Forensic and Wildlife Tracking
Definitions of Key Terms

March 11, 2018

NOTE: You will NOT be tested on these terms. I may reference them in class, but you are not expected to use them. Please do not be intimidated by the quantity or scientific nature of some of these terms. They are solely to illustrate and inform the scientific basis upon which the art of tracking is performed which is essential if tracking is to be incorporated in an academic or forensic investigation. Each term has been tagged with its applicable course number(s). Thus, searching this document by a specific course number in the box at right will locate each applicable term for that course.

Course Key:

013	Intro to Wildlife Tracking
014	Wildlife Trail Analysis
015	Wildlife Track Analysis
195c	Tracking Wildlife Corridors
195w	Winter Tracking Specialty

1. **Abductive Reasoning:** Abduction, or inference [86] -to-the-best-explanation, is a method of reasoning in which one chooses the hypothesis that would, if true, best explain the relevant evidence. Abductive reasoning starts from a set of accepted facts and infers most likely, or best, explanations. [Note: Abduction is about determining the *precondition;* induction is about determining the *rule;* and deduction is about determining the *conclusion*.][1] (013, 014, 015, 195c, 195w)
2. **Adaptive Behavior (Ecology):** In behavioral ecology, an adaptive behavior is a behavior which contributes directly or indirectly to an individual's survival or reproductive success and is thus subject to the forces of natural selection.[2] (195c)
3. **Adaptive Responses:** When the internal dynamics of a system cause it to respond to a perturbation (i.e. disturbance) by some external factor.[3] (014, 195c)
4. **Animal Locomotion:** The series of movements based upon the animal's anatomical structure that are employed to move from one place to another. (014, 195c)
5. **Appraise:** To evaluate the worth, significance, or status of; *especially* : to give an expert judgment of the value or merit of.[4] (013, 014, 015, 195c, 195w)
6. **Argumentative (mode of discourse):** One of the four modes of discourse (see also Narrative [118], Descriptive [46], Expository [65]). The argumentative mode requires the investigation of a topic including the collection, generation and evaluation of evidence; and establishing a position on the topic in a concise manner.[5] (195w)
7. **Arrhythmic:** Lacking rhythm or regularity.[6] (013)
8. **Asymmetrical:** Not symmetrical [170].[7] Having the property of remaining variant under certain changes.[8] (013)
9. **Atterberg Limits (of soil):** The points at which a soil's behavior changes from that of a solid, to a semi-solid, to a plastic, and to a liquid based upon variations in its moisture (i.e. water) content. Atterberg's 'limits' are the parameters at which changes to the water content in the soil changes the behavior of the soil from one classification to another.[9] (015)
10. **Attributes:** A quality, character, or characteristic ascribed to someone or something.[10] (013, 014, 015, 195c, 195w)
11. **Base of Support (BOS):** The area (of the foot or feet) that is in contact with the ground.[11] (015)

12. **Baseline:** A usually initial set of critical observations or data used for comparison or as a control.[12] (013, 014, 015, 195c, 195w)
13. **Bedrock Geology:** Refers to the origin and composition of the rock that underlies all soil and vegetation.[13] (195c)
14. **Biomechanics:** The study of the structure and function of biological systems such as humans, animals, plants, organs, fungi, and cells by means of the methods of mechanics. Biomechanics is closely related to engineering, because it often uses traditional engineering sciences to analyze biological systems. Some simple applications of Newtonian mechanics and/or materials sciences can supply correct approximations to the mechanics of many biological systems. Applied mechanics, most notably mechanical engineering disciplines such as continuum mechanics, mechanism analysis, structural analysis, kinematics and dynamics play prominent roles in the study of biomechanics.[14] (015)
15. **Bottom-Up Attention:** See Stimulus-Driven Attention. [163]
16. **Choreograph(ing):** Arranging or directing the movements, progress, or details of elements in a manner representative of telling a story.[15] (195w)
17. **Circuit:** A course around a periphery; a circuitous or indirect route; a regular tour around an assigned district or territory.[16] (013)
18. **Cognitive map:** A mental representation of physical space.[17] (015)
19. **Cognitive perspective:** The perspective on psychology that stresses human thought and the processes of knowing, such as attending, thinking, remembering, expecting, solving problems, fantasizing, and consciousness.[18] (013, 015, 195w)
20. **Cognitive processes:** Higher mental processes, such as perception, memory, language, problem solving, and abstract thinking.[19] (013)
21. **Cognitive psychology:** The *study* of higher mental processes such as attention, language use, memory, perception, problem solving, and thinking.[20] (013)
22. **Cognitive science:** The *interdisciplinary field* of study concerning the approach, systems and processes that manipulate information.[21] (013, 195w)
23. **Collective unconscious:** The part of an individual's unconscious that is inherited, evolutionarily developed, and common to all members of the species.[22] (013, 195w)
24. **Complex (Adaptive) Systems:** Complexity in systems arises from interactions among components that lead to non-linear behavior that can't be predicted by studying parts individually. Taking this a step further, in complex adaptive systems (CAS), the system components are related in such a way that the system as a whole has the ability to adjust or even fundamentally alter the connections and interactions among components, and even the components themselves, based on experience with, pressure from, or even sometimes anticipation of, external forces.[23] (195c, 195w)
25. **(Track) Compression:** A tracking term describing the overall surface area that remains depressed by pressure applied by the foot during contact with the substrate[167].[24] Geotechnical Engineering [75] refers to this dynamic as the 'total settlement' of the soil and the resultant shape of the compressed material as its 'settlement profile'[146].[25] The magnitude of the contact settlement, i.e. the degree to which the compression's features are 'muffled' or 'sharply defined', depends upon the (flexible) properties of the form that is imparting the force (i.e. the foot) and the substrate itself[26] (e.g. clay vs. dry sand). (013)

