DOWNLOAD PDF DEVELOPING BIOLOGICAL LITERACY

Chapter 1 : Developmental Norms

Developing Biological Literacy focuses on evolution, interaction and interdependence, genetic continuity and reproduction, growth, development, and differentiation, energy, matter, and organization, and maintenance of dynamic equilibrium. Help your students understand the unifying principles and major concepts of biology, the impact of humans.

December We live in an age of scientific discovery. Science literacy strengthens opinions and decisions about science-based issues. Newspaper headlines on November 21, We live in an age of constant scientific discovery â€" a world shaped by revolutionary new technologies. Just look at your favorite newspaper. Other stories featuring exotic materials, medical advances, DNA evidence, and new drugs all deal with issues that directly affect your life. As a consumer, as a business professional, and as a citizen, you will have to form opinions about these and other science-based issues if you are to participate fully in modern society. Scientific literacy helps us understand the issues. More and more, scientific and technological issues dominate national discourse, from environmental debates on ozone depletion and acid rain, to economic threats from climate change and invasive species. Understanding these debates has become as basic as reading. All citizens need to be scientifically literate to: What is scientific literacy? Why is it important? And how can we achieve scientific literacy for all citizens? Scientific literacy, quite simply, is a mix of concepts, history, and philosophy that help you understand the scientific issues of our time. Scientific literacy means a broad understanding of basic concepts. Scientific literacy is not the specialized, jargon-filled esoteric lingo of the experts. Scientific literacy is rooted in the most general scientific principles and broad knowledge of science; the scientifically literate citizen possesses facts and vocabulary sufficient to comprehend the context of the daily news. If you can understand scientific issues in magazines and newspapers if you can tackle articles about genetic engineering or the ozone hole with the same ease that you would sports, politics, or the arts then you are scientifically literate. Using science, not doing science, is the core of scientific literacy. Admittedly, this definition of scientific literacy does not satisfy everyone. Some academics argue that science education should expose students to mathematical rigor and complex vocabulary. But my colleagues and I feel strongly that those who insist that everyone must understand science at a deep level are confusing two important but separate aspects of scientific knowledge. As in many other endeavors, doing science is obviously distinct from using science; and scientific literacy concerns only the latter. Some scientists are so focused in one area that they lack scientific literacy. Surprisingly, intense study of a particular field of science does not necessarily make one scientifically literate. I once asked a group of twenty-four Ph. I found only three colleagues who could do so, and all three of those individuals did research in areas where this knowledge was useful. The education of professional scientists is often just as narrowly focused as the education of any other group of professionals, so scientists are just as likely to be ignorant of scientific matters outside their own specialty as anyone else. Scientific literacy is often confused with technological literacy â€" the ability to deal with everyday devices such as computers and VCRs. Technological literacy is important to many pursuits in modern society, but it is distinct from my definition of scientific literacy. The scope of the problem By any measure, the average American is not scientifically literate, even with a college degree: College graduates, as well, fall short on science basics. Fully half of the seniors who filled out a scientific literacy survey could not correctly identify the difference between an atom and a molecule. Most colleges and universities have the same dirty little secret: The problem, of course, is not limited to universities. We hear over and over again about how poorly American high school and middle school students fare when compared to students in other developed countries on standardized tests. Scholars who make it their business to study such things estimate the numbers of scientifically literate Americans to be: The numbers, then, tell the same story as the anecdotes. Americans at all academic levels have not been given the basic background they may need to cope with the life they will have to lead in the twenty-first century. Why is scientific literacy important? Scientific literacy is important. Why should we care whether our citizens are scientifically literate? Why should you care about your own understanding of science? Three different arguments might convince you why it is important:

Chapter 2 : Bioliteracy Project Home Page

"In this guide, we make three major recommendations: the content of biology must be unified by the theory of evolution; biology classes must provide opportunities for students to experience science as a process and to understand science as a way of knowing; and programs should help students develop biological literacy.

