

# Embodiment and Affectivity in Science Education: Socio-environmental Perspectives and Implications for Biology Teaching

## ABSTRACT

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What relationships can be established from a science education based on an epistemology that values the interconnection among species and the sensitive, affective embodied experience as central elements of the educational process? Every pedagogical proposal must consider a worldview. Thus, this article aims to reflect on the conception of the human-animal being, species *Homo sapiens sapiens*, not opposed to nature, possessing a fluid body integrated with nature's cycles and embodying the world itself. This approach integrates learning about and with nature, breaking down binarisms and hierarchies among species, inspired by a fluid body connected to natural processes. In dialogue with Timothy Ingold (2010), Maurice Merleau-Ponty (2018), Silvia Federici, and Ailton Krenak (2021), we problematize dichotomies in teaching, historically rooted in colonial patriarchal systems that fragmented women's bodies and their relationship with nature. We also critique the *Base Nacional Comum Curricular* (BNCC) biology teaching model, highlighting its emphasis on rationality as the sole axis of learning. Using a qualitative and reflective methodology in an essay format, this study emphasizes affective processes in scientific knowledge construction and proposes the concept of "learning biology" as an exercise of relational awareness among self, community, and the world. The presented perspective advocates for science education that values integrated flows among body, affectivity, and nature.

**KEYWORDS:** Affectivity; Embodiment; Science education; Biology teaching. Educational processes.

# Corporeidade e afetividade na educação científica: perspectivas socioambientais e para o ensino de Biologia

## RESUMO

Que relações podem ser traçadas a partir de uma educação científica baseada em uma epistemologia que valorize a interconexão entre espécies e a experiência corpórea sensível e afetiva como elementos centrais do processo educativo? Toda proposta pedagógica precisa considerar uma visão de mundo. Diante disso, neste artigo, propomo-nos a pensar uma concepção de ser animal-humano, espécie *Homo sapiens sapiens*, que não se opõe à natureza, detentor de um corpo fluido e integrado aos ciclos da natureza e que encarne o mundo em si. Essa abordagem integra o aprendizado *sobre e com* a natureza, rompendo binarismos e hierarquizações entre as espécies e inspirando-se em um corpo fluido e conectado aos processos naturais. Em diálogo com Timothy Ingold (2010), Maurice Merleau-Ponty (2018), Silvia Federici (2017), e Ailton Krenak (2021), problematizamos dicotomias no ensino, historicamente enraizadas em sistemas patriarcais colonizadores, que fragmentaram o corpo das mulheres e a relação com a natureza. Criticamos, também, o modelo de ensino de Biologia da BNCC, destacando sua ênfase na racionalidade como único eixo do aprendizado. Com uma metodologia qualitativa e reflexiva, em formato de ensaio, o estudo ressalta os processos afetivos na construção do conhecimento científico e propõe o conceito de “aprender biologia” como um exercício de consciência relacional entre o eu, o nós e o mundo. A perspectiva apresentada visa a uma educação científica que valorize fluxos integrados entre corpo, afetividade e natureza.

**PALAVRAS-CHAVE:** Afetividade; Corporeidade; Educação científica; Ensino de Biologia. Processos educativos.

## INTRODUCTION

For years, rationality has predominated in education; however, it is known that other perspectives are necessary when considering teaching and learning. In this context, driven by the idea of a science education beyond technical rationality, we ask: what relationships can be established from a science education grounded in an epistemology that values the interconnection among species, as well as the sensitive and affective embodied experience as central elements in the educational process? Every pedagogical proposal must consider a worldview. Thus, we propose to reflect on a conception of the human-animal being that does not oppose nature, but rather possesses a fluid body integrated with nature's cycles and embodies the world itself.

Steve Alsop (2005), a researcher and educator recognized primarily for his contributions to science education focusing on the relationship between science and affectivity, argues that the preference for rationality has strongly influenced how reason has been valued to the detriment of sensory and emotional experiences that traverse us. We acknowledge that this way of thinking and doing science has enabled many scientific advances and propelled the development of technologies, theories, and discoveries that have profoundly marked contemporary society. For example, it was through this perspective that we mastered our environment, increased food production, built cities, reduced disease incidence, and extended human lifespan (Harari, 2019).

Descartes is considered the main architect of rationalism and must be essentially recognized for his ability to intertwine two worlds that until then remained separate: the physical-inorganic and the living-organic (Alsop, 2005). However, one consequence of this revolution concerns the mode of thinking, which molded itself into a perspective denying the integrality that constitutes us as beings in relation to the surrounding environment. Furthermore, this perspective also affects our perception of emotions, which, from this viewpoint, came to occupy a place apart from the body, separated and relegated to the rarefied rationalism of the mind, emphasizing reason as the primary source of human knowledge. Emotional reactions such as frustration or joy became conveniently segregated from more rationalist and biological considerations like hunger and thirst. This mechanistic heritage is found in contemporary research in science education, in reform policies, as well as in classrooms in teacher training and basic education. According to Alsop and Watts (2003), most educational materials present an impersonal view of science, while curricular prescriptions adopt a technicist, rationalist approach distant from the dimensions that traverse us, especially emotions. This supposed neutrality conception is not devoid of a way of thinking about the world. On the contrary, it is articulated within a structured and intentional format. The intentionality mentioned here does not strictly refer to neutrality as a characteristic of science, but to the deliberate choice of an educational format that reinforces existing power and market structures, prioritizing technical and rational skills valued by the capitalist system.

