



The Literature of Fairy Tales and Misconceptions About Concepts of Physics

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Abstract

While fairy tales and other children's literature have long been popular, they often incorporate enchantment and wonder that, while not intended to be scientific, can inadvertently foster misconceptions about important scientific themes. With its significant findings, this study aims to shed light on how traditional fairy tales may lead to a misunderstanding of scientific concepts. By identifying typical misconceptions found in fairy tales, we can better understand the need to address these issues. Doing so is crucial to support children's education and their comprehension of the world, and this study's findings will greatly inform and enlighten the field of education and literature.

Keywords

Fairy tales; children's literature; scientific concepts; misconceptions; children's education; physics; comprehension of the world

1. Introduction

Children's literature, a cornerstone of education, not only enhances literacy rates and academic achievement among elementary school students but also plays a crucial role in fostering critical thinking and social-emotional skills. It is a powerful tool for engaging students in complex social issues (Pulimeno et al., 2020), developing writing skills, and nurturing a love for reading (Sen, 2021). Literature stimulates their cognitive abilities by encouraging students to analyze the themes and characters critically. Integrating children's literature into the curriculum can significantly improve literacy outcomes and academic performance (Reynolds, 2011). Teachers have observed that students show a keen interest in discussing topics like immigration and forced relocation, which are often introduced through literature (Cave, 2010). This engagement helps build culturally responsive skills crucial for participation in a diverse society. Literature also serves as a model for effective writing, providing students with examples of ideas, organization, and voice (Paquette, 2007). Picture books inspire students to write by offering a scaffold for incorporating writing attributes into their compositions (Pérez-Gómez & Daza, 2019). This engagement enhances writing skills and supports academic and social development. As students progress, they focus more on content and audience, moving from error avoidance to meaningful communication. Teachers who emphasize these aspects in their instruction support this transformation, improving writing achievement.

While children's literature significantly impacts literacy and academic achievement, it is essential to consider teachers' challenges in integrating complex social issues into the curriculum (Hawkman et al., 2022). Overcoming these challenges requires professional development and support to build teachers' confidence and knowledge in using literature effectively (Engeser et al., 2013).

A large part of children's literature is fairy tales. Fairy tales play a significant role in children's development by providing a medium for education, moral instruction, and, most importantly, emotional expression (Birhan et al., 2020). These stories are not just a source of entertainment but a tool for holistic development, helping children

navigate complex emotions and societal norms (Petrenko & Mitina, 2020).

Fairy tales are instrumental in promoting language skills and creating a positive classroom environment. They are a valuable educational resource, enhancing students' language abilities and fostering a respectful and friendly school atmosphere (Pulimeno et al., 2020). More importantly, fairy tales provide a safe space for children to express and process emotions, especially in challenging situations like illness. Fairy tales in group settings with onco-hematological children allow them to symbolically express their pain and improve communication and interpersonal relationships, offering comfort and support in difficult times (Margherita et al., 2014).

While fairy tales are beneficial, the portrayal of villains and their punishments in fairy tales can potentially cause fear or anxiety in children. Some children may experience fear from these elements, although most find satisfaction in resolving these stories (Tsitsani et al., 2012). This highlights the need for careful selection and presentation of tales to ensure they are age-appropriate and support children's emotional well-being.

Language in children's literature, particularly fairy tales, can create misconceptions about physics concepts. These narratives often include fantastical elements that defy physical laws, potentially leading to misunderstandings in young readers. This issue is compounded by the fact that children are in a critical stage of conceptual development, where they are highly susceptible to forming misconceptions based on the stories they encounter. There are several studies on how these misconceptions arise and their implications. The Grimm Brothers' stories are filled with elements that contradict basic physics principles. For instance, characters often perform impossible feats, such as flying without physical support, leading children to develop incorrect beliefs about gravity and motion (Kotsis, 2024). Like the Grimm Brothers, Perrault's tales contain numerous scientific inaccuracies. These stories can create alternative ideas in children's minds, such as misunderstanding the nature of forces and energy (Kazantzidou & Kotsis, 2023).

Traditional fairy tales consistently present magical elements that defy scientific explanations, contributing to children's broader misunderstanding of the principles of science (Kotsis, 2023). Language plays a crucial role in shaping children's understanding of misconceptions about physics-related concepts. Misconceptions can arise from the over-application of rules and the influence of dialogue in both formal and informal settings. Engaging children in meaningful conversations can help challenge and refine their misconceptions, leading to a more accurate understanding of physics (Hast, 2023).

