**Supplementary Materials**

**Figure S1.**



**Table S1**.

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Choanoflagellata 0000000-00000-00--00---0-----------0----------000-------------------------0---------0---------0000000000------00000-0000--

Porifera 1000000-11100-11-000---0-----------0-0-0------000--------0----------------0---------0----------011000001------001---00----

Ctenophora 1111110-11100-11-200-00000000-0000-0-0-0-0-0001010---00--00---0-00--------0--------0100000-0001-1-------000000-1-------00-

Cnidaria 1111110-11100-11-100-00000000-0000-0-0-0-0-0001010---00--00---0-00--------0-------00100000-0001111111-11000000-11-101-0001

Nematoda 11111110111110111300-00000000-0000-1-1-0-1-0001010---00--00---0-00--------00------00111001011011111--11-1010001-10100-0010

Hexapoda 11111110111110111300-00000000-0001111111011000101111100--00---0-00--------00------00111001111011111--1111000001-1010010010

Crustacea 11111110111110111300-00000000-0001011111111000101111100--00---0-00--------00------00111001111111111--1111000001110100-0010

Chelicerata 11111110111110111300-00000000-0001110101210000101100000--00---0-00--------00------00111001011011111--11-100000--10100-0010

Myriapoda 11111110111110111300-00000000-0001110111311000101111000--00---0-00--------00------00111001111011111--11-100000--10100-0010

Platyhelminthes 1111120-111010112300-00000000-0000-0-0-0-1-0001010---00--00---0-00--------00------00111001011011111--11110000011-------010

Annelida 11111110111110112300-00000000-0000-0-0-0-1-0101110---00--00---0-00--------00------00111001011111111--1111000001110101-0010

Gastropoda 11111110111110112300-00000000-0000-0-0-0-1-1111110---00--00-111-00--01011100------00111001011011111--11-1000001110101-0010

Bivalvia 11111110111110112300-00000000-0000-0-0-0-1-1111110---01--00-111-00--0100010-------001110010-1011111--1111000001110101-00-0

Polyplacophora 11111110111110112300-00000000-0000-0-0-0-1-1101110---00--00-001-00--1100000-------001110010-1011111--11-100000-0-------0-0

Cephalopoda 11111110111110112300-00000000-0000-0-0-0-1-1111110---00--00-111-00--01111100------00111001011011111--1111000001111100-1010

Echinodermata 11111111111111110400-00000000-0000-0-0-0-0-0001010---10--010--0-00--------0-------0013-00-01--1111111011100000-1-------002

Cephalochordata 11111111111111110310-01000000-0000-0-0-0-0-0001010---10--011--0000--------00---00-101220010---111111101-1000001--11----012

Urochordata 11111111111111110310001000000-0000-0-0-0-0-0001010---10--010--0000--------00---00-121221010-10111111101-100000-111101111-2

Chondrichthyes 11111111111111110310011111001-1110-0-0-0-0-0001010---1000011--000000------11000110111221110-1-1111111011110101-0-110111112

Osteichthyes 11111111111111110310011111011-1110-0-0-0-0-0001010---1000011--010000------11110111111221110111111111101111010110-110111112

Amphibia 11111111111111110310011111111-1110-0-0-0-0-0001010---1000011--010010------11110111111221110111111111101111010110-110111112

Crocodilia 1111111111111111031111111111111110-0-0-0-0-0001010---1011111--011111------11111111111221110111111111101111000110-1101-1112

Aves 1111111111111111031111111111111110-0-0-0-0-0001010---1011111--011111------11110111111221110111111111101111000110-111111112

Mammalia 1111111111111111031111111111101110-0-0-0-0-0001010---1000011--012011------11110111111221110111111111101111001110-111111112

Lepidosauria 1111111111111111031111111111111110-0-0-0-0-0001010---1011011--011111------11111111111221110111111111101111000110-1101-1112

Testudinata 1111111111111111031111111111121100-0-0-0-0-0001010---1000011--011011------01111111111221110111111111101111000110-1101-1112