PDF version Introduction Learning to talk is one of the most visible and important achievements of early childhood. In a matter of months, and without explicit teaching, toddlers move from hesitant single words to fluent sentences, and from a small vocabulary to one that is growing by six new words a day. New language tools mean new opportunities for social understanding, for learning about the world, and for sharing experiences, pleasures and needs. Subject The nature of language knowledge Language development is even more impressive when we consider the nature of what is learned. It may seem that children merely need to remember what they hear and repeat it at some later time. But as Chomsky1 pointed out so many years ago, if this were the essence of language learning, we would not be successful communicators. Verbal communication requires productivity, i. This endless novelty requires that some aspects of language knowledge be abstract. Problems and Context The debate The nature of the mental activity that underlies language learning is widely debated among child language experts. One group of theorists argues that language input merely triggers grammatical knowledge that is already genetically available. However, there are at least two areas in which there is a substantial consensus that can guide educators and policy-makers: Most children begin speaking during their second year and by age two are likely to know at least 50 words and to be combining them in short phrases. They also learn how to create, and maintain, larger language units such as conversation or narrative. Theorists differ in the emphasis and degree of determination posited for a given domain, but most would agree that each is relevant. There is a large body of research supporting the view that language learning is influenced by many aspects of human experience and capability. I will mention two findings in each area that capture the flavour of the available evidence. Longitudinal data show that aspects of this early parental language predict language scores at age nine. Auditory perceptual skills at six or 12 months of age can predict vocabulary size and syntactic complexity at 23 months of age. In English, the forms that are challenging for impaired learners are forms with reduced perceptual salience, e. Children who hear an unusually high proportion of examples of a language form learn that form faster than children who receive ordinary input. For example, children make more errors on small grammatical forms such as verb endings and prepositions in sentences with complex syntax than in sentences with simple syntax. Words that express notions of time, causality, location, size and order are correlated with mental age much more than words that simply refer to objects and events. Children who have difficulty recalling a word also know less about the objects to which the word refers. If a verb ends in â€"ing, three-year-olds will decide that it refers to an activity, such as swim, rather than to a completed change of state, such as push off. Toddlers usually decide that a new word refers to the object for which they do not already have a label. Children come to the task of language learning with perceptual mechanisms that function in a certain way and with finite attention and memory capacities. These cognitive systems will, at the least, influence what is noticed in the language input, and may well be central to the learning process. Later, they will also make use of language cues. The course of language acquisition is not, however, driven exclusively from within. The structure of the language to be learned, and the frequency with which various forms are heard, will also have an effect. Despite the theoretical debates, it seems clear that language skills reflect knowledge and capabilities in virtually every domain and should not be viewed in an insular fashion. The research evidence suggests instead that language acquisition should be treated as an important barometer of success in complex integrative tasks. Indeed, major epidemiological studies have now demonstrated that children diagnosed with specific language disorders at age four i. A Review of Verbal Behavior by B. Language learnability and language development. Harvard University Press; A connectionist perspective on development. The language development survey: A screening tool for delayed language in toddlers. Journal of Speech and Hearing Disorders ;54 4: Bates E, Goodman JC. On the inseparability of grammar and the lexicon: Evidence from acquisition, aphasia, and real-time processing. Language and Cognitive Processes ;12 The lexicon in acquisition. Cambridge University Press; Analyzing complex sentence development. Assessing language production in children: University Park Press; Allyn and Bacon; The grammatical analysis of language disability: The role of discourse novelty in early word learning. Child Development ;67 2: Hart B, Risley TR. Meaningful differencesin the everyday experience of young American children. Temporal resolution and subsequent language development. Journal of Speech and Hearing Research ;39 6: The use of morphology by children with specific language impairment: Evidence from three languages. Processes in language acquisition and disorders. Mosby Year book; Effects of imitative and conversational recasting treatment on the acquisition of grammar in children with specific language impairment and younger language-normal children. Journal of Speech and Hearing Research ;39 4: Namazi M, Johnston J. Language performance and development in SLI. Journal of Child Language ;6 3: Semantic representation and naming in young children. Journal of Speech, Language, and Hearing Research ;45 2: Carr L, Johnston J. Morphological cues to verb meaning. Applied Psycholinguistics ;22 4: Relation between mental age and vocabulary development among children with mild mental retardation. American Journal of Mental Retardation ;97 5: Young adult academic outcomes in a longitudinal sample of early identified language impaired and control children. Journal of Speech and Hearing Disorders ;52 4: How to cite this article: Factors that Influence Language Development. Rvachew S, topic ed. Encyclopedia on Early Childhood Development [online]. Accessed November 10,

Chapter 3 : ActionBioscience - promoting bioscience literacy

Language development and literacy This topic aims to help understand the close link between learning to talk and learning to read, their importance in children's intellectual development, the learning mechanisms involved and the external factors that influence them, and signs that could indicate a learning disability.