While fairy tales play a significant role in emotional and moral education, their fantastical elements may conflict with scientific realities, particularly in understanding physics. Although fairy tales are not intended to be scientific texts, their fantastical elements can inadvertently lead to misconceptions about physics. However, these misconceptions can be addressed with appropriate educational strategies and dialogue, allowing children to better and more accurately understand scientific principles.

This study identifies physics misconceptions in popular fairy tales and explores their potential impact on early scientific understanding. It emphasizes the importance of addressing these misconceptions in the context of children's education.

2. The most common misconceptions

While it is important to remember that fairy tales are works of fiction, they can unintentionally foster misunderstandings about the fundamental principles of science. This paper explores some of the most common misconceptions in traditional fairy tales and examines their potential implications for our understanding of science.

2.1 Instantaneous transformation

Fairy tales are renowned for their magical and fantastical elements, and one of the most common misconceptions they propagate is the notion of instantaneous transformation. This phenomenon is frequently depicted when characters like Cinderella experience radical and immediate changes in their circumstances or appearances through magical means. While this concept adds a sense of wonder and wish fulfillment to these narratives, it also challenges our understanding of biological processes, chemistry, and the laws of nature.

One of the quintessential examples of instantaneous transformation can be found in the story of Cinderella. In this tale, Cinderella, a downtrodden and poorly dressed young woman, undergoes a remarkable transformation at the hands of her fairy godmother. In an instant, her tattered clothes are replaced with a stunning ballgown, and her pumpkin carriage becomes a majestic carriage fit for a princess. This seemingly miraculous transformation occurs with the mere wave of a wand.

A classic example is the story "Jack and the Beanstalk." Jack climbs the beanstalk, which extends to the sky. This

presents some physics issues:

- *Atmospheric Pressure*: As Jack climbs higher, the atmospheric pressure decreases. At the altitude where he reaches the clouds, the lack of oxygen makes it nearly impossible for humans to survive, especially without acclimatization or supplemental oxygen.
- *Gravitational Forces*: The energy required for Jack to climb such a tall beanstalk would be immense. As he ascended, gravity would still act on him, and the higher he went, the more complex the climb would become. In reality, fatigue and energy expenditure would limit his ascent long before he reached the top.

Jack's rapid ascent into the clouds defies the principles of gravity and acceleration, leading children to misunderstand the effects of force and motion.

The portrayal of instantaneous transformation in fairy tales contradicts the fundamental principles of biology and chemistry. Biological processes such as growth, development, and healing require time and specific conditions.

An example is the story "Jack and the Beanstalk." Jack plants a magic bean, which grows overnight into a giant beanstalk that reaches the clouds. From a science perspective, this is problematic for several reasons:

- *Energy and Matter*: A plant to grow to such a massive size quickly requires enormous energy and raw material. Plants typically grow through photosynthesis, a slow process of converting sunlight, water, and carbon dioxide into energy. The rapid growth described would violate fundamental energy conservation and material sourcing principles.
- *Structural Integrity*: Even if a beanstalk could grow to such a height, the structural strength required to support the weight and height of such a plant would be immense. Natural plants have limits on size due to material strength and the need to transport water and nutrients to higher parts of the plant.

Similarly, chemical reactions involve rearranging atoms and molecules, which follow precise pathways and kinetics. These processes are governed by the laws of thermodynamics and kinetics, which dictate that transformations must obey specific rules and occur over measurable periods.

The danger in perpetuating the misconception of instantaneous transformation is that it can lead to misunderstandings among young readers or viewers, particularly in science education. When exposed to fairy tales from a young age, individuals may develop unrealistic expectations about biological, chemical, and physical changes occurring in the real world. This can hinder their grasp of scientific concepts, as they may come to believe that instant transformations are possible without considering the underlying mechanisms.

This misconception can have implications beyond science education. It may influence individuals' perceptions of self-improvement, making them less patient and more inclined to seek immediate results in various aspects of life, from personal development to career advancement.

It is important to emphasize that fairy tales are not meant to be scientific treatises; they are works of fiction designed to captivate and entertain. However, it is equally important to recognize the potential consequences of perpetuating misconceptions about the laws of nature in these stories.