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**Table S2**.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Carater | Name | States | Groups | Species | References | L | IC | IR |
| 0 | Multicelularity | (0) absent; (1) present | Metazoa |  | Sorensen, et al. 2000; Lecointre & Le Guyader, 2006; Nielsen, 2012; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 1 | - | - |
| 1 | True Tissues | (0) absent; (1) present | Eumetazoa |  | Dunn et al. 2014 | 1 | 100 | 100 |
| 2 | Basal membrane | (0) absent; (1) present | Eumetazoa |  | Dunn et al. 2014 | 1 | 100 | 100 |
| 3 | Specialized gonads | (0) absent; (1) present | Eumetazoa |  | Dunn et al. 2014 | 1 | 100 | 100 |
| 4 | Spermatogenesis | (0) absent; (1) present | Metazoa |  | Dunn et al. 2014 | 1 | 100 | 100 |
| 5 | Embryo leaflets | (0) diblastics, (1) triblastics, (3) third incomplete embryo leaflet. | Eumetazoa |  | Lecointre & Le Guyader, 2006; Nielsen, 2012; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 2 | 100 | 100 |
| 6 | Coelom | (0) absent; (1) present | Bilateria |  | Hallam, 1977; Lecointre & Le Guyader, 2006; Nielsen, 2012; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 2 | 50 | 75 |
| 7 | Coelom formation | (0) schizocely; (1) enterocoely | Bilateria |  | Hallam, 1977; Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 8 | Collagen | (0) absent; (1) present | Metazoa |  | Sorensen, et al. 2000; Lecointre & Le Guyader, 2006; Nielsen, 2012; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 1 | - | - |
| 9 | Intermediate filaments | (0) absent; (1) present | Metazoa |  |  | 1 | - | - |
| 10 | Microfilaments | (0) absent; (1) present | Metazoa |  |  | 1 | - | - |
| 11 | Circulatory system | (0) absent; (1) present | Bilateria |  | Lecointre & Le Guyader, 2006; Nielsen, 2012; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 2 | 50 | 75 |
| 12 | Excretory system | (0) absent; (1) present | Bilateria |  | Lecointre & Le Guyader, 2006; Nielsen, 2012; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 13 | Blastopore destiny |  | Bilateria |  |  | 1 | 100 | 100 |
| 14 | Actin | (0) absent; (1) present | Metazoa |  | Lecointre & Le Guyader, 2006; Nielsen, 2012 | 1 | - | - |
| 15 | Miosin | (0) absent; (1) present | Metazoa |  | Lecointre & Le Guyader, 2006; Nielsen, 2012 | 1 | - | - |
| 16 | Clivage | (0) radial, (1) surface, (2) spiral | Bilateria |  |  | 2 | 100 | 100 |
| 17 | Symmetry pattern | (0) radial, (1) birradial, (2) bilateral, (3) later modified bilaterally in radial | Eumetazoa |  |  | 4 | 100 | 100 |
| 18 | Endostyle | (0) absent, (1) present | Chordata |  | Ruppert et al. 1999; Sorensen, et al. 2000; Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 19 | Amnion | (0) absent, (1) present | Crocodilia, Aves, Mammalia, Lepidosauria e Testudinata |  | Lecointre & Le Guyader, 2006; Nielsen, 2012; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 20 | Orifice near the ocular cavity | (0) absent, (1) present | Crocodilia, Aves, Mammalia, Lepidosauria e Testudinata |  | Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 21 | Miomers | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 22 | Somites | (0) absent, (1) present | Chordata |  | Lecointre & Le Guyader, 2006; Nielsen, 2012; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 23 | Hemoglobin | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006; Nielsen, 2012 | 1 | 100 | 100 |
| 24 | Vertebrae | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006; Nielsen, 2012; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 25 | Endoskeleton | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 26 | Lacrimal duct | (0) absent, (1) present | Amphibia, Crocodilia, Aves, Mammalia, Lepidosauria e Testudinata |  | Lecointre & Le Guyader, 2006; Nielsen, 2012 | 1 | 100 | 100 |
| 27 | Tetrapod | (0) absent, (1) present | Tetrapoda |  | Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 28 | Cranium | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006; Nielsen, 2012 | 1 | 100 | 100 |