Alves (2019) argues that it no longer makes sense to believe that science and emotions operate in distinct spheres, considering that discussions on new teaching methodologies have gained prominence in the current scientific education scenario. Given the above, this article aims to propose an approach to

Biology teaching that overcomes some limitations of classical epistemology, promoting teaching based on learning with nature alongside learning about it, in a movement to overcome imposed binarisms and hierarchization among species.

With this approach, we seek the reconnection of Biology teaching to nature. Thus, we aim to interrelate the field of Biology with other areas of knowledge, such as Philosophy and Ecological Anthropology, to jointly and interdisciplinarily support our line of thought and discuss it based on theoretical pillars. The theoretical framework is constituted by authors from diverse fields, among them Timothy Ingold (2010), whose theory of the Education of Attention, in the field of Anthropology, proposes an approach aligned with the concept of intentionality and challenges the traditional distinctions between *Homo sapiens sapiens* and other animals; the philosopher Maurice Merleau-Ponty (2018), with the concept of embodiment, emphasizing the reciprocity of perception and revealing the intimate and inseparable relationship between subject and world; and Ailton Krenak (2021), an indigenous philosopher and activist for Earth and ancestral knowledge causes, whose ideas reinforce an organic and affective connection with the Earth.

We intend to problematize dichotomies in teaching, historically rooted in colonial patriarchal systems that fragmented women's bodies and their relationship with nature. Using a qualitative and reflective methodology in an essay format, this article highlights affective processes in the construction of scientific knowledge and proposes the concept of "learning biology" as an exercise in relational awareness among self, community, and the world. The perspective presented aims to build a science education that values integrated flows among body, affectivity, and nature.

According to Pagan (2020, p. 4),

[...] to *enjoy* is something visceral. It is not a mental thing; it passes through your entire body. Some people look at a work of art and it will awaken feelings, pleasure, ecstasy, pain, despair. Compared to other organisms, we also have these types of reactions; we also experience the process of feeling, of intuiting.

Thus, we propose to *enjoy*, as nature, relational flows, becoming aware of the encounters between self-community-world – and we call this "learning biology." We highlight that this article originates from the doctoral research of one of the authors. The ongoing doctoral thesis is linked to a broader national project entitled "Methods for Producing Data on Vulnerability and Quality of Life (Physical-Psychological, Social, and Environmental) in the Post-COVID-19 Pandemic." The project aims to develop methods to map the quality of life (physical-psychological, social, and environmental) of students from the five regions of the country, correlating it with vulnerability to the impacts of the COVID-19 pandemic, and is funded by the Coordination for the Improvement of Higher Education Personnel (CAPES).

## BIOLOGY TRACHING, THE BNCC, AND SOCIO-ENVIRONMENTAL ISSUES IN CONTEMPORARY TIMES

Biology Teaching in Contemporary Times Faces the Challenge of Addressing Increasingly Complex Socio-environmental Issues, within a Context Marked by Climate Change, Biodiversity Loss, and Deep Social Inequalities. These challenges were further intensified by the COVID-19 pandemic, first identified at the end of 2019 in Wuhan, China, which quickly became a global public health emergency. Its impacts continue to influence our lives, with repercussions across multiple spheres.

Although the pandemic reduced global pollution levels, it also highlighted existing environmental negligence and socioeconomic failures (Souza, 2020). In this context, Biology plays a fundamental role in shaping citizens capable of understanding the interconnections among health, society, and the environment. However, despite its importance, Duré et al. (2021) argue that, in the Brazilian context, Biology teaching remains based on outdated conceptions, such as rote memorization and little contextualization of content. Furthermore, according to the study by these authors, the difficulties faced by Basic Education teachers in Brazil regarding the teaching and learning process of Biology include contextualizing content to students' realities and fostering a relationship of respect and care.

Alsop and Watts (2003) state that most educational materials present an impersonal view of science, while curricular prescriptions adopt a technicist, rationalist approach distant from the dimensions and emotions that traverse us. This conception of supposed neutrality is not devoid of a worldview; on the contrary, it is articulated within a structured format based on intentionality.

Considering that schools are stages for social representations that manifest and reveal how these representations are influenced by existing societal power dynamics, we specifically reflect on the normative guidelines of the *Base Nacional Comum Curricular* (BNCC) for Biology teaching. Selles and Oliveira (2022) claim there is a growing influence of neoliberal orientations in the discipline's objectives.

Among the BNCC's effects on the Biology teaching and learning process in Basic Education is the dissolution of the discipline, which is integrated into the field of Natural Sciences and its technologies. This may threaten the stability of the discipline, with implications for teacher training, textbook production, and scientific societies dedicated to this field.

The BNCC implementation reveals a pedagogical orientation that, while including socioemotional competencies — such as empathy, collaboration, and emotional intelligence — does so from a functionalist perspective aimed at meeting labor market and capital demands. However, this approach neglects essential affective constructions related to self-knowledge, subjects' integral identities, and alterities, especially in the dimensions of body, gender, and sexuality. The silencing of these themes in schools results not only in impoverished scientific content but also in gaps in students' ethical and civic formation, compromising the understanding of fundamental issues such as respect for differences, inclusion, and ethnic diversity.