To strike a balance between the magic of fairy tales and the need for scientific literacy, teachers and storytellers can take a more proactive approach. They can encourage critical thinking and curiosity about the natural world, guiding young minds to differentiate between the enchanting narratives of fiction and the factual basis of science.

In conclusion, fairy tales' portrayal of instantaneous transformation challenges our understanding of biology, chemistry, and the laws of nature. While these misconceptions charm the narratives, they can distort perceptions of reality, particularly among young audiences. By promoting scientific literacy and fostering critical thinking, we can ensure that the wonder of fairy tales coexists harmoniously with an accurate understanding of the natural world.

2.2 Communication with animals

Fairy tales frequently depict characters with extraordinary abilities to communicate effortlessly with animals. Snow White, for example, converses with forest creatures as if they were human beings. While human-animal communication is a subject of scientific study, it is far more intricate and nuanced than the straightforward portrayals in fairy tales.

In countless fairy tales, humans are presented as having the capacity to communicate fluently with animals. Snow White can summon woodland creatures to help her with household chores, and Cinderella seeks advice from her friendly mice friends. These portrayals enchant audiences, fostering a sense of wonder and interconnectedness with the natural world.

Animal communication is an intricate field of study encompassing many behaviors, signals, and mechanisms.

Scientists who study animal behavior, ethologists, and animal communication specialists dedicate their careers to understanding how different species communicate within their societies and with other species.

Animal communication involves many sensory modalities, including visual signals, vocalizations, chemical cues, and tactile interactions. These communication systems have evolved over millions of years and are often species-specific, tailored to each species' unique needs and constraints. Moreover, decoding and interpreting these signals can be challenging, as they vary in context and meaning.

The depiction of effortless human-animal communication in fairy tales can lead to misconceptions about the complexities of animal behavior and communication in the real world. It may give rise to unrealistic expectations, such as the belief that humans can effortlessly communicate with and control wild or domesticated animals without understanding their natural behaviors, instincts, and limitations.

Furthermore, this misconception may hinder efforts to study and conserve wildlife effectively. When individuals believe that communicating with animals is as simple as depicted in fairy tales, they may underestimate the necessity of careful research and observation in understanding and protecting animal species. Conservation efforts require a deep understanding of animal behavior, habitat requirements, and ecological interactions, which cannot be achieved through simplistic notions of communication.

While fairy tales are cherished for their ability to inspire wonder and imagination, it is essential to balance their enchanting narratives with the need for a realistic understanding of animal behavior and communication. Teachers and storytellers can use these tales as a starting point for discussions about the complexities of the natural world.

A classic example of a fairy tale that creates misconceptions about communication with animals is "Cinderella." In particular, the versions in which Cinderella communicates and interacts with animals, such as birds and mice, who understand her perfectly and perform complex tasks.

Encouraging scientific literacy and fostering an appreciation for the intricacies of animal behavior can help individuals develop a more nuanced and accurate understanding of their relationships with animals. By promoting respect for wildlife and emphasizing the importance of conservation efforts, we can ensure that the wonder of fairy tales coexists harmoniously with a deep and realistic appreciation for the animal kingdom.

2.3 Unrestricted magical potions

Fairy tales frequently feature magical potions and elixirs as crucial plot devices, enabling characters to heal, transform, or accomplish extraordinary feats. While these fantastical concoctions add an element of wonder and enchantment to the stories, they often lack the scientific rigor and safety protocols observed in the real world, especially in pharmaceuticals and drug development. The portrayal of these magical potions in fairy tales can inadvertently convey that creating potent substances is as simple as mixing ingredients in a cauldron. This misconception may lead to misunderstandings about the complexities and safety precautions involved in drug development and the potential dangers of using untested substances.

Magical potions have been a staple of folklore and mythology throughout history. These elixirs often possess miraculous properties, such as healing the sick, granting superhuman strength, or transforming individuals into animals or inanimate objects. In fairy tales, the creation and use of these potions are depicted as relatively straightforward, often involving the brewing of various ingredients and the recitation of incantations.

In the real world, drug development and the creation of pharmaceuticals are highly regulated and scientific processes. Developing safe and effective medications involves rigorous research, clinical trials, and adherence to strict safety standards. Scientists and researchers must thoroughly test potential drugs for efficacy and safety, considering factors such as dosage, side effects, and interactions with other medications.

