process skills that reportedly require improvement among this generation of students (Seemiller and Grace 2017; Seibert 2021).

Our aim in this exploratory qualitative study is to assess student perception of the activity in an unbiased manner. We wondered whether students would make meaningful connections between the visual novel and science process skills. Therefore, upon completion of the activity, we asked students to respond to the open-ended prompt, "What are you taking away from this activity?" We hope the student perceptions shared through this qualitative study will inform educators about ways in which they might facilitate the development of science process skills, a task with which educators reportedly struggle (Coil et al. 2010). Our study may also reveal whether an interactive digital activity is perceived positively by the current generation of undergraduate students, which may inform the development of additional digital education tools.

We anticipate this activity will be beneficial as an introductory activity to scientific thinking, and serve as a simple, engaging, and easily implemented tool for educators across scientific disciplines who wish to facilitate the development of science process skills among their students. In this paper, we first describe the assignment and then present student perceptions of the activity.

Figure 1. Visual Novel Example: An example frame from the visual novel

THE ASSIGNMENT

This case scenario activity can be administered in any science course that is aimed at helping students identify and practice science process skills. This activity was implemented at the beginning of Science of Fictional Characters, a course that asks students to use science process skills to analyze fictional characters. This activity can be implemented in both online and face-to-face classes; and although we implemented the activity into smaller classes of around 15–30 students, it can easily be scaled to larger class sizes.

Assignment preparation and software

The activity's content was presented in the form of a visual novel, an interactive storybook with visuals and audio that is experienced on a personal computer. This novel was developed using TyranoBuilder Visual Novel Studio (version 41.0.2272.76) for Mac OS. We then exported the visual novel to be read on a web browser, so students may access the novel irrespective of their operating system (see Supplemental Online Material to access the visual novel). The visual novel is accompanied by a map in which the story takes place (see Supplemental Online Materials to download the map). The scenario outlined in the visual novel is fictional and describes the interactions of several children over several days. The students' task is to read the visual novel, refer to the map, and generate hypotheses to explain the seemingly "odd" behaviors of the children described in the story. See Appendix for a transcript of the story (this transcript can be shared with students; however, if the instructor wishes to encourage note taking as a skill, this step can be omitted).

The instructor should begin the activity by dividing the class into groups of no larger than five or six individuals, either in-person for face-to-face classes or in breakout rooms for online classes. For this study, we randomly assigned students into groups. However, due to the open-ended nature of the activity, we found it helpful for students to form groups based on differing expertise. In Science of Fictional Characters, for example, an elective course, we often have students enrolled who have different academic backgrounds (e.g., kinesiology, biology, psychology, health sciences) and the hypotheses generated by the student groups often encompass their respective fields of focus. Anecdotally, we have found students engaged in more discussion if they read through the visual novel together, with one member of the group sharing their screen and audio.

Once in groups, the instructor should provide students with about 30–40 minutes to complete the activity. In the generation of their hypothesis, ask students to outline their (1) observations, (2) rationale/evidence, and (3) assumptions and limitations. Once the time is up or when all students have generated their hypotheses, ask each group to share their hypothesis with the class (for larger class sizes, ask for volunteers). Because this activity was not developed with a single correct answer in mind, the hypotheses generated by the students can vary, especially if the class makeup contains students with various academic backgrounds. Depending on the length of the class, the instructor may wish to conduct a debrief session where students are asked to share their thoughts on their peers' hypotheses as a means of stimulating scientific dialogue. As the facilitator of the activity, it is important to remain unbiased and comment on the diversity of the hypotheses, highlighting the differences and similarities between what was shared.

Post-activity reflection

Following the activity, ask students to write a reflection about their experience. The question(s) can be tailored to specific learning outcomes. Some ideas for questions include:

(1) What are you taking away from the activity?
(2) How does the activity relate to what we might do as scientists?
(3) What are some skills you used to accomplish this activity? How might these relate to the scientific process/research methods?