This reality highlights the need to rethink Biology teaching from a perspective that embraces embodiment and affectivity, implying recognizing the body as a means of sensitive and relational learning. An affective Biology of embodiment challenges the fragmented logic of technicist science, promoting an education that values the human being in its entirety — body, emotions, subjectivity, and interconnection with nature. According to Puhl et al. (2021), a school context that considers affectivity contributes to the development of social and emotional skills. Students learn to work in groups, respect differing opinions, and manage their own emotions, which is fundamental for collaborative learning in Science and Mathematics.

In this sense, the central question is: What relationships can be established from a science education based on an epistemology that values the interconnection among species and the sensitive and affective embodied experience as central elements of the educational process?

### **BETWEEN REASON AND AFFECT: THE PLACE OF/IN NATURE**

Regarding the Western way of life, Ailton Krenak (2021, p. 101) argues that “the natural world was formatted as a commodity and replicates this so naturally that a child raised within this logic experiences it as a total life experience.” This utilitarian and anthropocentric conception, which places human beings, *Homo sapiens sapiens*, at the center of the universe, has achieved the desired progress by devastating everything around it. We began to institute a kind of caste that, justified by its technological advances, became estranged from its own condition of being – human – animal.

The COVID-19 pandemic highlighted that the separation between humanity and nature is an illusion. The pandemic period showed us that no sophisticated system is necessary for us to be eliminated from the planet. If nature falls ill, we fall ill together. If nature is vulnerable, so are we.

The dichotomization between what it means to be *Homo sapiens sapiens* and nature has generated illnesses affecting both the biosphere in its biophysical condition and us, sensitive and complex animal beings. The colonizing mindset, ingrained in our midst, prevented us from developing the understanding that we and nature are one and the same entity.

Regarding this dissociation between human and nature, Pagan (2020, p. 6) states that “we fall ill in this lack, even though we often feel comfortable in environments like large houses with pools and resorts. However, there is a pulsating need to put one’s feet in river water, in the water of a stream, in a waterfall.” In line with this view, Krenak (2020, p. 11) says we need to experience being alive beyond the technological devices we can invent.

Perceiving the integrality and connection of all elements that compose our existence challenges us to a thought that embarks on the path of rethinking the scientific conception, transcending dichotomies and revisiting the affective processes involved in knowledge construction. According to Merleau-Ponty (2018), our understanding of nature is deeply rooted in our sensory and bodily experiences.

Furthermore, according to the author, human society is not a community of “rational spirits.” Just as we recognize the challenge of breaking away from the conception of a rigid separation between mind and body, we identify the difficulty of perceiving ourselves as part of nature and the interdependence among beings and the world we share. Maurice Merleau-Ponty (2018), the French phenomenological philosopher, addresses the issue of nature in his works *Phenomenology of Perception* (2018) and *Nature* (2000).

For this author, nature is primordial, that is, the unconstructed, the uninstituted; it is our ground—not what is before us, but what sustains us (Merleau-Ponty, 2000). He also claims that nature is not simply an object external to the subject, but inseparable from the perceptual experience of the body. We are not separate from nature or using it as an element apart from ourselves: we are nature, and it is within us.

Aligned with this view, Timothy Ingold (2010), an ecological anthropologist, challenges the traditional view that humans are separate from nature and proposes a perspective of “dwelling” in the world, rather than merely observing it from outside. This perspective suggests that learning and knowledge are deeply rooted in practice and lived experience, involving the body, movement, and the senses. One of the central concepts developed by the author — which interests us here — is the “education of attention,” which suggests that knowledge and experience emerge from the dynamic interactions between living beings and their environment.

The relationship between ecological anthropology and education is fundamental to understanding, in a practical and sensitive manner, how we engage with the world around us. Ingold’s ecological anthropology (2010) proposes that humans and the environment do not exist as separate entities, but as interconnected parts of a network of interactions. The author argues that we not only inhabit the environment but also develop and learn in constant relation to it. This understanding breaks the traditional view that learning occurs isolated within the mind, highlighting instead how practical and perceptual interactions shape knowledge.

In summary, our journey evidences the importance of recognizing the divisions that tend to shape us as subjects/subjected. This awareness intensifies as we neglect the emotional and physical elements that play a fundamental role in knowledge formation during Biology teaching and learning.

Based on Ingold (2010) and Merleau-Ponty (2018), we seek to conceive knowledge from a non-dichotomized viewpoint, shedding light on affective processes in scientific knowledge construction, overcoming the limited perspective that considers only the rational as both starting point and destination. Therefore, we propose the concept of “learning Biology,” understood as an exercise in relational awareness among self, community, and the world, aiming for a science education that integrates relational flows among body, affectivity, and nature



## **BODY AND MIND, *Homo sapiens* AND NATURE: ECOFEMINISM, BIOLOGY TEACHING, AND THE DECONSTRUCTION OF PARADIGMS**

What is the Place of the Body in Biology Teaching? Biology teaching presents the body to students as a fragmented object of study, frequently reduced to anatomy, physiology, and biological processes. According to Silva's (2014) study with teachers in Belo Horizonte (MG), based on focus group interviews, the researcher confirms that hegemonic perspectives of scientific production persist in classrooms. Moreover, the author notes that this reinforces the view of the body as a biomedicalized, functional machine, disregarding the multiplicity of dimensions constituting it, such as culture, gender, and subjectivity. This mechanistic view shapes not only the perception of the body but also normalizes identities and perpetuates social barriers, as analyzed by Santos and Silva (2019).