Linkedin A couple of years ago a group of students collected sushi samples from restaurants and grocery stores around New York revealing, to their astonishment, fraud in the local dining industry. Using DNA barcodes, they were able to prove that many restaurants substituted expensive delicacies with alternatives of cheaper or different origin. They were not trained biologists, but still had the confidence and enough knowledge to adapt biotechnologies to their own investigations. This new type of biological literacy has parallels with the early stages of the open source computing movement. But biological organisms do not follow the neat logic of a software programme: These factors limit the analogy with the success of open source computing; they limit the potential success of amateur biologists. So how much is DIY biology like learning to code, or really more like learning to type? DIYbio - the backyard labs DIYbio is a worldwide network of amateur biologists whose objective is ensuring there are accessible facilities for those fascinated in biology, who want to develop their interest in an open and safe setting. Setting up a grass roots biolab is not a cheap activity as these Nature estimations suggest , but this was also the case for the first commercial mainframe computers. Since then, multiple similar projects launched around the world including: More about DIYbio can be read on their website. Running a DIY lab requires a set of hardware. This amplifies small pieces of DNA for analysis, giving an opportunity for investigating selected elements of your own DNA or your yoghurt or strawberries. Another solution for backyard biolabs is the Dremel Fuge - a centrifuge, which thanks to open source hardware and 3D printing is becoming more affordable. An instrument used predominantly for educational purposes is the Spiker Box. It is a DIY tool box designed for experimenting with insects to observe how the brain works and to hear and see the electrical impulses in neurons. This TEDEd video shows how it works with a cockroach: Biohacking - experimenting with the DNA Biohacking emerged as a parallel stream of a relatively new field of science, synthetic biology - a discipline focused on combining elements of life sciences with engineering. Biohacking - like other forms of hacking - relies on advances in computer technologies which permit easy assembly and experiment with hardware in the case of biohacking, nucleotides and software elements. And it seems to create a similar sort of hype among its early adopters that computer hacking did decades earlier. The kind of Chinese whispers that this creates between imagined technologies and current science are beautifully illustrated by this blog post on how hype effects the future of science: The Prozac Yoghurt effect. In this respect biohacking is not far from the movement of the quantified self, a group of users and tool makers who share a common interest in knowledge about their bodies and use different sensing and tracking technologies to gather data about themselves. The piece described the sub-culture of disciples of the cyberpunk vision - body hackers, who decide to experiment with their bodies through augmenting into them digital devices. A pioneer of these developments is the British cyberneticist Kevin Warwick who was the first to augment electrodes into the median nerve of his hand. A short article and interview with body hackers can be read in this article. Biological literacy and citizen science Biological literacy has been fostered among the wider public through the development of citizen science research collaborations between scientists and volunteers , which in the last few years, especially thanks to the use of digital technologies considerably increased. Examples include iNaturalist , Project Noah and WildLab which are all platforms for documenting global biodiversity with the use of digital technologies. Presentations about citizen science from PopTech conferences are available here and here. A more remote, but still engaging project is the Whale Song Project , where participants help marine researchers localise and understand what whales have to say. Where is there potential to do the same thing in the UK? Could biohacking help businesses to change the way they operate too? What are the limits of this kind of literacy, and what kind of expert can we realistically become without a PhD in biochemistry?

Chapter 4 : Why is Information Literacy Important

curriculum in Tanzania supports or constrains the development of biological literacy and how institutional context, particularly as it relates to urban and rural schools, influences the delivery of the Biology curriculum.