Once students have had a chance to individually reflect on the question(s), the facilitator may wish to invite students to share their thoughts and capture the themes that arise on a physical board (e.g., whiteboard, sticky notes) or virtual board (e.g., Jamboard, MURAL).

METHODS

Fifteen out of 30 upper-level (years three and four) science and health sciences undergraduate students who were enrolled in Science of Fictional Characters at McMaster University provided informed consent for our use of their reflective assignment for this paper. In our exploratory appraisal of this activity, we used question one listed above (i.e., What are you taking away from this activity?) due to its open-ended nature to ascertain whether meaningful themes and codes related to science process skills would emerge unprompted. We did not ask students about specific science process skills, as we wanted to assess which skills would be most salient to our students after the activity. The use of student assignments for this paper was approved by the Hamilton Integrated Research Ethics Board.

Science of Fictional Characters is a student-directed, project-based course focused on the development of science process skills; the students' goal is to analyze the science of fictional characters by utilizing the scientific literature. For example, students may wish to analyze and hypothesize the biological or psychological mechanisms that underlie zombie behaviours. Once students have selected their fictional character(s), the assessments, activities, and discussions within the course emphasize science process, inquiry, and interdisciplinary skills (e.g., hypothesis generation, scientific discourse, dissemination). This elective course is open to years three and four science students enrolled in the Bachelor of Health Sciences (BHSc) (Honours) Program. The BHSc Program is a four-year undergraduate program that places skills development at the core of its curriculum; apart from a few mandatory courses (e.g., cellular and molecular biology, inquiry), students have flexibility in designing their own educational experience (McKinnell et al. 2005). Given the skills-based nature of the curriculum, this course provides students with the opportunity to integrate and apply the science process skills they have accumulated in their first few years of study. The course focuses on fictional characters because it is both engaging and provides a space for students to take risks without worrying about the "correct" answer. The present fictional visual novel activity, which was implemented at the beginning of the course (and before students formed groups for their larger fictional character(s) analysis), thus served as a springboard for the activities and discussions that followed.

Qualitative analysis

The responses to the reflection prompt were qualitatively analyzed using an inductive thematic analysis approach that was adapted from Bree and Gallagher (2016). We read each submission and any statements that were indicative of an opinion on the activity were put into a raw data spreadsheet. Codes were then generated from these data. Sentences or parts of sentences within each response contained one or multiple codes which served as categories for analysis (Bree and Gallagher 2016). The statements were assigned a code if they explicitly stated or implied an opinion on the activity. For example, the statement: "This activity was really an eye-opener for me and taught me to be creative" explicitly mentioned "creativity" and was coded as such. In addition, the statement: "I learned a lot about thinking outside of the box" implied "creativity" and was assigned the same code. Furthermore, some statements expressed more than one opinion and were therefore assigned multiple codes. For example: "Through the small group process we engaged in out of the box thinking" was assigned both the "group work" and "creativity" codes. Each code was grouped together and the number of responses per code was counted. The codes were then further categorized and grouped into themes (Table 1), as described by Graneheim and Lundman (2004).

Table 1. Description of the themes that emerged from the codes

Themes	Code	Occurrence (% out of 15)	Criteria for Selection	Example Quote
Scientific Inquiry	Hypothesis Generation	8 (~53%)	Students used words describing hypothesis generation	"This activity has provided me with a framework with which to generate hypotheses for novel phenomena."
	Literature Search	4 (~27%)	Students mentioned different strategies to conduct literature searches/relying on information in the literature	"... when we are generating hypothesis, we should really conduct a literature search to make sure that the ideas that we exclude are based on scientific fact rather than intuition."
	Consolidating Evidence	4 (~27%)	Students mentioned ways of putting together the evidence presented to them	"I think focusing on various parts of the story as well as distinct interpretations are the basis to analyzing a story."
	Making Observations and Assumptions	5 (~33%)	Students mentioned their observations, assumptions, or the importance of being observant	"The key to being observant is to not only note everything that happens, but also possible connections between the observances so as to gain a better sense of the whole picture, rather than just have random pieces of the picture sitting next to each other."
Student Satisfaction	Enjoyable	5 (~33%)	Students mentioned the words fun, exciting, or enjoyable	"It was overall a very fun activity..."
	Personal Growth	6 (~40%)	Students mentioned noticing their personal growth as they applied past knowledge	"I think that this activity demonstrated the growth I have had since first year in both my repertoire of knowledge and skills, which was satisfying to notice."