The modern scientific view, influenced by rationalism and patriarchy, historically marginalized the female body, as Federici (2017) argues in *Caliban and the Witch*. The author highlights how the transition from feudalism to capitalism exploited women's bodies, reducing them to tools for reproduction and labor, thus shaping the concept of the body as an object. This idea perpetuates in school curricula, where bodies are presented under biologically determined standards, neglecting issues such as gender diversity and identity. Pagan (2018) emphasizes the imposition of a binary system and the exclusion of intersex and transgender bodies, often normalized surgically even before identity formation.

Silva (2010) exposes the possible disturbances caused by notions of the body taught in Science and Biology classes, according to the understanding of high school teachers and students in Minas Gerais. The study's results demonstrate significant markers of the idea of the body conveyed in our schools. Regarding knowledge and understanding of the body, "biology, beyond normalizing individuals, distributes knowledge and thus contributes to delineating subjective territories through the selection of standards" (Silva, 2010, p. 20). This comprehension emphasizes how Biology education plays a central role in normalizing individuals and distributing knowledge.

By considering biologically determined standard models, science not only categorizes bodies but also reinforces norms that shape our perceptions of ourselves and others, classifying what is normal, deviant, healthy, or sick. According to Santos and Silva (2019), the field of Biology teaching treats existences and the bodies they mobilize from the verifiable, reinforcing a binary narrative anchored in genes, hormonal physiology, and anatomical constitution. This results in an abusive reduction and impoverishment of existence from experiences of gender and sexuality. From this perspective, Biology teaching is not limited to describing the natural world; it is strongly related to the construction of identities and social barriers, maintaining power and control dynamics.

More than a sum of physical parts—muscles, bones, and viscera—the body is influenced by the clothes and accessories that adorn it, by interventions performed on it, by the images it emanates, by machines connected to it, and by the senses that manifest within it. The conception of the body is not neutral; it is



“contaminated” by ideological influences, and in the context of human reproduction, the absence of realistic representations is associated with values and beliefs rooted in patriarchal domination, reflecting a historical tendency to homogenize representations, ignoring the ethnic and cultural diversity of society.

But at what moment did a fragmented body come to represent us? Based on the hypothesis of a body tied to a utilitarian and objectified perspective, we were inspired by the research developed by historian and feminist Silvia Federici (2004; 2017), compiled in one of her main works, *Caliban and the Witch: Women, Bodies, and Primitive Accumulation*. In this work, the author addresses the main lines of a research project developed on the role of women during the transition from feudalism to capitalism.

An important issue highlighted by Federici (2017) is the devaluation of domestic labor and the pressure toward reproductive work. In curricula, for example, there is pressure to address body, gender, and sexuality with a focus on reproduction, without discussing the exploitation of bodies, especially women's. This false neutrality colludes with the patriarchal capitalist model, which has been questioned by feminists like Federici.

Thus, Federici (2017) sheds light on social control strategies and extermination practices during the period commonly known as the “witch hunts.” In this context, the hypothesis for the emergence of the concept of the body as an object was born: a body devoid of essence, which can be explained by the exploitation of women's bodies, used as a source for producing and reproducing the most essential commodity for the capitalist accumulation process: labor power.

Such perceptions are tied to a patriarchy that marginalized women's bodies and considered the connection to the body and the relationship with nature reasons for accusations of witchcraft. The modern view, influenced by the growing valuation of reason and science, reinforced persecutions by underestimating or disqualifying these practices as superstition or heresy. Women, subjected to patriarchal control, became objects destined to fulfill needs, such as ensuring labor reproduction by caring for children, household chores, and the elderly, without economic recognition (Federici, 2017).

Thus, the woman's body is disconnected from her and comes to serve the needs of a hegemonic system that subjects her to a condition similar to other living beings. Relating this reflection to Biology teaching, traces of this legacy can be observed.

For example, the scientific maxim that associates XX chromosomes with women and XY with men remains present in our classrooms, replicated as truth by teachers who, consciously or not, reproduce the discourse of the hegemonic system. According to Pagan (2018), intersex people undergo surgical procedures soon after birth, forced to conform to a binary division even before having the chance to explore their sexual identities and orientations, along with the refusal to recognize transgender identities.

Similarly, within schools, Biology teachers, armed with textbooks and complying with a supposedly neutral curricular prescription—imposed by a teaching model that serves the capital market—are deprived of critical analysis

due to training distortions and reinforce in their classes the standardizations of a mythically rational science. The analysis of public policies from the National Textbook Program (PNLD) shows that how textbooks are developed in Brazil frequently serves market interests, contributing to standardization and limiting critical approaches in education. This dynamic reinforces a model prioritizing technical efficiency and profit, to the detriment of critical and transformative reflection in Biology classes (Pinheiro et al., 2021).

Silva (2010), in her doctoral thesis aimed at investigating the disturbances caused by the idea of the body in Science and Biology subjects, conducted a study with public school teachers and students in Minas Gerais. The results demonstrate that the human body has been analogously understood as a complex machine composed of organs and systems in physiological harmony. While this approach may respond to a thought model with its own purposes, it is possible to argue that there is no problem in it, and that there is no other way to approach the body in Science teaching. On the other hand, breaking away from this model—this is the intention—makes possible another approach (other bodies) (Silva, 2014).