26. **Concentrics:** The propagation of force throughout the material encompassing the foot[27], similar to that which takes place when a pebble drops into water, based upon the scientific principles of Continuum Mechanics, notably linear and soil elasticity [153], the mechanics of deformable solids, and effective stress at depth [152]. (013)
27. **Concept:** A concept is a mental abstraction which allows generalization and the extension of knowledge from some known objects to others unknown.[28] (013, 015)
28. **Concurrent Validity:** The degree to which the story corresponds to an external criterion that is known concurrently (i.e. occurring at the same time). If the story is validated by a comparison with a currently existing criterion, there is concurrent validity. Adapted from McLeod, 2013.[29] See Construct [35], Face [68], Predictive [133], Internal [93] and External [67] Validities. (015, 195w)
29. **Confirm:** To make firm or firmer, strengthen, i.e. *confirm* one's resolve.[30] (015, 195w)
30. **Connecting Habitat:** Land that links larger patches of habitat within a landscape, allowing the movement, migration, and dispersal of animals and plants. Also, commonly referred to as a 'corridor'.[31] See Wildlife Corridor [179]. (195c)
31. **Consciousness:** The quality or state of being aware especially of something within oneself; the state or fact of being conscious of an external object, state, or fact.[32] (013, 014, 015, 195c, 195w)
32. **Conservation of Energy (Law of):** The conservation of energy is a fundamental concept of physics along with the conservation of mass and the conservation of momentum. Within some problem domain, the amount of energy remains constant and energy is neither created nor destroyed. Energy can be converted from one form to another (potential energy can be converted to kinetic energy) but the total energy within the domain remains fixed.[33] (013, 015)
33. **Constraint:** The state of being checked, restricted, or compelled to avoid or perform some action; a constraining condition, agency, or force; a check.[34] (013, 014, 015, 195c, 195w)
34. **Constraints of Movement:** The three 'constraints' of movement are: 1) the characteristics of the individual; 2) the task they are trying to perform; and 3) the environment in which they are trying to perform it. The organization of movement is said to be constrained by factors within the individual, the task, and the environment, i.e. in abbreviated notation, I+T+E=M.[35] (014, 015)
35. **Construct Validity:** Construct validity entails demonstrating the power of the tracker's story to explain a network of findings and to predict further relationships. The more evidence a tracker can demonstrate for a story's construct validity the better. However, there is no single method of determining the construct validity. Adapted from McLeod, 2013.[36] See Concurrent [28], Face [68], Predictive [133], Internal [93] and External [67] Validities. (015, 195w)
36. **Contemplative Inquiry: "**Contemplative inquiry is a set of practices that allow first person understanding regarding our inner dynamics in relation to the world, i.e. what beliefs and values we have and the ways in which we connect and relate with our world. Contemplative inquiry allows for that understanding to be deep and critical at the same time."[37] (195w)

37. **Contiguous Forest:** Contiguous forest habitat is an area of forested land with either no roads or low densities of class III or IV roads and little or no human development (buildings, parking areas, lawns, gravel pits).[38] (195c)
38. **Contour:** The general form or structure of something : characteristic —often used in plural, e.g. the *contours* of a melody.[39] (013, 014, 015, 195c, 195w)
39. **Correlate (correlation):** To present or set forth so as to show relationship.[40] (015, 195w)
40. **Corridor:** Land that links larger patches of habitat within a landscape, allowing the movement, migration, and dispersal of animals and plants; also, commonly referred to as a 'connecting habitat.[41] See Wildlife Corridor [179]. (195c)
41. **Corroborate (corroboration):** To support with evidence or authority; to make more certain.[42] (015, 195w)
42. **Cycle:** A course or series of events or operations that recur regularly and usually lead back to the starting point.[43] (015, 195w)
43. **Deductive Reasoning (Deduction):** Deductive reasoning is a basic form of valid reasoning. Deductive reasoning, or deduction, starts out with a general statement, or hypothesis, and examines the possibilities to reach a specific, logical conclusion (i.e. its inferences are based on generally accepted theories instead of observations). The scientific method uses deduction to test hypotheses and theories. Thus, for deductive reasoning to be sound, the hypothesis or theory it is based upon must be correct.[44] Deductive reasoning happens when a researcher works from the more general information to the more specific. Sometimes this is called the "top-down" approach because the researcher starts at the top with a very broad spectrum of information and they work their way down to a specific conclusion.[45] In deductive reasoning, if something is true of a class of things in general, it is also true for all members of that class. (For example, "All men are mortal. Harold is a man. Therefore, Harold is mortal." For deductive reasoning to be sound, the hypothesis must be correct. It is assumed that the premises, "All men are mortal" and "Harold is a man" are true. Therefore, the conclusion is logical and true.[46]) Deductive reasoning underpins the famous quote by Sir Arthur Conan Doyle's character, Sherlock Holmes, "When you have eliminated the impossible, whatever remains, *however improbable*, must be the truth."[47] Deductive reasoning is flawed/abused when we pre-judge someone based on a particular 'class/label' that we assign them, e.g. age, race, gender, nationality, etc. [Note: Abduction [1] is about determining the *precondition;* induction [85] is about determining the *rule;* and deduction is about determining the *conclusion.*[48]] (013, 014, 015, 195c, 195w)
44. **Deep Listening:** A practice associated with contemplative inquiry that aspires to objectively (visual and non-visual) receive what is happening within and around the person without them trying to control it or judge it.[49] (195w)
45. **(The) Degrees of Freedom Problem:** The term used to express the multitude of ways in which a movement *can* be performed; making the *choice* among multiple equivalent solutions; and, then, coordinating the many muscles and joints involved.[50] This is analogous and applicable to the many locations in which to find a track or trail of a given species (i.e. the remnants of their chosen motion) based upon the tracker's understanding of the parameters underpinning the evolution of the species locomotive apparatus and overlaying these locomotive preferences upon the topographical features of the landscape. (014, 015, 195c)