Flexibility	Creativity	6 (40%)	Students mentioned the word creative, the phrase "thinking outside the box," or alluded to using their imaginations to broaden their learning	"… let our imaginations run free!"
	Inter-disciplinary	7 (~47%)	Students mentioned the word interdisciplinary or commented on the need to draw from different areas of science	"I also learned to embrace different avenues and different disciplines of science using the game as a model."
Collaboration	Appreciating Different Perspectives	5 (~33%)	Students mentioned relying on the different perspectives and expertise each group member provided	"Just as there are so many fictional characters, I have also learnt there are also so many perspectives one can take in analyzing one fictional character."
	Group Work	10 (~67%)	Students mentioned working in a group	"One important takeaway is the importance of the members in one's group. If it weren't for collaborating between group members I don't think our explanation would have been as detailed and applicable as it was."

RESULTS

The 10 codes identified (Table 1) resulted in four main themes: scientific inquiry, student satisfaction, flexibility, and collaboration. These themes demonstrate the different benefits this activity provided students, and how it created an open, creative, and collaborative environment that fostered scientific learning.

Scientific inquiry

From the students' reflections, it appeared that this activity helped engage students in science process skills. Many students expressed their ability to make observations, analyze the information presented to them, perform literature searches, and create and share hypotheses. Furthermore, the activity provided students with skills they could later apply to other science courses and contexts. One student said:

> The biomedical research that I conduct [outside of the course] employs cellular and molecular biology experiments, wherein I am often required to make conclusions from experiments… this was done in the activity wherein the clues and snippets of information obtained from the virtual novel and map itself were slowly put together.

Another student mentioned: "I really enjoyed the activity, the main reason being that I really enjoy problem solving and critical thinking…both of these skills are required in research, particularly whilst hypothesizing possibilities and analyzing results."

Student satisfaction

The students expressed their enjoyment with the activity, which stemmed from the interaction of their usual scientific topics with the more engaging fictional/game scenario and media. This activity also helped them realize their own personal growth by applying past skills and knowledge to solve the problem. One student commented: "... from the game we played in class, it made me realize that learning and fun really do help with motivating my personal learning process." Another student stated: "It was overall a very fun activity…"

Flexibility

The students expressed that they had creative freedom in completing the activity. One student commented:

> As a scientist, I think it is important to have a good imagination, as this allows one to think out of the box and develop areas of investigation that will elucidate new and exciting areas of research that will be of benefit to society. Similarly, fiction is a narrative that also incorporates a great deal of imagination.

In addition to creative thinking, students found the activity provided flexibility in its interdisciplinary nature. One student's response was: "I also learned to embrace different avenues and different disciplines of science using the game as a model."

Collaboration

Finally, students commented that the ability to collaborate allowed them to integrate the different perspectives and educational backgrounds of each group member. One student commented:

> I believe another lesson I will take away [from] this is the richness that peer collaboration brings in analyzing fictional concepts. Just as there are so many fictional characters, I have also learnt there are also so many perspectives one can take in analyzing one fictional character.

DISCUSSION

This activity was created to help students develop and apply their science process skills—skills that are often not taught in classrooms since they are difficult and time consuming to teach (Coil et al. 2010). Our activity is meant to be a tool for educators which serves as a starting opportunity for students to exercise their science process skills. Our visual novel is also easy to implement within the classroom and does not require a lot of time to complete.