Amid this exacerbated rationality, attributed to a science model rooted in a patriarchal context, we identified gaps regarding what is considered to belong to the “feminine,” such as emotions, intuitions, affectivity, sensitivity, and the relationship with the body. It is essential to recognize that these attributes are stereotypes that do not apply to all individuals. Moreover, it is necessary to consider that notions of gender are evolving toward recognition of diversity and fluidity of gender identities. In this context, ecofeminism emerges as a bridge toward building a less masculinized science.

The concept of ecofeminism was first identified in 1974 in the book *Le Féminisme ou la mort*, by Françoise d'Eaubonne (1974), a writer and activist born in 1920 in Paris. The book addressed issues related to femininity, environment, and sexuality, advocating that women should lead changes in gender thinking by incorporating ecological principles and promoting an environmental revolution to save the planet and strengthen the female role.

The ecofeminist movement advocates the fight against domination over women and nature in various aspects—historical, symbolic, spiritual, and especially political—and can thus be seen as a contextual ethics (Lessa; Galindo, 2017).

The possibility of integrating ecofeminist perspectives into scientific knowledge construction may challenge the traditional masculinization of science and promote a more equitable and sustainable approach. This involves rethinking power hierarchies, recognizing the diversity of voices and experiences. According to Pagan (2022), the same mechanisms that sustain oppression against women are used to subjugate animals. Therefore, including the feminine in science appears as a path that can positively affect women's conditions in society.

Considering learning with nature in Biology teaching beyond learning about it, the ecofeminist approach reveals itself as a possibility in constructing scientific knowledge through the rescue of emotions, intuitions, and affectivity concerning living beings. Furthermore, it simultaneously challenges hierarchical and dualistic structures that often distance science from human subjectivity and nature.

## SCIENCE EDUCATION AND EMBODIMENT: BUILDING KNOWLEDGE AND AFFECTIVITY IN CONNECTION WITH NATURE

Recalling that the guiding objective of this study seeks to propose a science education beyond rationality, recognizing the intrinsic relationship between objectivity and subjectivity, considering the conception of a human-animal being, species *Homo sapiens sapiens*, that is not opposed to nature. Therefore, in this section, we delve deeper into how to put this into practice.

Timothy Ingold (2010) mentions that cognitive science often starts from the idea that knowledge is transmitted from one generation to another through concepts and mental patterns gradually accumulated over time. Contrary to this perspective, the author developed the theory of the Education of Attention, arguing that cognitive development occurs from and during the sensory engagement of the subject with the world. It is based on the idea that learning does not occur purely through the transmission of information but through the subject's experience in their environment as a whole.

According to the anthropologist, the development of our skills happens in the world and with the world, where we affect and are affected, in a continuous relationship (Ingold, 2010). He understands human abilities as emergent properties of dynamic systems in which each generation reaches and surpasses the wisdom of its predecessors. The author concludes that the contribution each generation makes to the next, in increasing human knowledge, occurs less through an accumulated supply of representations and more through an education of attention.

The author further proposes that the process of individual learning development does not stem from innate characteristics or acquired competencies but from the awakening of skills emerging in a dynamic context of experience and environmental perception and interaction with others, that is, from an education of attention. The evolution of knowledge from one generation to another does not simply occur through transmission and enculturation, as there is no accumulation of representations, but a progression of knowledge arising from a lived experience sustained by this systemic and singular (particular) set of the individual (Ingold, 2010). This anthropological approach opens avenues for reflection on the different learning paces of each individual.

The theory of the Education of Attention justifies how connection with nature can enrich learning, considering that this process is not isolated but deeply collective. Connection with nature is a subjective bond between humans and the natural world, manifesting in various forms. Studies show that Amazonian elders present high levels of connection with nature, even in urban areas (Marques; Higuchi, 2024). Connection with nature is positively related to environmental concern and sustainability orientation in youth (Corraliza; Bethelmy, 2011).

Beyond fostering environmental preservation and conservation, it is necessary to embrace what can be called a deeper connection with nature, a movement recognizing that we are an integral part of it, not separate from it. We adopt the term "connection with nature" because we believe being connected

involves more than knowing and understanding; it is feeling, from an affective perspective of belonging.

Connection with nature has sparked research interest in various fields, especially Psychology, Ecology, Education, and Public Health, giving the theme an interdisciplinary character with different interpretative approaches. In the field of teaching and learning natural sciences, studies on the importance of affectivity in knowledge construction have advanced significantly.

According to Pagan (2017), in learning about nature, it is essential to consider the affective component if the intention is to build relations of alterity between our species and others. Another study in Biology teaching, developed by Santos (2022), supports this perspective, showing the importance of socioemotional skills in forming students' conceptions of nature in high school and how these skills influence their perception and interaction with the environment. According to the research findings, students exhibiting agreeableness showed greater affinity with nature conceptions.

In Ecopsychology, Roszak (1995) understands that the concept of connection with nature relates to the feeling of belonging and emotional relationship individuals develop with the natural environment. From this viewpoint, being emotionally connected generates caring behavior and engagement with environmental causes. Studies by Schultz (2002) and Mayer and Frantz (2004) suggest that strengthening connection with nature can be a promising path to fostering sustainable attitudes and behaviors regarding environmental issues.