46. **Descriptive (mode of discourse):** One of the four modes of discourse (see also Narrative [118], Argumentative [6], Expository [65]), requiring the conveyance of the texture of an experience. In other words, in a descriptive essay your description of your subject (an emotion, a scene, a conversation, etc.) should get your reader as close as possible to experiencing that subject (to feeling that emotion, watching that scene, overhearing that conversation, etc.)[51] A great deal of artistic freedom is allowed in the descriptive mode of discourse.[52] (195w)
47. **Designate (designation):** To indicate and set apart for a specific purpose; to point out the location of a marker; to distinguish in re: assign to a class.[53] (013, 014, 015, 195c, 195w)
48. **Disturbance:** A force imparted through a form that is greater than the constraints of the baseline upon which it has been imparted. (013, 015)
49. **Disturbance-to-a-Baseline:** The operational definition of a track.[54] A soil specimen will be remolded when it is subjected to some degree of disturbance.[55] It denotes any anomaly within the normative environment. See Disturbance [48]. (013, 014, 015, 195c, 195w)
50. **Dynamic Systems Theory of Motor Control:** A systems theory whereby movement is seen as an emergent property that emerges from the interaction of multiple elements that self-organize based on certain dynamic properties of the elements, themselves. The elements whose confluence of dynamic properties influence movement are: the individual, the task, and the environment in which the task is being performed.[56] (014, 015)
51. **Duty Factor:** The percentage of time a foot is on the ground over the duration of the stride.[57] (014)
52. **Ecological Conscience:** The upshot of a land ethic. See Land Ethic [99] by Aldo Leopold. (013, 195c)
53. **Ecological Stoichiometry:** Ecological stoichiometry seeks to discover how the chemical content of organisms shapes their ecology, including how the balance of energy and elements affects, and is affected by, organisms and their interactions in ecosystems.[58] Ecological stoichiometry primarily asks: 1) why do elemental imbalances arise in nature? 2) how is consumer physiology and life-history affected by elemental imbalances? And 3) what are the subsequent effects on ecosystem processes?[59] (014, 195c)
54. **Ecological Theory of Motor Control:** The theory of movement focusing on how a creature's movement is dependent upon, i.e. controlled by, its perception of environmental factors important to its task. The organization of its movement is specific to the task and the environment in which the task is being performed.[60] (014, 015, 195c, 195w)
55. **Ecotone:** A transition area between two biomes. It is where two communities meet and integrate. It may be narrow or wide, and it may be local (the zone between a field and forest) or regional (the transition between forest and grassland ecosystems). An ecotone may appear on the ground as a gradual blending of the two communities across a broad area, or it may manifest itself as a sharp boundary line.[61] (195c, 195w)
56. **Edge Effect:** (also Edge Influence) The change in composition, structure, or function of the forest near its edge, as a result of influences from the adjacent development or land use (Harris 1984; Harper et al. 2005). Edge effects also occur in natural settings between two very different habitats or natural communities (such as lake shoreline and adjacent forest).[62] (195c)

57. **Elastic Strain Energy:** The energy within an elastic medium when it is stretched or compressed. Muscles, tendons, and elements of the skeletal system to which muscles attach have elastic properties that allow them to store energy in this manner, principally the tendons. When a foot hits the ground during locomotion it stops and converts and stores its kinetic energy[97] of forward motion briefly as elastic strain energy in the same manner that a bouncing ball will stop and stretch (briefly) as it hits the ground before rebounding upward.[63] (015)
58. **Embodied Cognition Theory:** The theory that many features of cognition, whether human or otherwise, are shaped by aspects of the entire body of the organism. The features of cognition include high level mental constructs (such as concepts [27] and categories) and performance on various cognitive tasks (such as reasoning or judgment). The aspects of the body (i.e. the 'embodied' component) include the motor system, the perceptual system, bodily interactions with the environment (i.e., situated-ness) and the assumptions about the world that are built into the structure of the organism. The 'embodied mind' thesis challenges other theories, such as cognitivism, computationalism, and Cartesian dualism. It is closely related to the extended mind thesis, situated cognition and enactivism. The modern version (of embodied theory) depends on insights drawn from recent research in psychology, linguistics, cognitive science, dynamical systems, artificial intelligence, robotics, animal cognition, plant cognition and neurobiology.[64] (013, 195w)
59. **Empathic Understanding:** A core element of Rogerian Therapy, developed by Carl Rogers as a more humanistic approach to counseling and psychotherapy. Rogers stated (1986), 'It is that the individual has within himself or herself vast resources for self-understanding, for altering his or her self-concept, attitudes and self-directed behavior. According to Rogers (1975), accurate *empathic understanding* is as follows: 'If I am truly open to the way life is experienced by another person...if I can take his or her world into mine, then I risk seeing life in his or her way...and of being changed myself, and we all resist change. Since we all resist change, we tend to view the other person's world only in our terms, not in his or hers. Then we analyze and evaluate it. We do not understand their world. But, when the therapist does understand how it truly feels to be in another person's world, without wanting or trying to analyze or judge it, then the therapist and the client can truly blossom and grow in that climate'.[65] (013, 014, 195w)
60. **Endpoint forces:** The forces imparted by the foot upon the ground as a result of the torque (i.e. force) generated by the hip, knee and ankle to regulate motion.[66] (015)
61. **Enduring Features (of the Landscape):** The parts of the landscape that resist change. They are the hills and valleys, the underlying bedrock, and the deposits left behind by glaciers. They remain the same even when changes in land cover and wildlife occur. They remain the same as plants and animals move, and they remain the same even as the climate changes.[67] (014, 195c, 195w)
62. **Energetics:** A branch of mechanics that deals primarily with energy and its transformations; the total energy relations and transformations of a physical, chemical, or biological system (e.g. the energetics of an ecological community).[68] (013, 014, 015, 195c, 195w)
63. **Environmental Load:** The forces imparted by weather, topography, or other natural phenomena within a given location[69]; typically used in association with their impact upon a

non-natural structure like a building, but are also applicable to the decomposition and aging of a track. (013, 015)