| 29 | Patterns of temporal fossa | (0) synapsid, (1) diapsid, (2) anapsid | Crocodilia, Aves, Mammalia, Lepidosauria e Testudinata |  | Lecointre & Le Guyader, 2006 | 2 | - | - |
| 30 | Jaw | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006; Nielsen, 2012 | 1 | 100 | 100 |
| 31 | Dorsal tubercle | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 32 | Teeth with dentine | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006 | 2 | 50 | 83 |
| 33 | Paired ventrolateral appendages | (0) absent, (1) present | Arthropoda |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018 | 1 | 100 | 100 |
| 34 | Type of articulated appendices | (0) biremes, (1) unirremes | Arthropoda |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018 | 1 | - | - |
| 35 | Cuticle | (0) absent, (1) present | Ecdysozoa |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 36 | Appendices modified in antennas | (0) absent, (1) present | Arthropoda |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 37 | Articulated exoskeleton | (0) absent, (1) present | Arthropoda |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 38 | Head with acron and 6 more segments | (0) absent, (1) present | Hexapoda |  |  | 1 | - | - |
| 39 | Tagmatization | (0) absent, (1) present | Arthropoda |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 40 | Tagmosis patterns | (0) head, thorax and abdomen, (1) cephalotorax and abdomen, (2) prosoma and opisthosoma, (3) several tagmas | Arthropoda |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018; Giribet & Edgecombe, 2021 | 3 | 100 | 100 |
| 41 | Hemocoel | (0) absent, (1) present | Protostomia |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 42 | Third segment of head with jaw | (0) absent, (1) present | Arthropoda |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018 | 1 | - | - |
| 43 | Dorsal epithelium forming a mantle | (0) absent, (1) present | Mollusca |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 44 | Gonopericardium complex | (0) absent, (1) present | Mollusca |  | Valentine, 2004; Lecointre & Le Guyader, 2006; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 45 | Unified shell presence | (0) absent, (1) present | Mollusca |  | Valentine, 2004; Lecointre & Le Guyader, 2006; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 46 | Epithelium with polarized cells and cellular junctions |  | Mollusca |  | Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 47 | Trochophore larva | (0) absent, (1) present | Spiralia |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 48 | Hox genes | (0) absent, (1) present | Eumetazoa |  | Dunn et al. 2014; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 49 | Paired segmental saculiform nephroids | (0) absent, (1) present | Arthropoda |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 50 | First segment of the modified head in antennas | (0) absent, (1) present | Arthropoda |  | Grimaldi & Engel, 2005; Lecointre & Le Guyader, 2006; Brusca et al. 2018 | 1 | - | - |
| 51 | Omatidial structure | (0) absent, (1) present | Hexapoda, Crustacea |  | Richter, 2002; Giribet & Edgecombe, 2020 | 1 | - | - |
| 52 | Four cones in the omatids | (0) absent, (1) present | Hexapoda, Crustacea |  | Richter, 2002 | 1 | 100 | 100 |
| 53 | Pharynx with gill slits | (0) absent, (1) present | Deuterostomia |  | Valentine, 2004; Lecointre & Le Guyader, 2006; Schmidt-Rhaesa, 2007; Brusca et al. 2018 | 1 | 100 | 100 |
| 54 | Dorsal articulated valves | (0) absent, (1) present | Bivalvia |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | - | - |
| 55 | Temporal bars formed by the postorbital and squamosal bones | (0) absent, (1) present | Crocodilia, Aves and Lepidosauria |  | Pough et al. 2003; Hickman et al. 2016 | 1 | 100 | 100 |
| 56 | Temporal bars formed by the postorbital and quadratojugal | (0) absent, (1) present | Crocodilia, Aves and Lepidosauria |  | Pough et al. 2003; Hickman et al. 2017 | 1 | 100 | 100 |