Ailton Krenak (2022), in his book *Futuro Ancestral*, resorts to the verb *mundizar*, a term created by Andean thinkers to explain the possibility of affective experience between worlds, human and non-human. According to the author, "the encounter with the mountain not as an abstraction, but as a dynamic of affections, in which it is not only subject but can also initiate engagement with whoever it wishes" (Krenak, 2022, p. 83). This thought deconstructs the centrality of all existences based on the anthropocentric stance. We start, then, from the understanding that connection with nature is permeated by individual and collective dimensions. Thus, deepening studies in this construct presents itself as a path to investigate students' conceptions regarding nature.

Regarding learning, Ingold (2010) shows in his approach that the process involves observing and imitating others' actions within a network of interactions where each individual contributes to the development conditions of others.

According to the author, when a child observes an adult or peer preparing soil, sowing, or watering plants, they learn not only to perform the tasks but also to relate the interactions among the involved elements, such as soil, water, light, and development time—essential factors for plant growth. This learning does not occur as a transfer of information but as practice, with attention to the environment and collaboration with others. Caring for the garden becomes a shared experience developing skills, environmental awareness, and collective sensitivity.

At this point, we connect the thoughts of two fundamental references for underpinning our arguments: while anthropologist Timothy Ingold (2010) advocates embodied learning emerging amid interactions with the environment,

suggesting learning is deeply rooted in practice and experience, philosopher Merleau-Ponty (2018) draws attention to the body's centrality in perception, arguing that human experience is always mediated by the body, constantly interacting with the world.

According to Merleau-Ponty (2018), the perceptual experience of the subject arises from their presence as a body in the world, a being not enclosed in pure interiority. The author highlights perception as a pre-reflective, immediate process, where the body is already attuned to the environment before conscious reflection.

This perspective opens an investigative field in teaching-learning processes for pedagogical approaches that go beyond students' intellectual aspects. Recognizing embodiment as an intrinsic part of learning implies understanding that our experiences are not limited to rational cognition; they are also shaped by our bodies, emotions, and relations with the world. The philosopher encourages reflecting on how our affectivity is not restricted to an internal state but intrinsically linked to our perception and body.

A contemporary example of this theory's application in a socio-environmental context can be observed in equine therapy—a therapy involving interaction with horses used to develop social and functional skills in children and adolescents with autism. Therapy involving horses includes activities favoring eye contact, expressive language, animal care, and improvement of social behaviors (Bender et al., 2016).

Thus, Merleau-Ponty's theory manifests in practice, showing how body perception in the world and affectivity can foster learning connecting environmental, social, and emotional dimensions integrally. For example, when walking through nature, we do not merely observe the environment but feel the soil underfoot, the wind caressing the skin, and the scent of flowers in the air, translating into active participation in the surrounding space. In this experience, the body proves essential to understanding the environment's nuances.

Based on the views of Merleau-Ponty (2018) and Ingold (2010), practicing education of attention encourages slowing down, observing ourselves, our feelings, and emotions more attentively in the face of the whole that surrounds us. Moreover, it enables more meaningful engagement with the natural and social environment of which we are part, beyond passive observation, remaining open to new experiences.

Embodiment arises in this interaction where our body affects and is affected by the surrounding environment, allowing deeper and more meaningful appreciation of our place in the world. It involves feeling and perceiving oneself.

Our experience in the world is incarnated in bodies traversed by history and identity. Considering indigenous peoples and their relationship with the environment, in various indigenous cultures, the body is sacred, a temple, adorned; ancestry and its paintings carry symbolism. The own body has the power to join and synchronize with things: it secretes meaning and projects it onto its environment (Merleau-Ponty, 2018).

Being in direct contact with the surrounding nature, learning at the source, stepping on the earth, feeling plants, hearing the sounds of other species; being

in relation—and paying attention to this—can lead us on a path of self-knowledge and reconnection with other species. This may reflect in ecological balance with the whole.

Envisioning Biology teaching that incorporates affectivity from embodiment also leads us to interdisciplinary dialogue with other areas, such as Sociology, Anthropology, Philosophy, and the Arts, which go beyond mental activity by considering perceptions and the enjoyment of senses and emotions. These approaches are as legitimate as those between Biology, Mathematics, and Physics in the early years of science construction.

Art, from the Merleau-Pontian phenomenological perspective,

communicates without rules; the artist reveals to the public a personal vision of things, not describing this vision in a language governed by rules, but creating something that can awaken experience in those who desire and are capable of responding to it (Matthews, 2010, p. 186).

As an example, we can mention the work developed by the drag queen Uýra Sodoma, a hybrid entity that connects scientific knowledge and Indigenous ancestry in her performance. The biologist Emerson Munduruku, through his queer artistic interpretation, broadens the objectives of Biology teaching by educating about environmental degradation and its consequences for nature and traditional peoples. Furthermore, he incorporates elements of nature into his performance, evoking feelings and emotions in the audience.

Another reference experience is the Sensory Garden project, carried out by the Institute of Biosciences at the Federal University of Mato Grosso (UFMT), inaugurated on June 5, 2014, with the aim of promoting inclusive activities for socio-environmental education studies. The Sensory Garden allows handling of local fauna and flora species, encouraging visitors' sensory perception and experience. Currently, the space is used by UFMT's academic community in teacher training and visited by school communities (Miyazaki, 2019).