64. **Ethology:** The scientific and objective study of animal behavior especially *under natural conditions.*[70] See also Fixed Action Patterns [70] and Habituation [81]. (014, 015, 195c, 195w)
65. **Expository (mode of discourse):** One of the four modes of discourse (see also Narrative [118], Descriptive [46], Argumentative [6]), requiring the investigation of an idea including the evaluation of evidence, and expounding on the idea and setting forth an argument concerning that idea in a clear and concise manner. This can be accomplished through comparison and contrast, definition, example, the analysis of cause and effect etc.[71] (195w)
66. **External Kinetic Energy:** The energy of a (living creature's) body in motion, due to its mass moving at a given rate of speed. See Internal Kinetic Energy [92].[72] (015)
67. **External Validity:** "External validity refers to the extent to which the results of a story can be generalized to other settings (ecological validity), other people (population validity) and over time (historical validity)." Adapted from McLeod, 2013.[73] See Construct [35], Concurrent [28], Face [68], Predictive [133], and Internal [93] Validities. (015, 195w)
68. **Face Validity:** "Face validity is simply whether the story appears (at face value) to explain what it claims to. The face validity of a story can be considered a robust construct only if a reasonable level of agreement exists among listeners." Adapted from McLeod, 2013.[74] See Concurrent [28], Construct [35], Predictive [133], Internal [93] and External [67] Validity. (015, 195w)
69. **Fitness for survival (species):** The relationship between a species' capacity to reproduce (fecundity) and avoid death (mortality). In terms of locomotion, fitness depends upon: speed, acceleration and maneuverability, endurance, economy of energy, stability, and ability to compromise for optimal effect.[75] (014, 195c, 195w)
70. **Fixed Action Pattern:** An instinctive behavioral sequence that is relatively invariant within the species and almost inevitably runs to completion; one of the few types of behaviors which was thought to be 'hard-wired' and instinctive.[76] See in comparison Habituation [81]. (014, 015, 195c, 195w)
71. **Force Vector:** A means of visually notating the force acting upon an object, describing both the magnitude of force and its direction; commonly represented by an arrow.[77] (015)
72. **Fragmentation** (re: forest and/or habitat): When referring to natural communities, wildlife habitat, and landscapes, fragmentation means dividing land with naturally occurring vegetation and ecological processes into smaller and smaller areas as a result of roads, land clearing, development, or other land uses that remove vegetation and create physical barriers to species' movement and ecological processes between previously connected natural vegetation.[78] (014, 195c)
73. **Froude Number:** A mathematical computation expressing the moment at which an animal will change gaits, for example from a walk to a run. It is derived by the following equation: $(\text{Speed})^2/(\text{Gravitational acceleration} \times \text{hip height})$. Thus, the underlying characteristics of when animals change gaits is scalable across species. For example, dogs change gait at about half the speed at which horses with legs four times as long make the corresponding changes.[79] Thus, the selection of gaits can be deduced across species. (014, 195c)

74. **Gait:** An anatomical pattern of movement, often distinguished by foot placement, that is employed to move from place to place at a desired rate of speed. Further, a gait is "a pattern of locomotion characteristic of a limited range of speeds, described by quantities of which one or more change discontinuously at transitions to other gaits. Two of the quantities are the percentage of time the feet are on the ground over the duration of the stride (the 'duty' factor) and the pattern of force exerted upon the ground (the 'shape' factor).[80] (014, 195w)
75. **Geotechnical Engineering:** The sub-discipline of civil engineering that involves natural materials found close to the surface of the earth.[81] (013, 015)
76. **Gravitational Potential Energy:** Gravitational potential energy is energy an object possesses because of its position in a gravitational field (e.g. the earth's gravitational field). The general expression for gravitational potential energy is 'the work done against gravity to bring a mass to a given point in space'.[82] See Kinetic Energy [97], Internal Kinetic Energy [92], External Kinetic Energy [66]. (014, 105)
77. **Grounded Cognition Theory:** A theory of brain function that proposes the anthropological evolution of human cognition based upon a *multi*-component 'grounding' of that cognition involving: a) sensory modalities, b) the body and its actions, c) the physical environment, and d) the social environment. Its principle distinction is an emphasis on the fundamental role that the sensory and motor systems perform in an individual's learning and knowing, as well as their doing.[83] (013, 195w)
78. **Goal-Oriented Attention:** Also referred to as top-down attention. The voluntary allocation of attention to certain features, objects, or regions in space. For instance, a subject can decide to attend to a small region of space in the upper- left corner or to all red items. Both cases are examples of top-down attention, the first of top-down spatial attention, the latter of top-down feature attention (Beauchamp, Cox, & Deyoe, 1997; Bressler, Tang, Sylvester, Shulman, & Corbetta, 2008; Giesbrecht, Woldorff, Song, & Mangun, 2003).[84] (013, 014, 015, 195c, 195w) See Stimulus-Driven Attention [163] in comparison.
79. **Habitat Block:** A contiguous area of natural vegetative cover with little or no permanent internal fragmentation from human development. The boundaries of habitat blocks are delimited by roads, other forms of permanent development, and agricultural lands. The term habitat block is used instead of forest block to reflect the varied habitat types that occur within these blocks, including interior forest habitat, forested and open wetlands, ponds and streams, cliffs, rock outcrops, and early successional forest. Habitat blocks are areas of contiguous forest and other natural habitats that are un-fragmented by roads, development, or agriculture. Vermont's habitat blocks are primarily forests, but also include wetlands, rivers and streams, lakes and ponds, cliffs, and rock outcrops.[85] (195c)
80. **Habitat Loss:** The permanent conversion of habitat to a developed state; habitat loss is probably most significant for sensitive habitats (such as wetlands, shoreline and riparian habitat, and vernal pools), rare species habitats, and rare natural communities (such as Pine-Oak-Heath Sandplain Forest and Limestone Bluff Cedar-Pine Forest).[86] (195c)
81. **Habituation:** A simple form of learning that occurs in many animal taxa. It is the process whereby an animal ceases responding to a stimulus. Often, the response is an innate behavior. Essentially, the animal learns not to respond to irrelevant stimuli. For example, prairie dogs give alarm calls when predators approach, causing all individuals in the

group to quickly scramble down burrows. When prairie dog towns are located near trails used by humans, giving alarm calls every time a person walks by is expensive in terms of time and energy. Habituation to humans is therefore an important adaptation in this context.[87] See in comparison Fixed Action Patterns [70]. (195c, 195w)