Pharmaceutical companies invest significant time and resources in researching and developing new drugs, often taking many years to bring a single medication to market. This process includes pre-clinical testing in laboratories, followed by a series of clinical trials involving human subjects. Regulatory bodies, such as the U.S. Food and Drug Administration (FDA) and the European Medicines Agency (EMA), oversee and approve these drugs based on extensive scientific evidence.

The portrayal of magical potions in fairy tales as readily available, quick-fix solutions can contribute to misconceptions about the safety and efficacy of real-world medications. People exposed to such narratives may develop unrealistic expectations about the development and use of pharmaceuticals. This can lead to dangerous behaviors, such as self-medicating with untested substances or neglecting prescribed medications in favor of purported "magical" remedies.

Additionally, the oversimplification of potion-making in fairy tales may trivialize the importance of scientific research and rigorous testing. Individuals must understand that creating safe and effective medications involves a meticulous, evidence-based approach to ensuring their efficacy and safety.

To mitigate the potential harm caused by the misconception of magical potions, educators, and storytellers can use these tales to discuss the importance of scientific rigor and safety in drug development. Encouraging scientific literacy and critical thinking can help individuals distinguish between the imaginative world of fairy tales and the evidence-based practices of the real world.

A classic fairy tale that creates misconceptions about unrestricted magical potions is "Alice's Adventures in Wonderland" by Lewis Carroll, particularly the scene where Alice drinks a potion labeled "Drink Me" and instantly changes size. In Alice's Adventures in Wonderland, Alice shrinks to a fraction of her original size after drinking the mysterious potion almost immediately. This creates a misconception about how substances work in the body:

- *Speed of Reaction:* Any potion or substance consumed must undergo biological processes like digestion and absorption before it can take effect. The story suggests that a liquid can instantaneously change the body's physical characteristics, which violates basic biological principles.
- *Reversibility of Effects:* Later in the story, Alice eats a cake ("*Eat Me*") to grow larger again, implying that the effects of potions or substances can easily be reversed. In reality, once physical changes occur, such as growing or shrinking, reversing them would involve complex biological processes, not simple consumption of another substance.

In the same fairy tale, Alice experiences dramatic changes in size without experiencing any harmful side effects. This suggests that potions can alter the body without negative consequences:

- *Ignoring Biological Constraints:* In reality, extreme changes in size would drastically affect bodily functions. For example, if Alice shrank, her body's proportions, muscle strength, metabolism, and organ functionality would all be impacted. Additionally, growing too large would strain her bones and cardiovascular system, something not addressed in the story.
- *Ignoring Conservation of Mass and Energy:* The story implies that Alice can shrink or grow without concern for where the additional mass comes from or where it goes. From a physics and biology perspective, such changes would require vast amounts of energy or mass, violating the conservation of mass and energy.

By fostering an appreciation for the complexities of drug development and the importance of regulatory oversight, we can ensure that individuals make informed decisions about their health and well-being. Ultimately, the wonder and magic of fairy tales can coexist with a realistic understanding of the processes involved in pharmaceutical research and development.

2.4 Inanimate objects with sentience

Fairy tales often weave captivating narratives in which inanimate objects come to life, exhibiting human-like emotions and personalities. A classic example of this can be found in "Beauty and the Beast," where the castle's objects, such as the talking candlestick Lumière and the singing teapot Mrs. Potts, possess sentience and the ability to interact with the story's characters. While this concept adds a layer of enchantment to these tales, it challenges our understanding of consciousness and the fundamental nature of life.

The idea of objects with sentience has fascinated storytellers and audiences for centuries. In fairy tales, this concept allows for a magical world where everyday objects become characters in their own right, contributing to the plot and often providing comedic relief. These sentient objects may exhibit a range of emotions, desires, and even interpersonal relationships, blurring the lines between the living and the non-living.