The student responses from the post-activity written reflection suggest our activity succeeded in providing educational benefits; it engaged students in science process skills while being an enjoyable experience. This is evidenced by the emergence of four meaningful themes: scientific inquiry, student satisfaction, flexibility, and collaboration.

Scientific inquiry

The emergence of the theme scientific inquiry suggests the activity may serve as a successful springboard for the development of science process skills. In the student responses from the reflective assignment, students mentioned a host of these science process skills. These skills are crucial for scientific training and conducting research (Addis and Powell-Coffman 2018; Coil et al. 2010; Dirks and Cunningham 2006; Kardash 2000; Seymour et al. 2004). Critical thinking, for instance, is a skill that allows students to evaluate data by detecting thinking and logic errors, determining the credibility of information, and identifying the explicit and/or implicit assumptions in a statement or argument (Parcha 2021; Vieira, Tenreiro-Vieira, and Martins 2011). There is a suggestion in the literature that students who practiced science process skills not only felt they had a higher understanding of the nature of science, but they were also better at scientific writing and making sense of data (Brownell et al. 2015; Kinner and Lord 2018; Seymour et al. 2004). Our activity provided students with a platform for scientific thinking and inquiry by steering away from a subject-matter focus and instead posing an open-ended question that prompts students to creatively think, analyze, and conduct research. The results of the student responses demonstrate the educational benefit of our activity and open an exciting new and alternative way of teaching science inquiry that is beyond didactic learning.

Student satisfaction

In addition to teaching science process skills, we also aimed to make the learning process enjoyable and engaging with this activity. The theme student satisfaction suggests our activity achieved this goal. One student made the connection that enjoyment improves the learning process. Indeed, the literature suggests that student engagement has implications for student success; in a recent meta-analysis of 69 studies, Lei, Cui, and Zhou (2018) reported that improved student engagement is associated with increased academic achievement. This is especially important when teaching science process skills both because faculty reportedly struggle with teaching these skills and also because students tend to dislike and lack motivation to learn concepts related to research methods (Coil et al. 2010; Coleman and Conrad 2007; Earley 2014). The activity presented here combined elements of fiction, gaming, and active learning, components that have shown to both promote engagement and have positive effects on student learning (Blatch et al. 2017; Cookson, Kim, and Hartsell 2020; Ketelhut 2007; Kiran et al. 2016; Liu and Elms 2019; Roehl, Reddy, and Shannon 2013). This contrasts with lecturing, which studies have shown to be largely ineffective. During lectures, students tend to lose engagement and interest in the class, which may lead to poor attendance and lower grades (Bunce, Flens, and Neiles 2010; Chin and Chia 2004; Cleary-Holdforth 2007; DiCarlo 2009; Freeman et al. 2014; Gilboy, Heinerichs, and Pazzaglia 2015; Mann and Robinson 2009; Mestre 2005; Mikol 2005; Rose et al. 2006).

Flexibility

The theme flexibility suggests our activity achieved its goal of encouraging exploration and risk-taking by not limiting students to a single answer. Fostering creativity within the classroom can be an essential tool in engaging students in the learning process. Facilitating a creative learning environment provides students with the opportunity to express their opinions, hear different perspectives, and focus on their strengths and interests (DeSouza Fleith 2000; Galbraith and Jones 2012; Maksić and Spasenović 2018; Roehl, Reddy, and Shannon 2013; Tsai 2012). All these factors are suggested to increase student investment and learning (Maksić and Spasenović 2018). In addition to having creative freedom, the students appreciated the interdisciplinary aspect of the activity. By expanding their thinking beyond a single discipline, the students were able to create different hypotheses. Thus, the students were not forced towards one right or expected answer, which could stifle creativity (Amabile 1998).