82. **Hydrology:** A science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere.[88] (195c)
83. **Hypothetico-Deductive Reasoning:** In contrast to inductive-deductive reasoning, hypothetico-deductive reasoning involves the explanation of observations in terms of hypothetical causes. The hypotheses may be used as premises in conjunction with initial conditions from which certain implications may be deduced. Some of the implications deduced in such a way may include novel predictions. Hypothetico-deductive reasoning is an exploratory dialogue between the imaginative and the critical, which alternate and interact. A hypothesis is formed by a process which is not illogical but non-logical, i.e. outside logic. But once a hypothesis has been formed it can be exposed to criticism (Medawar, 1969).[89] (015, 195c, 195w)
84. **Idiom:** A style or form of artistic expression that is *broadly* characteristic of an individual, a period or movement, or a medium or instrument; for example, the modern jazz *idiom.*[90]
85. **Inductive Reasoning (Induction):** Inductive reasoning is the opposite of deductive reasoning [43]. Inductive reasoning makes broad generalizations from specific observations (i.e. its inferences [86] are based upon observations). Inductive reasoning has its place in the scientific method; it encompasses making observations to discern a pattern so that a theory can be formed to explain why. Deductive reasoning, on the other hand, allows scientists to apply and test the theory to specific situations.[91] Inductive reasoning works the opposite way than deductive reasoning, it moves from specific observations to broader generalizations and theories. This is sometimes called a "bottom up" approach. The researcher begins with specific observations and measures, begins to then detect patterns and regularities, formulate some tentative hypotheses to explore, and finally ends up developing some general conclusions or theories.[92] Inductive reasoning is flawed/abused when we observe someone do something once and say, 'You *always* do that.' [Note: Abduction[1] is about determining the *precondition;* induction is about determining the *rule;* and deduction [43] is about determining the *conclusion.*[93]] (013, 014, 015, 195c, 195w)
86. **Inference:** The act of passing from one proposition, statement, or judgment considered as true to another whose truth is believed to follow from that of the former. The act of passing from statistical sample data to generalizations usually with calculated degrees of certainty. A conclusion or opinion that is formed because of known facts or evidence.[94] (015, 195w)
87. **Inner and Outer Landscape:** The application of grounded cognition theory to tracking whereby the individual must be mindful of both the *external* and *internal* factors impacting their observation and awareness of their surrounding environment; typically, this is of primary importance when the next track cannot be found. (013, 195w)
88. **Inquiry:** Inquiry is the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole. (Dewey 1938)[95] (013, 014, 015, 195c, 195w)

89. **I+T+E=M (Individual + Task + Environment = Motion):** From the prevailing Dynamic Systems Theory of Motor Control (see [50]) whereby movement is 'regulated' (i.e. the neurological term is 'motor control') by three constraints [33]: 1) the condition of the individual, 2) the specifications of the task they are trying to perform, and 3) the environment in which they are trying to perform that task. These three constraints, taken together, determine the individual's motions.[96] (013, 014, 015)
90. **Interdependent Networks:** The study of interdependent networks is a subfield of network science dealing with phenomena caused by the interactions between complex networks.[97] (195c, 195w)
91. **Interior Forest:** Forest that shows no detectable edge influence from adjacent development.[98] (195c)
92. **Internal Kinetic Energy:** The energy of (a living creature's) independently moving body parts relative to each other, for example, the energy of a moving arm, leg or head even though the creature's overall body is not in motion, i.e. is standing still. See also External Kinetic Energy [66].[99] (015)
93. **Internal Validity:** "Internal validity refers to whether the effects observed in a story are due to the manipulation of the independent variable and not some other factor. In-other-words there is a causal relationship between the independent and dependent variable." Adapted from McLeod, 2013.[100] See Concurrent [28], Construct [35], Face [68], Predictive [133], and External [67] Validities. (015, 195w)
94. **Intuit(ion):** Quick and ready insight; immediate apprehension or cognition; knowledge or conviction gained by intuition; the power or faculty of attaining to direct knowledge or cognition without evident rational thought and inference.[101] (013, 195w)
95. **Kinematics:** A branch of dynamics that deals with aspects of motion apart from considerations of mass and force. In other words, the overall geometry, or 'shape', of motion. See Motor Image [114] and Motor Plan [115]. (014, 015)
96. **Kinetic Analysis—Inverse Dynamics:** A process that allows researchers to calculate 'joint moments of force' responsible for locomotion and bodily movements by collecting data pertaining to the endpoint forces [60] between the foot and substrate [167].[102] (015)
97. **Kinetic Energy:** Energy associated with motion.[103] See Internal Kinetic Energy[92], External Kinetic Energy [66], and Gravitational Potential Energy [76]. (014, 015)
98. **Kinesiology:** The scientific study of human (or non-human) body movement. Kinesiology addresses physiological, biomechanical, and psychological mechanisms of movement.[104] (014, 015)
99. **Land Ethic:** In Aldo Leopold's vision of a land ethic, the relationships between people and land are intertwined: care for people cannot be separated from care for the land. A land ethic is a moral code of conduct that grows out of these interconnected caring relationships.[105] (195c, 195w)
100. **Landscape:** The landforms (i.e. natural features of a landscape) of a region in the aggregate.[106] (013, 014, 015, 195c, 195w)
101. **Landscape Connectivity:** Landscape connectivity is the opposite of fragmentation [72] – it refers to the degree to which blocks of suitable habitat are connected to each other (Noss and Cooperrider 1994). Landscape connectivity can be described in at least two ways:

structural connectivity refers to a property of the landscape and the spatial arrangement of habitat patches and barriers; functional connectivity refers to the behavior of the dispersing organism or an ecological process and how they are affected by landscape structure (Crooks and Sanjayan 2006; Boitani et al. 2007; Baguette and Van Dyck 2007).[107] (195c)

102. **Landscape Ecology:** Landscape ecology often emphasizes large areas or regions and includes humans and their activities, which reflects a strong European tradition. The focus of landscape ecology is more anthropocentric in Europe and aligned closely with land planning (e.g., Bastian 2001, Opdam et al. 2002). However, landscape ecology also encompasses the causes and consequences of spatial pattern at variable spatial scales defined by the organism or process of interest, which reflects traditions in North America and Australia. Thus, streambeds may be considered landscapes for stream invertebrates (Palmer et al. 2000), and spatial heterogeneity in soils may be characterized at very fine scales relevant to individual plants or even microbes. These diversities in approach and tradition are both contrasting and complimentary (Wu & Hobbs 2002) and an inherent part of the field.[108] (195c)
103. **Landscape Limnology:** The spatially-explicit study of lakes, streams, and wetlands as they interact with freshwater, terrestrial, and human landscapes to determine the effects of pattern on ecosystem processes across temporal and spatial scales (Soranno et al. 2010).[109] (195c)
104. **Lateral Continuity:** Steno's 3rd and final principle [162] which says that sediment layers spread out until they reach an obstacle that keeps them from spreading further, the way soup spreads out in a bowl until it reaches the sides of the dish. "Wherever bared edges of strata are seen," he wrote, "either a continuation of that same strata must be looked for or another solid substance must be found that kept the material of the strata from being dispersed."[110] (015)
105. **Line Load:** The force imparted into the substrate [167] when applied through a sheet-like medium such as a sidewalk, asphalt road, concrete foundation *or a paw, hoof, or shoe*.[111] (015)
106. **Linear Elasticity:** The mathematical study of how solid objects deform and become internally stressed due to prescribed loading conditions.[112] In regard to soils, the geotechnical assessment of 'soil plasticity' [155] is measured by the percentage of water content in soil.[113] (013, 015)
107. **Linkage Habitat:** Land that links larger patches of habitat within a landscape, allowing the movement, migration, and dispersal of animals and plants. Also, commonly referred to as a 'corridor'.[114] See Wildlife Corridor [179]. (014, 195c)
108. **Listening Disposition:** "Listening with all the senses but in a habitual passive state. The body is calm but aware and poised, ready to respond. Living in a constant subconscious state of attentiveness through which the individual processes the opportunities, dangers and trajectories of their environment. Similar dispositions of attentiveness are frequently recorded in hunter gatherer ethnography (Berman 2000: 8). Ingold (2000, building on Gibson 1979) and Brody (1981: 43) describe this respectively as 'education of attention' and a state of 'attentive waiting'."[115] (013, 195w)
109. **Locomotion**: An act or the power of moving from place to place.[116] (014, 195c)