Another example related to the arts is one of Brazil's greatest literary figures, the poet Manoel de Barros, native of Mato Grosso, who drew inspiration from the Pantanal wetlands for his works. Known as "the poet of insignificances," he reveals in his writing the beauty of nature's details. The poet brings us closer to nature, diminishing the dichotomy between us and it. In one of his poems, he invites us to learn to fall like a tree leaf and accept the fall, the end, the loss, what is over. He presents the hope that other people, leaves, and seasons will come (Barros, 2006).

Given the above, we propose to consider a new perspective on Biology teaching and learning, based on a science education that integrates affective elements through embodiment; this is a thinking that can certainly be applied to other natural science disciplines. By adopting this approach, we move toward developing interconnectivity among all beings.

## SOME CONSIDERATIONS

The paths we have traveled indicate that learning biology becomes more than acquiring information; it becomes a practice of recognizing and valuing our interdependence as nature, contributing to a more humane and conscious



formation regarding the impacts of individual and collective actions on the environment.

To achieve this purpose, integrating embodiment and affectivity into teaching—recognizing the body not as an object but as the primary mediator of experiences and knowledge—proves to be a fruitful, albeit challenging, possibility.

Proposing a science education, specifically a Biology teaching that considers the construction of affective aspects from embodiment in the learning process, may seem utopian. However, as addressed in this research, we rely on theoretical frameworks that show us pathways for materializing this perspective in the field of science and life.

Among these, the ecofeminist movement emphasizes the importance of a more sensitive and empathetic approach toward living beings and the Earth itself, as well as denounces the false idea of neutrality tied to scientific rationality, which excludes the feminine from knowledge construction processes.

Returning to the theoretical foundation presented here, based on Federici (2004), it was possible to understand the origins of this distancing of the feminine and affectivity in the construction of dichotomies that strengthen reason and masculinity over affectivity and the feminine—dualities that also reflect the false separation between humans and nature.

The dialogues with thinkers Merleau-Ponty (2018) and Tim Ingold (1995) invite us to rethink dichotomies—mind-body, internal-external—and to adopt a more integrated understanding of relation in the natural world. Awareness of this legacy of distancing and disconnection is a crucial starting point. As presented here, it was significant to realize that affectivity is not secondary in our perceptual experience but plays an essential role in how we perceive and relate to the world. This challenges us to seek new paradigms in learning ourselves as nature, in a movement of self-knowledge, recognition, and reconnection with and of nature, promoting human well-being as well as the health and resilience of the entire terrestrial ecosystem.

We will continue the path traveled in this research, as although the inclusion of embodiment in constructing affective science education is a challenge, it may be a less arduous path when considering that a being disconnected from itself may suffer illnesses and chaotic results similar to those we are currently experiencing. In essence, we do not intend to exhaust the subject or formulate a definitive thought but to open pathways for teaching and learning that contribute to a deeper and compassionate understanding of the relationships among species and the world we share.

In summary, our journey manifests the need for awareness of the false, forced dichotomies that seek to constitute us as subjects/subjected beings, as we ignore the affective and bodily aspects inherent in knowledge construction in Biology teaching and learning.

Thus, we propose to flow as nature inherent to the relational flows of the natural world, becoming aware of these encounters of self-community-world; this we call “learning Biology.”



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## REFERENCES

- Alsop, S. (Ed.). (2005). *Beyond Cartesian dualism: Encountering affect in the teaching and learning of science*. Dordrecht: Kluwer Academic Publishers.
- Alsop, S., & Watts, M. (2003). Science education and affect. *International Journal of Science Education*, 25(9), 1043–1047. <https://doi.org/10.1080/0950069032000052180>
- Alves, L. R. (2019). *Afetividade na prática docente: Teoria e aplicações práticas*. São Paulo: Editora XYZ.
- Bender, D. D., & Guarany, N. R. (2016). Efeito da equoterapia no desempenho funcional de crianças e adolescentes com autismo. *Revista de Terapia Ocupacional da Universidade de São Paulo*, 27(3), 271–277.
- Brasil. Ministério da Educação. (2018). *Base Nacional Comum Curricular*. Brasília. Disponível em <http://basenacionalcomum.mec.gov.br/>
- Duré, R. C., Andrade, M. J. D., & Abílio, F. J. P. (2021). Biologia no ensino médio: concepções docentes sobre ensinar e aprender. *ACTIO*, 6(3), 1-24. <http://periodicos.utfpr.edu.br/actio>.
- Harari, Y. N. (2019). *21 lições para o século 21*. São Paulo: Companhia das Letras.
- Federici, S. (2017). *Calibã e a bruxa: Mulheres, corpos e acumulação primitiva* (Coletivo Sycorax, Trad.). São Paulo: Elefante.
- Gauthier, J., & Adad, S. (2020). A sociopoética como abordagem de pesquisa e ensino decolonial, contracolonial e libertadora. *Revista Educação Aperta*(7).
- Gomes de Lima, L., & Venturi, T. (2024). Currículo poderoso de biologia: Uma proposta de superação e emancipação intelectual, cultural e social aos estudantes de escolas públicas. *Investigações em Ensino de Ciências*, 29(1), 372–395. <https://doi.org/10.22600/1518-8795.ienci2024v29n1p372>
- Ingold, T. (1995). Humanidade e animalidade. *Revista Brasileira de Ciências Sociais* (28), 1–15.
- Ingold, T. (2010). Da transmissão de representações à educação da atenção. *Educação*, 33(1), 6–25.