| 57 | Gizzard | (0) absent, (1) present | Crocodilia and Aves |  | Pough et al. 2003; Hickman et al. 2018 | 1 | 100 | 100 |
| 58 | Origin of the mouth from stomodeu | (0) absent, (1) present | Deuterostomia |  | Hyman et al. 1959. | 1 | 100 | 100 |
| 59 | Muscle fibres in the body wall | (0) smooth, (1) cross-striated | Cephalochordata and Vertebrata |  | Pough et al. 2003; Ruppert, 2005; Hickman et al. 2016 | 2 | 50 | 0 |
| 60 | Three folds on the edge of the mantle | (0) absent, (1) present | Bivalvia and Cephalopoda |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | - | - |
| 61 | Shell style | (0) multiples, (1) fused | Mollusca |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | - | - |
| 62 | Spicules in mantle | (0) absent, (1) present | Mollusca |  | Valentine, 2004; Lecointre & Le Guyader, 2007 | 1 | 100 | 100 |
| 63 | Bones | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006Nielsen, 2012 | 1 | 100 | 100 |
| 64 | Annex Structures | (0) absent, (1) scales, (2) hairs | Crocodilia, Aves, Mammalia, Lepidosauria e Testudinata |  | Hill, 2016; Hickman et al. 2016 | 2 | 100 | 100 |
| 65 | Hook shaped fifth metatarsal | (0) absent, (1) present | Crocodilia, Aves and Lepidosauria |  | Hickman et al. 2016 | 1 | 100 | 100 |
| 66 | Distal extremity of members with carpal and tarsais | (0) absent, (1) present | Tetrapoda |  | Hickman et al. 2017 | 1 | 100 | 100 |
| 67 | Extra-embryonic membranes with chorion ans allantois | (0) absent, (1) present | Crocodilia, Aves, Mammalia, Lepidosauria e Testudinata |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 68 | Perinoto | (0) absent, (1) present | Polyplacophora |  | Brusca, 2018 | 1 | - | - |
| 69 | Palial cavity | (0) absent, (1) present | Mollusca |  | Brusca, 2018 | 0 | - | - |
| 70 | Shell state | (0) external, (1) internal and reduced | Mollusca |  | Valentine, 2004; Brusca, 2018 | 1 | - | - |
| 71 | Cavity of the mantle located later | (0) absent, (1) present | Gastropoda |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 72 | Shell winding | (0) absent, (1) present | Gastropoda and Cephalopoda |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 73 | Shell with prismatic, nacreous and periostracum layer | (0) absent, (1) present | Gastropoda, Bivalvia and Cephalopoda |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | - | - |
| 74 | Presence of real prismatic tooth enamel | (0) absent, (1) present | Vertebrata |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 2 | 50 | 83 |
| 75 | Optical capsule with two sensory channels | (0) absent, (1) present | Vertebrata |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 76 | Diverticulum in the digestive tract giving rise to the lung or swim bladder | (0) absent, (1) present | Vertebrata |  | Valentine, 2004; Lecointre & Le Guyader, 2006 | 1 | - | - |
| 77 | Skeleton endochondral ossification | (0) absent, (1) present | Osteichthyes and Tetrapoda |  | Pough et al. 2003; Valentine, 2004; Ruppert, 2005; Lecointre & Le Guyader, 2006; Hickman et al. 2016 | 1 | - | - |
| 78 | Body covered with queratinized skin | (0) absent, (1) present | Crocodilia, Lepidosauria and Testudinata |  | Pough et al. 2003; Valentine, 2004; Ruppert, 2005; Lecointre & Le Guyader, 2006; Hickman et al. 2016 | 2 | 50 | 50 |
| 79 | Extrinsic eye muscles | (0) absent, (1) present | Vertebrata |  | Pough et al. 2003; Valentine, 2004; Ruppert, 2005; Lecointre & Le Guyader, 2006; Hickman et al. 2016 | 1 | 100 | 100 |
| 80 | Endostyl transformed into thyroid in adult phase | (0) absent, (1) present | Vertebrata |  | Valentine, 2004; Hickman et al. 2016 | 1 | 100 | 100 |
| 81 | Pentadactyl condition of the digits | (0) absent, (1) present | Osteichthyes and Tetrapoda |  | Valentine, 2004; Hickman et al. 2016 | 1 | - | - |
| 82 | Notochord at some stage of development | (0) absent, (1) present | Chordata |  |  | 1 | 100 | 100 |