Using this literature review, we identified skills related to two major categories of scientific literacy skills: Categories of scientific literacy skills Questions Examples of common student challenges and misconceptions I. Understand methods of inquiry that lead to scientific knowledge 1. Evaluate the validity of sources 10, 12, 17, 22, 26 Distinguish between types of sources; identify bias, authority, and reliability Inability to identify accuracy and credibility issues 3. Evaluate the use and misuse of scientific information 5, 9, 27 Recognize a valid and ethical scientific course of action and identify appropriate use of science by government, industry, and media that is free of bias and economic, and political pressure to make societal decisions Prevailing political beliefs can dictate how scientific findings are used. All sides of a controversy should be given equal weight regardless of their validity. General lack of understanding of elements of good research design. Organize, analyze, and interpret quantitative data and scientific information 5. Create graphical representations of data 15 Identify the appropriate format for the graphical representation of data given particular type of data Scatter plots show differences between groups. Scatter plots are best for representing means, because the graph shows the entire range of data. Read and interpret graphical representations of data 2, 6, 7, 18 Interpret data presented graphically to make a conclusion about study findings Difficulty in interpreting graphs Inability to match patterns of growth, e. Solve problems using quantitative skills, including probability and statistics 16, 20, 23 Calculate probabilities, percentages, and frequencies to draw a conclusion Guessing the correct answer without being able to explain basic math calculations Statements indicative of low self-efficacy: Understand and interpret basic statistics 3, 19, 24 Understand the need for statistics to quantify uncertainty in data Lack of familiarity with function of statistics and with scientific uncertainty. Statistics prove data is correct or true. Justify inferences, predictions, and conclusions based on quantitative data 21, 25, 28 Interpret data and critique experimental designs to evaluate hypotheses and recognize flaws in arguments Tendency to misinterpret or ignore graphical data when developing a hypothesis or evaluating an argument Open in a separate window Faculty Survey. Because expert agreement provides strong support for content validity, we sought to verify the consistency of the skills we articulated through our literature review with the opinions of faculty teaching Gen Ed courses. Alignment between these two sources would support the claim that we included major facets of scientific literacy, and, in addition, would provide evidence of utility for faculty beyond our own courses. To determine the degree of consistency, we designed an online survey to elicit feedback from faculty teaching Gen Ed biology courses nationwide included in the Supplemental Material. Specifically, we asked faculty to list the three most important skills for scientific literacy and to rate the importance of the skills required for students to be considered scientifically literate described in Table 2. Finally, we asked these faculty whether they currently teach and assess these skills. All three coauthors individually read and classified the survey responses into categories. Through discussion, we clarified and consolidated the categories we identified. Finally, one coauthor M. The three most important skills that faculty listed for Gen Ed biology students to demonstrate scientific literacy strongly corresponded to our TOSLS skills. Of all skills cited by faculty respondents, the most frequent responses were related to understanding the nature of science NOS; Similarly, faculty identified skills related to other aspects of NOS, with the second, third, and fourth most frequent responses closely corresponding with skill 4: Although there has been an emphasis recently on the importance of quantitative literacy, only Responses categorized as specific content knowledge accounted for more responses than any one other skill described Respondents were asked to identify the importance, on a scale from 1 unimportant to 5 very important for undergraduates in Gen Ed biology courses to develop each of the nine TOSLS skills, as well as whether they currently taught and assessed the skills Figure 1. When prompted with the skill, faculty rated the importance of teaching quantitative skills equal to that of NOS skills. All skills are described in Table 2.

Chapter 5 : MDI Biological Laboratory awarded NIH grant to promote data literacy | EurekAlert! Science Ne