A classic fairy tale that creates misconceptions about inanimate objects having sentience is "Beauty and the Beast," particularly in the depiction of objects in the Beast's enchanted castle, such as Lumière the candelabra, Cogsworth the clock, and Mrs. Potts the teapot. In Beauty and the Beast, everyday household objects like clocks, candlesticks, and teapots are portrayed as conscious, thinking beings with human-like personalities and emotions. This creates the misconception that:

- *Objects Can Have Awareness and Thought:* In reality, inanimate objects do not have consciousness, cognitive abilities, or emotions. The story anthropomorphizes these items, giving them human traits like the ability to think, feel, and communicate, which is entirely fictional.
- *Objects Can Interact with Humans:* These enchanted objects converse with humans, form relationships, and even perform tasks like serving tea or managing the castle. While this is entertaining in the story's context, it

promotes the idea that non-living objects can act with agency and interact with the world around them, which contradicts the fundamental laws of biology and physics.

In the same fairy tale, enchanted objects retain functionality despite being turned into sentient beings. For example, Mrs. Potts still holds and pours tea, and Cogsworth continues to tell time. This suggests the following misconceptions:

- *Transformation Without Physical Changes:* The story implies that inanimate objects can undergo magical transformations (gaining sentience) while retaining all their original physical properties and functions. In reality, if an object were to gain sentience somehow, it would require significant alterations to its structure (e.g., a brain or nervous system), which would likely interfere with its original purpose.
- *Dual Nature of Objects:* The idea that objects can serve both their mechanical function (as clocks, teapots, etc.) and have a conscious experience at the same time promotes a misunderstanding of how objects operate. Objects are designed for specific purposes; without biological mechanisms, they cannot be functional and sentient.

The portrayal of inanimate objects with sentience in fairy tales challenges our understanding of consciousness and life. In the real world, consciousness is a complex and highly debated topic in philosophy, neuroscience, and psychology. It remains a mystery how and why certain organisms, such as humans, possess subjective experiences, thoughts, and emotions while inanimate objects lack these attributes.

Furthermore, the concept of objects exhibiting emotions and consciousness in fairy tales may complicate discussions in scientific fields like artificial intelligence (AI) and robotics. These fields aim to create machines and algorithms that simulate human-like intelligence and emotions. While AI and robotics have made remarkable advancements, developing true sentience and consciousness remains a profound challenge that is not as easily achieved as depicted in fairy tales.

The perpetuation of the misconception of sentient objects in fairy tales may lead to confusion, particularly in discussions about the criteria for consciousness and the boundaries between the living and non-living. It can create unrealistic expectations about the capabilities of AI and robots, potentially leading to misunderstandings about the ethical implications of AI and the nature of human-machine interactions.

To address these potential misunderstandings, educators and storytellers can use fairy tales to discuss the nature of consciousness, life, and the ethical considerations surrounding AI and robotics. Encouraging critical thinking and emphasizing the distinction between fiction and reality can help individuals navigate the complexities of these topics. It is essential to foster an appreciation for the ethical challenges posed by the development of AI and robots that exhibit advanced levels of intelligence and emotional simulation. These discussions can lead to a more informed and responsible approach to AI and robotics, ensuring we continue advancing technology while respecting consciousness and life's unique attributes. Also, teachers can use interactive experiments to counter misconceptions, such as demonstrating gravity through hands-on activities after reading a story that contradicts it, ensuring students can differentiate between fictional magic and scientific reality.

In conclusion, the portrayal of inanimate objects with sentience in fairy tales adds enchantment to these stories but challenges our understanding of consciousness and life. By promoting critical thinking and ethical discussions, we can navigate the potential confusion and ethical dilemmas arising from this misconception, allowing us to appreciate the magic of fairy tales while engaging in informed and responsible debates about the future of AI and robotics.

3. Educational Implications

Children's literature, especially fairy tales, has long been cherished for its ability to transport us to magical worlds, ignite our imaginations, and impart valuable life lessons. These enchanting narratives, filled with fantastical elements, are significant in our cultural heritage. However, it is essential to recognize that fairy tales are not intended to be scientific treatises or factual accounts of the natural world. Nevertheless, the potential consequences of perpetuating misconceptions about science in these tales should not be underestimated.

Misconceptions about science concepts in fairy tales can have far-reaching implications, influencing how individuals perceive and interact with the world around them. The paper has examined several common misconceptions in fairy tales, including instantaneous transformations, communication with animals, magical potions, and sentient objects. While serving the narrative and imaginative purposes of fairy tales, these misconceptions can foster a lack of appreciation for the depth and complexity of scientific fields.