110. **Locomotive Apparatus**: Simply, the musculoskeletal system of the creature in reference to its utility for locomotion. (014)
111. **Logical-Scientific Communication:** Logical-scientific communication is context-free in that it deals with the understanding of facts that retain their meaning independently from their surrounding units of information. It aims to provide abstract truths that remain valid across a specified range of situations. An individual may then use these abstract truths to generalize down to a specific case and ideally provide some level of predictive power regarding that specific. *The legitimacy of its message is judged on the accuracy of its claims.* In essence, the utilization of logical-scientific information follows deductive reasoning [43], whereas the utilization of [personal] narrative [118] information follows inductive reasoning [85]. Three areas in particular where logical-scientific and narrative formats differ are in their direction of generalizability, their reliance on context, and their standards for legitimacy.[117] (195w)
112. **Mechanoreceptor:** A sensory receptor that responds to mechanical pressure or distortion.[118] Cells specialized to transduce mechanical stimuli and relay that information centrally in the nervous system.[119] (013)
113. **Motor Control:** The ability to regulate or direct the mechanisms essential to movement. A key component of motor control is the central representation of the overall movement otherwise referred to as the 'motor image' [Bernstein, 1967]. Subsequently, the 'motor plan' theory guiding modern physiological research, holds that achieving envisioned movement (i.e. the motor image) is 'closely related to the *topography* of the trajectory' (that the image represents) [Bernstein, 1967; Hollerbach, 1990].[120] This is the underlying basis of the tracking phrase 'landscape large/landscape small' whereby species-specific patterns of motion, in both tracks (i.e. the 'small') and trails (i.e. the 'large') may be inferred by the topography of the landscape, such that 'landscape large/landscape small' may be used to intuit '*motion* large/*motion* small'. (014, 015, 195w)
114. **Motor Image:** A component of Bernstein's Systems Theory of motor control, the motor image is the central nervous systems' visual representation of the movement necessary to achieve the task.[121] (014, 015)
115. **Motor Plan:** The information used by the central nervous system to initiate and guide the muscle responses required to produce the visual representation of the motor image.[122] (014, 015)
116. **Muscle Synergies** (for Motor/Motion Control [113]): The term used to describe the functional coupling of groups of muscles that are constrained *to act together as a unit*, thus simplifying the demands on the central nervous system to coordinate many muscles into a single motion (for example, the act of squeezing a sponge or shaking someone's hand involves the same groupings of muscles that would be coordinated in the same 'synergistic' manner).[123]
117. **Narration:** The act of telling a story in detail.[124] (195w)
118. **Narrative (form of communication; mode of discourse):** One of four modes of discourse (see also Argumentative [6], Descriptive [4646], Expository [65]). Can be generalized as 'the telling of a story', often in anecdotal, experiential, and personal fashion.[125] Narrative communication provides a specific case from which an individual can generalize to infer what the general truths must be to permit such a specific to occur. It is context-dependent because it derives its meaning from the ongoing cause-and-effect structure of the temporal events of which it

is comprised. As such, it is much harder to break a narrative into smaller units of meaningful content without either greatly altering the understanding of the smaller unit or rendering the original narrative incoherent. *Because narrative communication aims to provide a reasonable depiction of individual experiences, the legitimacy of its message is judged on the verisimilitude of its situations.* In essence, the utilization of logical-scientific [111] information follows deductive reasoning, whereas the utilization of narrative information follows inductive reasoning. Three areas in particular where logical-scientific and narrative formats differ are in their direction of generalizability, their reliance on context, and their standards for legitimacy.[126] (195w)

119. **Natural Community Surrogates:** When organisms cannot be studied and preserved on a species-by-species basis, then conservation at the landscape level can be an effective approach for simultaneously protecting multiple species and natural community elements.[127] (195c)
120. **Navigation:** To steer a course through a medium; to operate or control the course of.[128] (013, 014, 015, 195c, 195w)
121. **Network Science:** The study of network representations of physical, biological, and social phenomena leading to predictive models of these phenomena.[129] (195c, 195w)
122. **Newton's Third Law of Motion:** Newton's third law states that for every action (force) in nature there is an equal and opposite reaction. In other words, if object A exerts a force on object B, then object B also exerts an equal force on object A.[130] (013, 015)
123. **Objective:** Expressing or dealing with facts or conditions as perceived without distortion by personal feelings, prejudices, or interpretations.[131] (195w)
124. **Observe:** To watch carefully especially with attention to details or behavior for the purpose of arriving at a judgment.[132] (013, 014, 015, 195c, 195w)
125. **Optimization Theory:** The branch of mathematics that finds the best possible solutions to problems.[133] (014, 015, 195c)
126. **Original Horizontality:** Steno's 2nd principle [162] which stated that upper surface levels ought to be smooth and parallel to the horizon, even if they were deposited onto an irregular surface with succeeding layers of sediment deposited in the same fashion. This has become known as Steno's "principle of original horizontality," and it has helped geologists understand that layers of sediment lying at an angle to the horizon were tilted or folded after they solidified.[134] (015)
127. **Outlook:** A point of view.[135] (013, 014, 015, 195c, 195w)
128. **Perceive:** To attain awareness or understanding of.[136] (013, 014, 015, 195c, 195w)
129. **Persuasive:** One of four modes of discourse (narrative, descriptive, expository, argumentative).
130. **Physiology:** A branch of biology that deals with the functions and activities of life or of living matter (as organs, tissues, or cells) and of the physical and chemical phenomena involved.[137] (013, 014, 195w)
131. **Point Load:** The application, i.e. 'loading', of force at a specific point on an elastic medium and the subsequent stresses produced within the elastic medium.[138] When applied to tracking, this explains how a person's toes will register through the soles of their shoes. (015)