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PDF version Introduction and Subject Advances in neuroimaging allow for the investigation of the neurobiological bases of language and the effects of environmental and genetic factors on neural organization for language in children. An understanding of the neurobiology of language has important implications for those seeking to optimize language development. Insights from this research may support practical, evidence-based advice for parents as well as the development of language and literacy curricula for first and second language learners. Problems A complex interaction between genetic and environmental factors produces substantial variation in rates of language development among children. Many behavioural studies illuminate the effects of environmental factors on language development; however, less is known about the neurobiological underpinnings of these effects. Most neurobiological research concerns individuals from middle and higher socioeconomic status SES backgrounds. Research Context Research on the neurobiology of language uses neuroimaging techniques with exquisite temporal resolution e. ERPs are better suited for use with infants and children, although fMRI is also used with younger populations. Increasingly, these methods are being used to characterize the developmental timecourse of different language subsystems and to more precisely examine the effects of language experience, and the timing of these effects, on the development of different language functions and on the neural mechanisms which mediate these subsystems. Key Research Questions Key research questions involve the use of neuroimaging techniques to characterize: Recent Research Results The neurobiological bases of three linguistic subsystems have been studied, specifically phonology sound system of the language , semantics vocabulary and word meanings , and syntax grammar. This research shows that brain responses to language at early ages are predictive of later language proficiency. Within the first year of life infants become increasingly sensitive to speech sound contrasts important to their native language s and insensitive to unimportant phonetic contrasts. The inverse relationship was noted for discrimination of non-native contrasts. In month-olds the brain response to known words differs from that to unknown words, with this effect broadly distributed over both the left and right hemispheres. In addition, such increased brain specialization is also associated with greater language ability in children of the same chronological age. For example, differences in the structure of left frontal brain areas important for language processing were found in five-year old children as a function of SES. In adults, specialized and efficient brain function is indexed by neural responses that originate from relatively focal brain areas whereas such responses in children may be more widespread in the brain. A brain response similar to that elicited by semantic violations in adults has been reported reliably in five-year old children, and even in children as young as 19 months. Though slower and more widely distributed, the response to syntactic violations found in children is similar to that found in adults. Selective attention is indexed by a larger brain response ERP to the attended auditory event compared with the competing auditory event. This attention effect is reduced in children diagnosed with specific language impairment27 and in typically developing children from lower SES environments. Importantly, this cognitive system is changeable with experience in young children. For example, high-intensity training was found to increase both language proficiency as well as the effects of attention on neural processing in year-olds. Additional studies with clinical populations will increase understanding of neurobiological changes that occur with different disorders. For example, see emerging research on neurobiology of stuttering. Research using these techniques with children from a wider range of SES backgrounds and other differences in early experience will lead to a more complete characterization of the developmental timecourse of language subsystems and effects of environmental factors on this development. Implications for Parents, Services and Policy This basic research can drive the development of evidence-based policies and services which improve language and other cognitive skills important for academic achievement. This is the focus of a non-profit video program produced by the University of Oregon