The influence of these misconceptions extends beyond the storytelling. They can shape decision-making in various aspects of life, from education to public policy. For example, misconceptions about instantaneous transformations

may lead individuals to seek quick fixes and immediate results, potentially affecting their approach to personal development and career goals. Misunderstandings about communication with animals may hinder practical wildlife conservation efforts, as they oversimplify the complexities of animal behavior.

Furthermore, the portrayal of magical potions may contribute to the rise of alternative medicine practices and the use of untested substances, potentially compromising individuals' health and well-being. Lastly, the misconception of sentient objects may impact discussions in fields like artificial intelligence and robotics, potentially leading to unrealistic expectations about these technologies' capabilities and ethical considerations. Children might assume that medicines work instantly, just like magical potions in fairy tales, so educating them on the time and safety considerations involved in drug development and treatment is crucial.

In recognizing the potential consequences of these misconceptions, it is essential to balance the magic of fairy tales and the need to promote accurate scientific understanding. Fairy tales can continue to captivate and inspire, but they can also serve as starting points for discussions about the natural world and the scientific principles that govern it.

Encouraging critical thinking and curiosity about the natural world can help mitigate the potential harm of these misconceptions. Educators, parents, and storytellers can play a pivotal role in guiding young minds to differentiate between the imaginative narratives of fiction and the evidence-based practices of science.

Educators and parents are essential in maintaining a balance between the imaginative allure of fairy tales and the necessity of precise scientific comprehension. Numerous strategies and curriculum approaches can elucidate scientific facts while maintaining the appeal of folk tales.

3.1 Promoting inquiry-based learning

Inquiry-based learning fosters students' curiosity and investigation, enabling them to question the world and investigate scientific concepts. Teachers and parents can assist children in posing inquiries after reading a fairy tale.

"Is it feasible for this to transpire in the actual world?"

"For this to occur in actual life, what modifications would be necessary?"

"What are the opinions of scientists regarding this concept?"

For instance, after reading *Beauty and the Beast*, a teacher may ask, "How do actual objects function?" Students may then investigate the mechanisms by which clocks regulate time or how teapots are designed to pour liquids. This can expand into a more comprehensive discussion regarding the distinction between an object intended to serve a specific purpose and a sentient object. Students can differentiate between the physical and imaginative worlds by contrasting actual objects with the enchanted ones in the story.

3.2 Incorporating science into narrative

Science courses may be initiated by employing fairy tales as a stimulus. Teachers can seamlessly transition from fiction to fact by incorporating lessons into the narrative. The curriculum has the potential to introduce scientific concepts through the use of fairy tale scenarios.

Specific Instructional Strategies:

- **Hands-on Experiments:** Utilize a fairy tale to introduce straightforward experiments that illustrate real-world scientific principles.
 - Plant seeds with the students and monitor their growth over time following the reading of *Jack and the Beanstalk* to demonstrate the slow growth of plants, which assimilate nutrients and sunlight.
 - Explore the concept of scaling by examining how animals such as ants perceive the world differently because of their diminutive size. This can lead to discussions about how humans diminishing or growing would impact the laws of physics and biology, as illustrated in *Alice's Adventures in Wonderland*.
- **Comparative Analysis:** Encourage students to contrast the elements of fairy tales with those of actual science. For instance, they can compare the immediate effects of a remedy in a story to the biological responses and digestive absorption of actual medications.

3.3 Using fairy tales to teach critical thinking

Fairy tales are the optimal method for cultivating critical thinking abilities. Teachers can motivate students to scrutinize the narratives and query the distinction between the conceivable and the fantastical. This can be accomplished

without diminishing the enjoyment of the narrative but rather by enhancing its profundity.

Specific Activities:

- **"Fact versus Fiction" Activity:** Following completing a fairy tale, students are permitted to generate two lists: one about events that could occur in the actual world and another entirely fantastical. For instance, in Cinderella, they could categorize "mice assisting in the sewing of a dress" as fiction and "using fabric to construct a dress" as fact. This enables students to comprehend the narrative while distinguishing between the real and the imaginary.
- **"What if?" Investigations:** Motivate students to consider hypothetical scenarios. For instance, consider the possibility of shrinking your size after reading about magical potions in Alice in Wonderland. What obstacles would you encounter? Encourage students to contemplate real-world science, physics, and biology boundaries. While allowing students to exercise their imaginations, this speculative, creative thinking reinforces real-world scientific principles.