132. **Posture:** the position or bearing of the body whether characteristic or assumed for a special purpose.[139] (015)
133. **Predictive Validity:** The degree to which a story accurately predicts a criterion that will occur in the future. Adapted from McLeod, 2013.[140] See Concurrent [28], Construct [35], Face [68], Internal [93] and External [67] Validities. (015, 195w)
134. **Pressure Release:** The resultant deformation and shape of the substrate once the pressure applied by the foot is released.[141] (015)
135. **Pressure Release Tracking System:** A system of tracking espoused (Brown 1983, 1999) as the essence of the Eastern Apache's philosophy and practice of human and wildlife tracking that is based upon the science of soil personality, behavior, and mechanics implicit to modern geotechnical engineering. (015)
136. **Proximate Causation:** The difference between proximate and ultimate [178] explanations of behavior is central to evolutionary explanation (Mayr, 1963; Tinbergen, 1963). *Ultimate* explanations are concerned with the fitness consequences of a trait or behavior and whether it is (or is not) selected. In contrast, *proximate* explanations are concerned with the mechanisms that underpin the trait or behavior—that is, *how* it works. Put another way, ultimate explanations address evolutionary function (the *"why"* question), and proximate explanations address the way in which that functionality is achieved (the *"how"* question).[142] See Ultimate Causation [178].[143] (014)
137. **Reconcile:** To settle, resolve *reconcile* differences; to make consistent or congruous.[144] (013, 014, 195c, 195w)
138. **Relative Date Aging:** The application of stratigraphy [165] to determine a relative sequence of events, but not their actual timing. (015)
139. **Rhythmic:** Of, relating to, or involving rhythm, i.e**.** movement, fluctuation, or variation marked by the regular recurrence or natural flow of related elements. (014)
140. **Riparian:** Relating to or living or located on the bank of a natural watercourse (such as a river) or sometimes of a lake or a tidewater.[145] (195c)
141. **Saccadic Eye Movements:** Small rapid jerky movements of the fovea of the eye (i.e. the 'cones'), especially as they jump from fixation on one point to another based upon the item of interest. This happens too fast for the person to be conscious of its occurrence.[146] (013, 195w)
142. **Scales of Integration:** A kind of hierarchy where small scales are imbedded within larger scales. They are different from the hierarchical systems we are familiar with because information and control flows in both directions.[147] (013, 014, 015, 195c, 195w)
143. **Schematic Disposition:** The mental makeup and codification of experiences that includes a particular organized way of perceiving cognitively and responding to a complex situation or set of stimuli.[148] A tracker's schematic disposition comprises how the 'see', how they 'think', and how the 'tell the story'. (013, 014, 015, 195c, 105w)
144. **Science of Attention:** An area of research within cognitive psychology[149] regarding the state of focused awareness on a subset of the available perceptual information.[150] (013, 014, 195c, 195w)
145. **Sequence:** The order of succession.[151] (015, 195w)

146. **Settlement Profile:** The overall surface area that remains depressed by contact pressure. Geotechnical Engineering [75] refers to this dynamic as the 'total settlement' of the soil and the resultant shape of the compressed material as its 'settlement profile'.[152] The magnitude of the contact settlement depends upon the flexible properties of the form that is imparting the force (i.e. the load) and the soil itself.[153] See(Track) Compression[25]. (013)
147. **Shape Factor:** A mathematical parameter describing the two-part exertion of force when a foot strikes the ground; the first force occurring as the foot lands upon the ground due to gravitational and kinetic energy and the second force occurring as the foot continues forward due to the energy of elastic strain within the muscles of the locomotive apparatus.[154] (014, 015)
148. **Soil Behavior:** The basis for classifying different soils with similar properties according to their engineering behavior[155] (i.e. how they respond to the stress of forces imparted upon them). (015)
149. **Soil Compaction:** The compression of soil in response to force(s) imparted upon it. The compression is caused by a) the *deformation* of soil particles, b) the *relocation* of soil particles, and c) the expulsion of water or air from the void *spaces between* particles.[156]
150. **Soil Deformation:** The combined effect of soil shearing [156] and soil compaction [149].[157]
151. **Soil Engineering:** Soil engineering, also known as geotechnical engineering [75], is a field of civil engineering that specializes in evaluating the characteristics of the ground upon which a structure is built. A soil engineer investigates and analyzes a site for such qualities as soil characteristics, composition, and drainage. Soil engineers also consider the weight-bearing capacity of the ground under a building's foundation. They evaluate the likelihood that the building will settle or shift over time.[158] (015)
152. **Soil Effective Stress (Principle of):** Developed by Karl Terzagi, the founder of modern soil mechanics. The principle can be generally summarized as the approximated force that can be supported by a unit area of soil without experiencing failure to the soil skeleton, i.e. a change in the soil structure. *Effective stress is considered the most important concept in geotechnical engineering because it is integral to solving engineering problems relating to the constructions of buildings, dams, and any load-bearing structures*.[159] (015)
153. **Soil Elasticity:** A parameter most commonly used in the estimation of settlement from static loads, more formally known as the 'modulus of elasticity' or Young's modulus of a soil.[160] (013, 015)
154. **Soil (Substrate) Personality:** A set of distinctive traits and characteristics pertaining to how the substrate reacts to a (set of) force(s) imparted upon it. (015)
155. **Soil Plasticity:** The difference between where a soil behaves like a liquid and a semi-solid based upon its moisture content.[161] (013, 015)
156. **Soil Shearing:** The point at which the soil skeleton fails to resist the (set of) force(s) imparted upon it such that it slides along a plane.[162]
157. **Soil Stress Path:** A (hypothetical) line through which successive states of stress are experienced within the soil as a result of a force imparted upon it.[163]
158. **Soil Structure:** The geometric arrangement of soil particles in relation to one another. The structures are categorized as either cohesive or cohesion-less. The structure is influenced by the attractive and repulsive forces operating between soil particles.[164] (013, 015)