| 83 | Muscular post-anal tail | (0) absent, (1) present, (2) present only in the larval phase | Urochordata and Vertebrata |  |  | 2 | 100 | 100 |
| 84 | Synaptic nervous system | (0) absent, (1) present | Eumetazoa |  | Wicht & Lacalli, 2005; Lecointre & Le Guyader, 2006; Watanabe et al. 2009; Nielsen, 2012; Dunn et al. 2014; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 85 | Organization of nervous system | (0) in net, (1) ventral, (2) dorsal, (3) radial | Eumetazoa |  | Loesel et al. 2013; Sigwart et al. 2014; Arendt et al. 2016; Feinberg & Malatt, 2016; Brusca et al. 2018; Giribet & Edgecombe, 2020 | 3 | 100 | 100 |
| 86 | Nerve cord | (0) absent, (1) lengthwise, (2) dorsal | Bilateria |  | Mashanov et al. 2006; Kardong, 2011; Dunn et al. 2014; Díaz-Balzac & García-Arrarás, 2018; Giribet & Edgecombe, 2020 | 2 | 100 | 100 |
| 87 | Hollow dorsal nerve tube | (0) absent, (1) present | Chordata |  | Lecointre & Le Guyader, 2006; Nielsen, 2012 | 1 | 100 | 100 |
| 88 | Neural crest | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006; Nielsen, 2012; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 89 | Horizontal commissures between the nerve cords | (0) absent, (1) present | Bilateria? |  | Budelmann, 1995; Nakazawa et al. 2003; Schmidt-Rhaesa, 2007; Evans & Bashaw, 2012; Schafer, 2016; Sumner-Rooney & Sigwart, 2018 | 1 | 100 | 100 |
| 90 | Tritocerebrum | (0) absent, (1) present | Hexapoda, Crustacea and Myriapoda |  | Grimaldi & Engel, 2005; Hirth, 2010; Giribet & Edgecombe, 2020 | 1 | 100 | 100 |
| 91 | Nociceptors | (0) absent, (1) present | Bilateria? |  | Kenton et al. 1971; Pezalla, 1983; Sneddon, 2003; Ashley et al. 2007; Crook et al. 2013; Walters, 2018; Wong & Rankin, 2019 | 1 | 100 | 100 |
| 92 | Amielinic nerve fibers | (0) absent, (1) present | Bilateria? |  | Hamamoto & Simone, 2003; Ashley et al. 2007 | 1 | 100 | 100 |
| 93 | Myelinic nerve fibers | (0) absent, (1) present | Annelida, Crustacea and Vertebrata | *Asychis elongata* (Verrill) | Bruesch,1942; Lass & Abeles, 1975; Snow et al. 1993; Liang et al. 1995; Sneddon, 2002; Hamamoto & Simone, 2003; Sneddon, 2004; Hartline & Kong, 2006; Jacobson et al. 2006; Ashley et al. 2007; Nanba et al. 2010; Bondan et al. 2015; Bellard, 2016. | 3 | 33 | 75 |
|  |  |  |  | *Capitella sp.* (Blake, Grassle & Eckelbarger) |  |  |  |  |
|  |  |  |  | *Oncorhynchus mykiss* (Walbaum) |  |  |  |  |
|  |  |  |  | *Himantura sp.* (J. F. Gmelin) |  |  |  |  |
|  |  |  |  | *Rhinobatus battilum* (H. F. Linck) |  |  |  |  |
|  |  |  |  | *Carcharhinus Melanopterus* (Quoy & Gaimard) |  |  |  |  |
|  |  |  |  | *Rana pipiens* (Schreber) |  |  |  |  |
|  |  |  |  | *Xenopus laevis*(Daudin) |  |  |  |  |
|  |  |  |  | *Bothrops jararaca* (Wied-Neuwied) |  |  |  |  |
|  |  |  |  | *Caretta caretta* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Alligator mississipiensis* (Daudin) |  |  |  |  |
| 94 | Neurotransmitters | (0) absent, (1) present | Metazoa |  | Liebeskind et al. 2017; Byrne, 2019 | 1 | - | - |
| 95 | Glycine Neurotransmitter | (0) absent, (1) present | Eumetazoa |  | Liebeskind et al. 2017; Byrne, 2019 | 1 | 100 | 100 |
| 96 | Glutamate Neurotransmitter | (0) absent, (1) present | Metazoa |  | Liebeskind et al. 2017; Byrne, 2019 | 1 | - | - |
| 97 | GABA Neurotransmitter | (0) absent, (1) present | Metazoa |  | Karhunen et al. 1993; Liebeskind et al. 2017; Byrne, 2019 | 1 | - | - |
| 98 | Dopamine Neurotransmitter | (0) absent, (1) present | Eumetazoa |  | Liebeskind et al. 2017 | 1 | 100 | 100 |
| 99 | Norepinephrine Neurotransmitter | (0) absent, (1) present | Cnidaria, Deuterostomia |  | Liebeskind et al. 2018 | 1 | 100 | 100 |
| 100 | Epinephrine Neurotransmitter | (0) absent, (1) present | Cnidaria, Deuterostomia |  | Liebeskind et al. 2019 | 1 | 100 | 100 |
| 101 | Octopamine Neurotransmitter | (0) absent, (1) present | Protostomia |  | Karhunen et al. 1993; Liebeskind et al. 2017; Byrne, 2019 | 1 | 100 | 100 |