3.4 Emphasizing STEM themes in fairy tales

There are frequently scientific inquiry kernels in fairy tales that can be emphasized. Teachers and parents can further explore STEM (Science, Technology, Engineering, and Math) themes within the stories during these moments. Examples:

- **Physics in Jack and the Beanstalk:** Examine the concept of gravity and the necessity of Jack's beanstalk's exceptional structural integrity to facilitate his ascent. This could result in straightforward teachings on structural engineering, balance, and weight.
- **Animal Communication in Cinderella:** After observing Cinderella converse with birds and mice, teachers can introduce real-world animal communication methods, such as bees' choreography to convey directions to food or dolphins' use of echolocation. This establishes a connection between the fictional events and actual biological phenomena.

3.5 Employing cross-disciplinary learning

Teachers can create cross-disciplinary courses that integrate art, science, and literature. Students can engage with the material on multiple levels by confronting fairy tales' scientific concepts and artistic aspects.

Specific Strategies:

- **Art and Science Collage:** Students are instructed to illustrate scenes from a fairy tale and subsequently identify the components of the scene that exemplify scientific principles or errors. This combines scientific learning with creativity. For example, after reading Beauty and the Beast, students may be able to create an enchanted clock and compose a description of its actual operation, which is based on gears and mechanisms rather than enchantment.
- **Story Redesign:** Encourage students to "rewrite" a portion of a fairy tale in order to improve its scientific accuracy. For instance, how could Jack construct a mechanical structure resembling a beanstalk to ascend to the heavens rather than allowing it to develop overnight?

3.6 Providing balanced perspectives

Teachers and parents can emphasize the imaginative nature of fairy tales by emphasizing that they are not intended to represent real-world facts while reading them. For younger pupils, merely acknowledging this distinction enables them to maintain a clear distinction between the enjoyment of the story and their comprehension of reality.

Specific Approaches:

- **Pre- and Post-Reading Discussions:** Prior to reading a fairy tale, it is important to emphasize that these narratives are entertaining and imaginative but not scientifically accurate. Following the reading, engage in a conversation regarding the scientific principles underlying certain fantastical elements to solidify the correct concepts. This method preserves the narrative's appeal while subtly rectifying misconceptions.
- **Utilizing Contemporary References:** Establish a connection between the concepts of fairy tales and contemporary science fiction or media. For instance, following the completion of Beauty and the Beast, you could discuss the ability of contemporary AI and robotics to make objects appear alive, such as smart speakers or robots. However, it is important to emphasize that these machines are not truly conscious but merely adhering

to programming.

3.7 Engaging with fairy tales through a scientific lens

One potential curriculum modification is implementing "science in fiction" lessons, which would require students to critically analyze prevalent motifs in fairy tales and other forms of media. Examples:

- **Chemistry vs. Magic Potions:** Compare how potions in stories such as Alice in Wonderland or Harry Potter operate instantly and produce dramatic effects versus the intricate interactions of real-world chemicals. This could result in chemistry experiments that demonstrate genuine cause-and-effect relationships.
- **Sentience and Robotics:** Use fairy tale examples such as Beauty and the Beast to initiate discussions regarding AI, robotics, and the possibility of machines being able to genuinely "think" or "feel." This is relevant to the ongoing discourse on ethics and technology.

The most effective approach to reducing the influence of misconceptions in fairy tales is to promote critical thinking and offer opportunities to investigate the boundaries between fantasy and reality enjoyably and engagingly.

4. Conclusion

In conclusion, fairy tales are integral to our cultural heritage, weaving magical narratives that capture our hearts and minds. However, it is crucial to acknowledge that they are not scientific documents, and their fantastical elements can introduce misconceptions about scientific concepts. By promoting scientific literacy, critical thinking, and an appreciation for the complexities of the natural world, we can ensure that future generations continue to enjoy the enchantment of fairy tales while embracing the wonder of scientific discovery. To balance the magic of storytelling with scientific understanding, educators should encourage children to ask questions after hearing fairy tales, promoting discussions about what is real and what is fictional in the context of scientific principles. Balancing the magic of storytelling with a firm grasp of scientific reality allows us to appreciate the richness of both worlds.

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