Brain Development Lab changingbrains. Neural substrates of language acquisition. Annual review of neuroscience ; Phonetic learning as a pathway to language: Biological sciences ; Language comprehension and cerebral specialization from 13 to 20 months. Developmental Neuropsychology ;13 3: Language acquisition and cerebral specialization in month-old infants. Journal of Cognitive Neuroscience ;5 3: Socioeconomic status predicts hemispheric specialisation of the left inferior frontal gyrus in young children. Neural correlates of socioeconomic status in the developing human brain. Family income, parental education and brain structure in children and adolescents. Socioeconomic deprivation and cortical morphology: Pakulak E, Neville H. Proficiency differences in syntactic processing of monolingual native speakers indexed by event-related potentials. Beyond the Million-Word Gap: Emergence of the neural network for reading in five-year-old beginning readers: A longitudinal fMRI study. Socioeconomic status and reading disability: Neuroanatomy and plasticity in response to intervention. Syntactically based sentence processing classes: Evidence from event-related brain potentials. Journal of Cognitive Neuroscience ;3 2: Brain systems mediating semantic and syntactic processing in deaf native signers: Maturational constraints on functional specializations for language processing: ERP and behavioral evidence in bilingual speakers. Journal of Cognitive Neuroscience ;8 3: Maturational constraints on the recruitment of early processes for syntactic processing. Neural systems mediating American sign language: Brain and Language ;57 3: Visual and auditory sentence processing: A Developmental analysis using event-related brain potentials. Developmental Neuropsychology ;8 Journal of Cognitive Neuroscience ;16 7: The neurobiology of sensory and language processing in language-impaired children. Journal of Cognitive Neuroscience ;5 2: Friedrich M, Friederici AD. Nlike semantic incongruity effect in month-olds: Journal of Cognitive Neuroscience ;16 8: Sentence processing in month-old children: An event-related potential study. An event-related brain potential study of sentence comprehension in preschoolers: Oberecker R, Friederici AD. Specific aspects of cognitive and language proficiency account for variability in neural indices of semantic and syntactic processing in children. Development of neural processes underlying language subsystems in young children from higher and lower socioeconomic status environments. Neurophysiological evidence for selective auditory attention deficits in children with specific language impairment. Brain Research ; 1: Differences in the neural mechanisms of selective attention in children from different socioeconomic backgrounds: An event-related brain potential study. Developmental Science ;12 4: Development of selective attention in preschool-age children from lower socioeconomic status backgrounds. Effects of early adversity on neural mechanisms of distractor suppression are mediated by sympathetic nervous system activity in preschool-aged children. Development Psychology ;54 9: Neural mechanisms of selective auditory attention are enhanced by computerized training: Electrophysiological evidence from language-impaired and typically developing children. Brain Research Family-based training program improves brain function, cognition, and behavior in lower socioeconomic status preschoolers. Atypical syntactic processing in individuals who stutter: Evidence from event-related brain potentials and behavioral measures. Hampton A, Weber-Fox C. Non-linguistic auditory processing in stuttering: Neural indices of semantic processing in early childhood distinguish eventual stuttering persistence and recovery. Journal of Speech, Language, and Hearing Research ;60 How to cite this article: Pakulak E, Hampton Wray A. Biological Bases of Language Development. Rvachew S, topic ed. Encyclopedia on Early Childhood Development [online]. Accessed November 10,