Collaboration

Our activity required students to work in groups for sharing and discussing their hypotheses. This fostered a collaborative environment, which was supported by the theme collaboration, where students practiced communication skills and critically evaluated each other's ideas. The setup of our activity naturally supports collaboration as it encourages students to work together while using their individual educational backgrounds to solve the activity's problem. In doing so, students have the opportunity to learn from each other and apply their skills in a group setting. Working in a group allows students to engage in active learning, where they can have discussions, engage in debates, and generate meaningful questions (Freeman et al. 2014; Laal and Ghodsi 2012; Robinson and Schaible 1995; Vieira, Tenreiro-Vieira, and Martins 2011; Zayapragassarazan and Kumar 2012). In alignment with the literature, one student commented that the collaborative nature of our activity made them realize the benefit of perspective taking. We noticed the students' hypotheses were generated from a combination of the group's expertise. For example, those groups with students in psychology would generate hypotheses that focused on psychological disorders, and those with students in biology would focus on topics such as immunology or virology. Given this observation, it would be beneficial to diversify the student groups based on academic expertise as much as possible to facilitate interdisciplinary collaboration.

Considerations and limitations

Although a literature search was not required nor mentioned during facilitation of the activity, this emerged as a code in our qualitative analysis. One student mentioned "...we should really conduct a literature search to make sure that the ideas that we exclude are based on scientific fact rather than intuition." This quote suggests students may benefit from adding a literature search practice to our activity. Nevertheless, this unprompted response suggests our activity was successful in facilitating student reflection about the value of scientific evidence. Since this is an upper-level course, it would be interesting to see if the same or similar themes would emerge for more junior-level courses where students are beginning to learn about information literacy and literature search. Additionally, although the purpose of our visual novel activity was meant to be a starting point for discussions about science process skills, the literature search code suggests our activity can be extended into a longer project, where students are required to incorporate the scientific literature into their hypotheses. Students could submit a formal written report describing their evidence-based hypotheses, which would then be shared with the class to analyze in preparation for a session dedicated to scientific discourse. From our observations facilitating this activity, this extension may prove beneficial, as we found the debrief session to be a particularly meaningful experience. We noticed, for example, that students asked questions and challenged their peers' hypotheses. Some students noticed limitations in their own hypotheses and vocalized their preference for others. What is most remarkable about this is none of this was prompted. In future applications of this activity, we suggest that students be intentionally organized into diversified groups based on their academic expertise. This might better facilitate interdisciplinary collaboration and scientific discourse as students can learn from each other's unique backgrounds and combine their knowledge to generate hypotheses.

One limitation of the study is that the appraisal of our activity was done with a small group of upper-year students in a course focused on the development of science process skills. Thus, it is unclear if such an activity would generate a similar degree of discussion or reflection among more junior-level students (i.e., in years one or two) or in other science courses. Additionally, given the skills-based nature of our curriculum, which focused on areas such as peer collaboration and problem solving, perhaps our students were more engaged and/or more inclined to practice science process skills than students in other curricula where subject matter is the focus. Therefore, additional scaffolding may be required in more traditional curricula. Moreover, only about half the students in the course provided informed consent for their reflective assignment to be used in this study. Our data may reflect views from only those students who enjoyed the assignment, who are potentially more motivated, and/or who saw value in the activity. Nevertheless, future studies should investigate the generalizability of such an activity across different science courses, curricula, and with a larger and more diverse sample of participants.

CONCLUSION

Students often have the preconception that there is a single correct answer in science, presumably as a result of how science is often taught (i.e., didactically). The way science is taught often involves memorization of content followed by traditional assessments, such as multiple-choice tests or exams. However, this process does not accurately reflect how science functions. In science, we often do not know the answers to our questions. This activity therefore more closely resembles what scientists do compared to traditional testing. Our activity brings awareness to the fact that science is messy, often without a single correct answer, and there may be multiple explanations to a single set of observations.