159. **Spatial Heterogeneity:** A property generally ascribed to a landscape or to a population. It refers to the uneven distribution of various concentrations of each species within an area. A landscape with spatial heterogeneity has a *mix* of concentrations of multiple species of plants or animals (biological), or of terrain formations (geological), or environmental characteristics (e.g. rainfall, temperature, wind) filling its area.[165] (195c)
160. **Spoor:** A term used to denote evidence of passage inclusive of both tracks and sign (i.e. scat, hair, scent, chew marks etc.) Origin is of Dutch Afrikaans, common throughout Southern Africa.
161. **State of Flow:** In positive psychology, flow, also known as 'the zone', is the mental state of operation in which a person performing an activity is fully immersed in a feeling of energized focus, full involvement, and enjoyment in the process of the activity. In essence, flow is characterized by complete absorption in what one does and loses sense of space and time. Named by Mihály Csíkszentmihályi, the concept has been widely referenced across a variety of fields (and has received special recognition in occupational therapy), though the concept has existed for thousands of years under other guises, notably in some Eastern religions. Achieving flow is often colloquially referred to as *being in the zone*.[166] (013, 195w)
162. **Steno's Laws:** Three fundamental principles of geology named after Niels Stensen (1638-1686), also known by his Latin-ized name of Nicolaus Steno. After making unprecedented discoveries in anatomy, he changed course and established three of the most important principles of modern geology: superposition [168], original horizontality [126], and lateral continuity [104].[167] (013, 015)
163. **Stimulus-Driven Attention:** Also referred to as bottom-up attention. Attention that can be voluntarily or involuntarily directed. Salient stimuli can attract attention, even though the subject had no intentions to attend to these stimuli (Schreij, Owens, & Theeuwes, 2008; Theeuwes, 1991, 1992). For instance, if a subject is engaged in a conversation, but a loud bang occurs, this bang may attract attention. Or, in the visual domain, someone may be looking for red items, but an unexpected, sudden appearance of a non-red object may inadvertently draw the attention of the subject.[168] (013, 014, 015, 195c, 195w) See Goal-Oriented Attention [78] in comparison.
164. **Storyline:** The plot of a story or drama.[169] See Timeline [172]. (195w)
165. **Stratigraphy:** Branch of geology concerned with the study of the formation, composition, ordering in time, and arrangement in space of stratified rocks.[170] (013, 015)
166. **Subjective:** Peculiar to a particular individual and modified or affected by their personal views, experience, or background; arising out of or identified by means of one's perception of one's own states and processes.[171] (195w)
167. **Substrate:** A substance acted upon.[172] In regard to tracking, the substrate is the surficial geology [169] and components, thereof, such as vegetation and other organic and non-organic matter. (013, 014, 015, 195c, 195w)
168. **Superposition:** The first and most important of Steno's principles [162] and known as the "principle of superposition," it states that the sediment layers are deposited in sequence, with the oldest layers on the bottom and newest layers on top.[173] (013, 015)

169. **Surficial Geology:** Vermont's surficial geology is defined by the sands, gravels, clays, peats, and other deposits found on top of the bedrock as a result of both glacial activity and post-glacial events (like flooding) that continue today.[174] (014, 195c, 195w)
170. **Symmetrical:** The property of remaining invariant under certain changes (as of orientation in space, of the sign of the electric charge, of parity, or of the direction of time flow) —used of physical phenomena and of equations describing them.[175] See Asymmetrical [8]. (013, 014)
171. **System:** A regularly interacting or interdependent group of items forming a unified whole, a number *system* : such as a (1) : a group of interacting bodies under the influence of related forces a gravitational *system* (2) : an assemblage of substances that is in or tends to equilibrium a thermodynamic *system*.[176] (014)
172. **TEK (Traditional Ecological Knowledge):** TEK is an accumulating body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (human and non-human) with one another and with the environment. It encompasses the world view of indigenous people which includes ecology, spirituality, human and animal relationships, and more.[177] (195w)
173. **Timeline:** A positional representation of events denoting their order of occurrence that may serve as a tacit means of inferring *potential* causal relationships. See Storyline [164].
174. **Top-Down Attention:** See Goal-Oriented Attention [78].
175. **Topography:** The configuration of a surface including its relief and the position of its natural *and* man-made features.[178] (013, 014, 015, 195c, 195w)
176. **Track:** A disturbance to a baseline [48], whereby a disturbance is a force imparted through a form that is greater than the constraints of the baseline.[179] See Compression [25], Concentrics [26], True Track [177]. (013, 014, 015, 195c, 195w)
177. **True Track:** The contact surface area through which the force was imparted.[180] (013, 015)
178. **Ultimate Causation:** The difference between proximate and ultimate explanations of behavior is central to evolutionary explanation (Mayr, 1963; Tinbergen, 1963). *Ultimate* explanations are concerned with the fitness consequences of a trait or behavior and whether it is (or is not) selected. In contrast, proximate explanations are concerned with the mechanisms that underpin the trait or behavior—that is, how it works. Put another way, ultimate explanations address evolutionary function (the "why" question), and *proximate* explanations address the way in which that functionality is achieved (the "how" question).[181] See Proximate Causation [136]. (014)
179. **Wildlife Corridor:** Also referred to as wildlife connecting habitat [30] or linkage habitat [107]. Lands and waters that connect larger patches of habitat together within a landscape and allow the movement, migration, and dispersal of animals and plants (Austin et al. 2004). Corridors describe specific paths along which animals and plants move and migrate, usually providing connections between blocks of suitable habitat across a dissimilar landscape matrix (Beier and Noss 1998). These terms 'corridor', 'linkage habitat' and 'connecting habitat' are sometimes used interchangeably but do have distinct meanings that can be useful in distinguishing between closely related concepts of animal and plant movement and propagation of ecological processes. Corridor generally refers to a swath of land that allows movement of particular species between two or more areas of 'disjunct' but suitable habitat. Corridors are often thought of as narrow strips of land but may also be wider areas of suitable

habitat used for animal or plant movement and migration. Linkage generally refers to broader regions of connectivity that allow the movement of multiple species and that maintain ecological processes. (Meiklejohn et al. 2009).[182] (195c)

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