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Chapter 6 : Language development and literacy: Biological basis | Encyclopedia on Early Childhood Develo

The term "development" refers to age-related changes in our characteristics and capacities. Developmental norms refers to typical characteristics or patterns of development at any given age. Thus, we may study the development of many different types of characteristics. There is now consensus among developmental psychologists i. We humans are genetically programmed to change over time. As a species, humans mature in specific, characteristic, and predictable ways. In many ways, the patterns and characteristics of human growth are highly similar across members of diverse cultures. Regardless of whether a person is born in Nigeria or the U. And the general patterns of growth are the same across all cultures, from conception through old age. And spritual development consists in age related improvements in our abilities to appreciate and comply with whatever spiritual forces one happens to believe in. We may differ in how fast or tall we grow, but not in how we grow. We may have different body types and personalities, but we have similar biological and emotional needs. This important property of human development enables researchers to identify benchmarks of development. These benchmarks are signs that a person has reached a particular point in development, e. It is because of this regularity of growth that many pediatritians will begin routine examinations of chidren by measuring their height and weight. But what do we mean by normal here? In this case, normal means average, or what is typical. It is possible to get from your doctor a chart showing the typical height and weight of children at different ages An important question to ask here is how does your child compare to these averages. In other words, a child who is developing in a way that deviates from normal e. A percentile is the percentage of people who get an equal or lower score than any given score. Often, though not always, this may be a sign that something is wrong. In that case, we may not need to be concerned. On the other hand, if it turns out that this child is malnourished we may need to change the way that child is being treated. So, the general rule is that whenever something about our child is far from normal we should try to understand why. Heredity Heredity is relevant to human development because it provides biological capacities and limitations. Heredity provides the body with specific characteristics. It provides organs and limbs, and all the abilities these enable. It also provides a blue print for the way your child grows up. And it provides a personality, along with reflexes and mental abilities. The abilities of the individual are generally compatible with the abilities of the species. Through heredity, the species general and parent specific capabilities are passed on from one generation to the next. That is, from us to our children. The biological and inherited capacities, and limitations, of the parents are passed on to their children through genes. Current estimates are that each of us possesses between 26,, genes. This means that in some ways your child is like you and in other ways like their other parent. They may or may not have the same personality that you do. They may or may not behave the way you do. And they may or may or may not like the same things you do. They are each a unique, distinctive, individual. Part of the joy and challenge of parenting lies in working with your child to discover their unique qualities and in helping them make the most of those qualities. Most children grow in average ways. Most children are not exactly normal in everything, but are close. Biology does not control what we do in a specific way, but it does influence everything we do in general ways. We also influence our environment. The ideal is when the characteristics and capacities of the child match the demands and resources provided by their environment. This makes it imperative for caregivers to be aware of, and responsive to, the needs of their child. For instance, a caregiver who discovers that their child is hungry and does not do their best to satisfy that need is insufficiently responsive to that needs. In extreme cases representatives of a governement agency may remove that child from that home. Part of the challenge is that children have a lot of different needs e. It is sometimes difficult to know what is going on. The answer is that the environment works with heredity but exerts a powerful influence. For instance, millions of children living in impoverished environments around the world are starving to death. So, there is an interaction between heredity and experience in the environment. Another way of saying this is that our development depends on the interaction between nature and nurture, where nature refers to our inherited genetic characteristics, and nurtrue refers to our experiences. The concept of reaction range refers to the extent to which any given biological trait may be altered by experience. More specifically, it is defined as the range of possible variation for any specific inherited biological trait. An example of this interaction was found by Iverson. Iverson studied the effects of environment on height. He monitored the growth of three groups of Japanese children from the end of World War II until they reached adulthood, i. Lower class Japanese children 2. Middle class Japanese children 3. Japanese children who grew up in the United States He found that the lower class children were the shortest of all. The middle class children were average height for Japanese people. The children who grew up in the United States were the tallest of all, yet shorter than the average American. This pattern of results is most likely due to the influence of environment, especially diet. A child with average genes for height who is raised in an average environment will grow up to have average height. A child with average genes for height who is raised in an impoverished environment will grow up to have below average height. And a child with average genes for height who is raised in an enriched environment will grow up to have above average height. So, biology sets broad limits and experience determines the specific outcome. The same is true of psychological characteristics, like intelligence or kindness. It is also important to keep in mind that we rarely know for sure what those biological limits are. So, the key question then becomes, how can we structure the environment to yield optimal child outcomes? What experiences can we give our children to enable them to become the kind of people we want them to be? This comes back to the first serious question I asked you, i. Age From the developmental perspective, the single most important thing to know about a person is their age. It provides a rough estimate of the intersection between heredity and experience. Thus, all five year olds have bodies that have been maturing for five years and have five years of experience in dealing with their environment. An infant has different physical and mental abilities than a nine year old child. The inability of a typical two year old child to catch a ball in the air is correlated with the maturation of their brain and a relative lack of experience in catching balls. You may find a list of milestones for each age between the prenatal period and 18 years of age at this site by clicking here. The things children are capable of doing at any given age are constantly surprising scientists. Sensitive parents sometimes detect skills in their children that exceed what is normal. However, proud parents also often think they detect skills in their children that exceed what is normal. What is a reaction range? A reaction range is the range of possible variation for any specific inherited biological trait. Psychologists interpret the word normal to mean what is typical. To say that children normally begin to speak in two word sentences at about two years of age means that most children start to do so at this age. It is understood by psychologists that there is a wide range of ages at which different children do different things. Most children are average in some areas, above average in other areas, and below average in still other areas. Why is it important for me to know what is normal at any given age? It is important to know what is normal because a child who differs significantly from normal i. How far away from normal does my child have to be before I should become concerned? There is no precise answer to this question. In general, the further away children are from their age norms the more reason there is for concern.