The case scenario activity presented here requires only about one and a half to two hours to complete; it can be easily implemented into any science course, including those that are more content focused. Based both on our informal observations and student reflections, our visual novel appears successful at facilitating critical and creative thinking, while being engaging. We have found that this activity serves as an excellent catalyst for discussions about the scientific process, and it may be most beneficial if implemented early in the semester. Thus, we offer this simple and engaging activity for educators who wish to implement science process skills in their classrooms.

ACKNOWLEDGMENTS

We would like to thank Setuniman for graciously sharing his music pieces for our visual novel (https://freesound.org/people/Setuniman/); and all students enrolled in Science of Fictional Characters at McMaster University who participated in our visual novel activity. We would like to extend our thanks particularly to Amna Zia, Yi Yang Fei, Parmida Behnia, Sotonye Krukrubo, Madison Hunter, Hetta Patel, Raquel Melanson, Harveen Sran, Zeest Kadri, Gemini Lo, Ali Al-Humuzi, and Angel Shon for both participating and providing their many helpful comments on the visual novel activity. A big thanks to Stacey Ritz, Assistant Dean of the BHSc Program, who believed in the potential of Science of Fictional Characters.

SUPPLEMENTAL ONLINE MATERIAL

The visual novel can be played directly in a web browser at the following URL: https://hillvalley.itch.io/hill-valley.

We recommend using either Google Chrome or Firefox. The supplemental online file contains a map that accompanies the visual novel. The map depicts the fictional village of Hill Valley in which the story from the case scenario activity takes place. Students are required to refer to the map while they follow the story to generate hypotheses.

FUNDING DETAILS

There are no funding details to declare.

DISCLOSURE STATEMENT

The authors declare they have no conflicts of interest.

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APPENDIX

Story Transcript

1. Location
Hill Valley

2. Children in the village
Ray
Keith
Michelle
Sean
Rita

3. Profile of the Village
Hill Valley is a small self-sufficient village enclosed by mountains. The only method of leaving the village is by boat on the lake. The village never gets visitors, and there are no imports or exports to/from the village. The residents grow crops on the fields in the east and fish in the lake in the west.

The village has a weekly get together during which dishes made from the local fish and crops are served. Most of the children dislike the strong "fishy" scent from the fish and avoid it, generally eating only the dishes made from the crops. Flowers from the local region are used for in-building decorations and decorative pieces for outfits.

Everyone in the village gets along. The parents work collaboratively to fish and tend the crops. The children are all friends. They walk to and from school together and play in the playground after school and on their days off.

4. Events

Day 1
During the day, the children attend school for a lesson on the village's history. Bored by the lesson, the students whisper to one another, making plans for what type of game they will play at the nearby playground after school. After school, they run to the playground for a friendly game of tag.

Day 2
In the morning, the children all meet at their common meeting place for their daily walk to school, but Michelle is missing. Puzzled, the children head over to Michelle's house to find out she woke up sick with a bad cold. The children assure Michelle that they will visit once school is over. While the children are at school, Michelle is in bed sneezing and coughing. At lunchtime, Michelle's mom brings a bowl of warm soup to her room. Upon entering, she looks in horror at what Michelle is doing to her neck – Michelle's hands are covered in blood as she scratches ferociously at her neck. "Get them out, get the bugs out!" yells Michelle. Terrified and concerned, Michelle's mom holds her hands and calms her with

a lullaby. When school is over, the children visit Michelle and notice a bandage around her neck. When asked what happened, Michelle mentions she must have fallen off her bed and scraped her neck.

Day 3

Michelle has now recovered from her cold. After school, the children decide to play a game of hide-and-seek at the playground. It is Rita's turn to be the seeker. As she is counting down from 10, Ray and Keith thought it would be funny to hide somewhere away from the playground, so they venture to the benches by the lake. After Rita has found everyone (except Keith and Ray), the children begin to worry about Ray and Keith; they search and search, but cannot find them on the playground (it's not that big after all). As they walk toward Ray and Keith's house, they hear a scream by the lake and run there quickly. They see Ray holding a long tree branch pointed at Keith, shouting, "Stay away from me! Don't hurt me!" Keith sees his friends and says, "I didn't do anything! He's been shouting at me to stay away for the last 10 minutes. All I did was pick up this rock to throw in the lake." Ray continues to shout at Keith and then at all his friends to stay away. After a few minutes, Ray seems to have calmed. He put down his arms, looked at his friends, and said, "Took you long enough to find me!"