- Krenak, A. (2019). *Ideias para adiar o fim do mundo*. São Paulo: Companhia das Letras.
- Krenak, A. (2022). *Futuro ancestral* (1ª ed.). São Paulo, SP: Companhia das Letras.
- Lessa, P., & Galindo, D. (2017). Relações multiespécies em rede: Feminismos, animalismos e veganismo. In *Relações multiespécies em rede* (pp. 47–99). Maringá: Editora da Universidade Estadual de Maringá (Eduem).
- Lopes, A. C. (2019). Itinerários formativos na BNCC do ensino médio: Identificações docentes e projetos de vida juvenis. *Retratos da Escola*, 13(25), 59–75.
- Nepomuceno, A. L. de O. (2017). Das tensões políticas à prática pedagógica socioambiental: Contextos da política estadual de educação ambiental (SE) (Tese de doutorado). Universidade Federal de Sergipe, São Cristóvão.
- Merleau-Ponty, M. (1942). *La structure du comportement*. Paris: Michel Letourneaux.
- Merleau-Ponty, M. (2000). *A natureza* (1ª ed.). São Paulo: Editora Martins Fontes.
- Merleau-Ponty, M. (2018). *Fenomenologia da percepção* (2ª ed.). São Paulo: Editora Martins Fontes.
- Nóbrega, T. P. da. (2010). *Fenomenologia do corpo*. São Paulo: Livraria da Física.
- Pagan, A. A. (2009). *Ser (animal) humano: Evolucionismo e criacionismo nas concepções de alguns graduandos em ciências biológicas* (Tese de doutorado). Universidade de São Paulo, São Paulo.
- Pagan, A. A. (2017). Biologia para o autoconhecimento: Algumas considerações autobiográficas. In *Anais do XI Encontro Nacional de Pesquisa em Educação em Ciências* (ENPEC), Florianópolis, SC.
- Pagan, A. A. (2018). O ser humano do ensino de biologia: Uma abordagem fundamentada no autoconhecimento. *Revista Entreideias: Educação, Cultura e Sociedade*, 7(3), 73–86.
- Pagan, A. A. (2020). *Biologia para o autoconhecimento: Um diálogo entre ciência e afeto*. São Paulo: Editora ABC.
- Pagan, A. A. (2022). Um olhar do feminino sobre a natureza: Pensando a pandemia de Covid-19. *Revista Sergipana de Educação Ambiental*, 9(2), 1–17.
- Pinheiro, R. M. de S., Echalar, A. D. L. F., & Queiroz, J. R. de O. (2021). As políticas públicas de livro didático no Brasil: Editais do PNLD de Biologia em questão. *Educar em Revista*. <https://doi.org/10.1590/0104-4060.77851>

- Puhl, C. S.; Amaral-rosa, M. P.; Lima, V. M. do R.; Ramos, M. G. (2021) Afetividade nos processos de ensino e aprendizagem: estudo de caso com professores de ciências e matemática. ACTIO, v. 6, n. 2, p. 1-19, mai/ago, Curitiba, PR. Disponível em: <https://periodicos.utfpr.edu.br/actio>. Acesso em: 20 de março de 2025.
- Ramos, S. S. (2010). *Corpo e mente*. São Paulo: Editora Martins Fontes
- Roszak, T., Gomes, M. E., & Kanner, A. D. (Eds.). (1995). *Ecopsicologia: Restaurando a terra, curando a mente*. São Francisco, CA: Sierra Club Books.
- Roszak, T. (2001). *A voz da terra: Uma exploração da ecopsicologia*. São Paulo, SP: Imprensa Fanes.
- Selles, S., & Oliveira, A. C. P. de. (2022). Ameaças à disciplina escolar Biologia no “novo” ensino médio (NEM): Atravessamentos entre BNCC e BNC-Formação. *Revista Brasileira de Pesquisa em Educação em Ciências*, 22, e40802. Disponível em <https://doi.org/10.28976/1984-2686rbpec2022u1e40802>
- Silva, E. P. de Q. (2010). *A invenção do corpo e seus abalos: Diálogos com o ensino de Biologia* (Tese de doutorado). Universidade Federal de Uberlândia, Uberlândia.
- Silva, E. P. de Q. (2014). Corpo e sexualidade: Experiências em salas de aula de ciências. *Revista Periódicus*, 1(2), 138–152.
- Santos, S. P., & Silva, E. P. de Q. (2019). Ensino de Biologia e transsexualidade. *Ensino em Re-Vista*, 26(1), 147–172. <https://doi.org/10.14393/er-v26n1a2019-7>
- Silva, L. F., & Inforsato, E. C. (2000). Algumas considerações sobre as críticas ao conhecimento científico moderno no contexto do processo educativo e a temática ambiental. *Ciência & Educação*, 6(2), 169–179.
- Silva, V. de O., Martelli, A. C., & Sandri, S. (2023). As temáticas de gênero e sexualidade na BNC-Formação. *Diversidade e Educação*, 11(1), 911–938. <https://doi.org/10.14295/de.v11i1.15228>
- Zancan Rodrigues, L., Pereira, B., & Mohr, A. (2020). Proposta para Base Nacional Comum da Formação de Professores da Educação Básica (BNCFP): Dez razões para temer e contestar a BNCFP. *Revista Brasileira de Pesquisa em Educação em Ciências*, 20, 1–39. Disponível em <https://doi.org/10.28976/1984-2686rbpec2020u1a113>

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