Chapter 7 : Biological literacy | Nesta

Traces the development of a teaching strategy, consisting of a model for bioethical decision making and related case studies, that addresses the value/moral/ethical concerns associated with the application of new biological knowledge. Discusses the implementation of this approach with college.

What is your definition of scientific literacy? Asking questions is at the root of scientific literacy. For me the definition of scientific literacy is being able to look at an article in a newspaper or in a magazine or listen to commentary on a newscast or on TV and be able to understand what is being talked about and also being able to be skeptical. Does that definition also apply to fostering scientific literacy in the classroom? Asking questions is basic to scientific literacy. I think it does. One of the most important skills that we can teach our students is how to ask a question, which is really at the root of scientific literacy. Why does this plant grow here and not there? Those are the kinds of questions that you want to get students asking at the very earliest age, and in fact, there is no dumb question. What school projects would you suggest to promote scientific literacy? Observation exercises promote inquiry. I get asked to go out to elementary and middle schools all the time to talk with students about science and also about the kind of science I do, which is ecology. When you actually get down on your hands and knees and you peer at the ground, you start to see little things going on, like tiny insects and little plants. From that , the questions just followâ€¦ I have never not seen that happen. Dink around first, make observations, and then your curiosity is peaked. That is the start of scienceâ€”at least that is the start of the type of scientific research that I do. Are there assessment strategies to evaluate student scientific literacy? Assessment is one of those final frontiers in a way, and I get asked that question a lot. Assessment is an interesting process and I like to think of assessment in two ways: Assessment is a map of the process. But as a scientist, if you really want to model science, I think assessment is a map of the process. Where did you start? What got you interested in the question? What tools did you bring to bear on figuring out how to do a fair test to answer that question? At the University we might call that an experiment, but what were those tools? How did you use the tools? What kind of evidence did you collect? How did you make sense of the evidence?. It evaluates habits of mind. So much of what we can do with in assessment can be in evaluating those habits of mind that people develop to be able to ask questions and figure out on their own how to answer them. I would urge people to look at those habits of mind, and see how people are posing and answering questions. It takes a little longer to do this, but when we assess we are fundamentally connecting all of teaching with student learning, and frankly, that is what it is all about! I think you have to use lots of different assessment choices. I teach large classes at the University of Montana, where you have to use multiple choice exams, but I also think that it is important to talk to my students and to quiz them verbally to see how they respond and how they are thinking. Having students write and reflect on what they think they are learning is also an important part of the assessment process. Is there a teaching model you recommend that promotes inquiry? The 5E model is good methodology. I am firmly rooted in the school of having people learn by doing and that is what the 5E model is all about and it works well. I am sort of embarrassed to say that I made it nearly all of the way through my PhD without knowing much about this model. I think we learn best by doing, and that is why I think it is so important, at least in my field, to get people outdoors and just stimulate their curiosity about what they see. Inquiry fosters life-long learning. Sometimes when you set up learning that way, students may come away with misconceptions. I think that really models what we need to be doing for developing life-long learning. We need to go out, we need to practice with our hands; we need to see with our eyes and hear with our ears; we really need to use all of our senses to gather information so our intellect is engaged in figuring out what all of that information means. Everyone can do that. Does the biology curriculum as practiced today do enough to improve science literacy? Textbooks may not cover relevant current issues. I will go out on a limb on this! I am a professional biologist who does biologic research and teaching for a living. When I started college in the s, I had a textbook that was about three quarters of an inch thick and it weighed about 3 pounds. When I started teaching intro biology in , I had a textbook that must have been 3. That book was just a distillation, just a cross cut, through the fact-based knowledge that some publisher thought was important to include. If you look at all of the journals that report on biology, how on earth could we pick a particular subset to say this is what you should know about biology? My biggest concern today, especially with the accountability movement as it is, is that we are picking certain kinds of facts that have a historical tradition and that certainly provide some important foundation for biology understanding, but frequently they may not point to the future. That is really troubling to me as a scientist. As an educator, I am concerned we are implying that if you can do well at a certain level of these fact-based multiple-choice assessments, then you have some sort of mastery of biology. I would argue that it gives the wrong impression about knowledge and about life-long learning. Some teachers struggle with teaching inquiry. I am troubled by how we are teaching biology today and I am worried about this because of what teachers are telling me on a very regular basis. They say that they are having trouble teaching about inquiry. They are having trouble giving students the time to ask and answer their own questions because they are studying for a test. That is the opposite of what a life in science is. Many years ago, I read this great anecdote, and I wish I could remember who said it, that we are starting to teach biology almost like teaching a crazy way to play baseball. For the first few years you let children touch the bat and the mitt. That would be like having your first pickup baseball game when you are already in your late 20s! That is a crazy way to teach people baseball, and it is a crazy way to teach people biology. The biology that we teach is the same for all students, regardless if they go on to major in the subject. Do you see that as a problem? My colleagues and I at the University of Montana have talked about this a lot. Some students, especially at the freshman levelâ€”whether they are adult reentry or students fresh out of high schoolâ€"come into my intro biology course with a biology major in mind. Others come to the class as non majors. But everybody in that class needs to be excited about the study of life, whether they are eventually going to be apprenticed into the fields of biology, or whether they are going to be captains of industry. In fact, maybe the captains of industry are our most important biology students. Non-traditional reading material appeals to all kinds of students. Many years ago, I decided that instead of using a very traditional biology textbookâ€"you know the 7 lb varietyâ€"I decided I was going to use a totally different approach to teach intro biology, and so I selected a book written by Pulitzer Prize author Edward Wilson titled Diversity of Life and that was our textbook. I made it clear to the students that there were going to be concepts in that book that needed to be explored using a traditional textbook or the Web or some other resource to fully understand them. My students, whether they were going to become biologists or not, were fascinated by a magical story that is full of discovery and questions yet to be answered vs. Educators have permission to reprint articles for classroom use; other users, please contact editor actionbioscience. The core philosophy of my research program is that acquisition of knowledge alone will not be sufficient for improving scientific literacy unless such knowledge is disseminated and applied effectively. Brewer was interviewed at the AIBS annual meeting.