Day 4

Today is the weekly festival, which marks a two-day break from school and work. The villagers crowd within the log cabin in the town centre, as they sing and dance to music. Each family brought a homemade dish to share. Hungry, the children rush to the food. Keith scoops some of his dad's fish casserole onto his plate and devours it. Keith notices the looks of disgust on the other children's faces and says, "What? The casserole is delicious; the fish tastes so fresh! You guys should try it!" The other children reply in unison, "That's gross! No, thanks!"

Later that evening Keith and Sean decide to take a break from the festival. Keith looks at Sean and asks, "Want to hit up the swings?" "Sure," replies Sean. Keith and Sean sit on the swings and begin to go higher and faster. Moments later, Sean slips off his swing and falls with a hard thud to the ground, injuring his leg. Keith gets off the swing in an attempt to help Sean to his feet. "Don't touch me! Stay away from me! Someone help!" screams Sean. "What did I do?" Asks Keith. "Just stay away, man, stay away from me. Don't you touch me! Don't hurt me, please!" Noticing Sean and Keith are missing, the other children go on a search for them. As they near the playground, they could hear Sean's plea for help. "What's happening here? What are you doing to Sean?" Ask the children. "Nnnothing!! Sean's acting all weird," says Keith in defense. "Don't believe him. He's trying to hurt me!" Cries Sean. This back and forth went on for a moment after which Sean suddenly looks at his friends and asks, "Are you guys just going to stand here? Or are you going to help me walk? My leg freaking hurts!"

Day 5

Still off from school, the children plan to go on a picnic by the lake. Rita apologizes to her friends that she would not be able to join them; she and her family are going on a trip to the "big" city. Before she leaves, Rita helps the rest of the children pack a light breakfast for their picnic. They wave to Rita as they depart their homes and make their way to the lake.

Hungry, the children each grab an apple from the basket. As Keith chomps down on his apple, he notices looks of terror on his friends' faces. "What's wrong?" Asks Keith? "M… m… my apple is full of bugs!" Cries Michelle. "And someone's poisoned my apple!" says Sean. "Mine too!" says Ray. All the children but Keith throw their apples to the ground, accusing one another for what had happened. "Who did this? Which one of you is trying to hurt us!?" Cries Ray. Noticing that Keith is still eating his apple, they all look at Keith and point at him. "It's Keith!" yell the children. "That's nonsense. You're all my friends. I would never hurt you!" says Keith. "We need to get him before he hurts us even more!" Cry the children. Worried, Keith runs into the log cabin in the town centre and barricades the door with the chairs inside. "Come out!" yell the children as they hit the door with their fists.

Terrified, Keith sits with his back against the chair-barricaded door as he tries to reason with his friends. Roughly half an hour later, the children see Rita running toward them smiling and shouting, "Hey guys! I'm no longer going to the city. My parents said the waves are too bad." As Rita approaches her friends, she asks "Where's Keith? How come you guys are all standing by the cabin? Where's the food?" The children all accuse Keith of trying to hurt them. Behind the cabin door, the children hear Keith yelling, "Rita! Rita! They're trying to hurt me!" A few minutes later, the children reply, "What do you mean? Why are you hiding in the log cabin? We would never hurt you!" After some time, the children convince Keith to exit the log cabin. Although Keith is still wary of his friends, the other children act as if the incident never occurred.

5. Your Task

Based on the series of events from days 1 to 5, generate a hypothesis for the seemingly odd behaviours of the children.