| 102 | Serotonin Neurotransmitter | (0) absent, (1) present | Eumetazoa |  | Liebeskind et al. 2017 | 1 | 100 | 100 |
| 103 | Histamin Neurotransmitter | (0) absent, (1) present | Metazoa | *Macoma balthica* (Linnaeus) | Karhunen et al. 1993 | 1 | - | - |
|  |  |  |  | *Cherax quadricarinatus* (Von Martens) |  |  |  |  |
|  |  |  |  | *Drosophila melanogaster* (Meigen) |  |  |  |  |
|  |  |  |  | *Geodia gigas* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Actinia equina* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Anemonica sulcata* (Pennant) |  |  |  |  |
|  |  |  |  | *CaIliactis parasítica* (Couch) |  |  |  |  |
|  |  |  |  | *Stylochus megalops* (Marcus & Marcus) |  |  |  |  |
|  |  |  |  | *Ctyloplanocera faciata* |  |  |  |  |
|  |  |  |  | *Arca zebra* (Swainson) |  |  |  |  |
|  |  |  |  | *Pheretima sp.* (Kinberg) |  |  |  |  |
|  |  |  |  | *Apis melífera* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Culex pipiens* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Echinaster echinophorus* (Lamarck) |  |  |  |  |
|  |  |  |  | *Litechinus variegatus* (Lamarck) |  |  |  |  |
|  |  |  |  | *Gasterosteus aculeatus* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Rana temporaria* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Pseudemys scripta* (Wied-Neuwied) |  |  |  |  |
|  |  |  |  | *Passer domesticus* (Rafinesque) |  |  |  |  |
|  |  |  |  | *Rattus norvegicus* (Berkenhout) |  |  |  |  |
|  |  |  |  | *Mus musculus* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Squalus acanthias* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Caiman crocodilus* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Lacerta viridis* (Laurenti) |  |  |  |  |
|  |  |  |  | *Octopus macro* (Cuvier) |  |  |  |  |
|  |  |  |  | *Octopus apollyon* (Wülker) |  |  |  |  |
|  |  |  |  | *Octopus bimaculatus* (Verrill) |  |  |  |  |
| 104 | Glia cells | (0) absent, (1) present | Eumetazoa | *Owenia fusiformis* (Delle Chiaje) | Hartline, 2011; Helm et al. 2017 | 1 | 100 | 100 |
|  |  |  |  | *Priapulus caudatus* (Lamarck) |  |  |  |  |
|  |  |  |  | *Asterias Rubens* (Linnaeus) |  |  |  |  |
| 105 | Spinal cord and encephalus | (0) absent, (1) present | Vertebrata |  | Lecointre & Le Guyader, 2006 | 1 | 100 | 100 |
| 106 | Nervous ring involving the pharynx | (0) absent, (1) present | Nematoda |  | Lecointre & Le Guyader, 2006 | 1 | - | - |
| 107 | Lateral line system | (0) absent, (1) present | Osteichthyes, Chondricthyes and Amphibia |  | Budelmann & Bleckmann, 1988; Kalmijn, 1988; Pichon & Ghysen, 2004; Lecointre & Le Guyader, 2006; Ghysen & Dambly-Chaudière, 2007; Nielsen, 2012; Baker et al. 2013 | 2 | 50 | 50 |
| 108 | Corpus Callosum Commission | (0) absent, (1) present | Mammalia |  | Suárez et al. 2014; Suárez et al. 2018 | 1 | - | - |
| 109 | Commission on the peripheral nervous system and spinal cord | (0) absent, (1) present | Vertebrata |  | Hill, 2016; Hickman et al. 2016 | 1 | 100 | 100 |
| 110 | Endogenous opioid receptors | (0) absent, (1) present | Eumetazoa | *Haemopis marmorata* (Say) | Stefano et al. 1980; Maldonado & Miralto, 1982; Djamgoz et al. 1981; Venturini et al. 1983; Núñez et al. 1983; Zabala et al. 1984; Kavaliers & Hirst, 1985; Kavaliers et al. 1985; Flanagan & Zipser, 1986; Lukowiak et al. 1986; Tzi Bum et al. 1986; Kavaliers, 1988; Lozada et al. 1988; Dalton & Widdowson, 1989; Valeggia et al. 1989; Leonard & Martiner-Padron, 1991; Zabala & Gomez, 1991; Bergamo et al. 1992; Dyakonova et al. 1992; Dyakonova & Sakharov, 1994; Chen et al. 1997; Cadet & Stefano, 1999; Dyakonova et al. 1999; Dyakonova, 2001; Machin, 2001; Dreborg et al. 2008; Miller-Pérez et al. 2008; Nordström et al. 2008; Im & Galko, 2012; Mans et al. 2012; Guo et al. 2013; Raffa et al. 2013; Sha et al. 2013; Mills et al. 2016; Scanes & Pierzchala-Koziec, 2018 | 1 | 100 | 100 |
|  |  |  |  | *Periplaneta americana* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Gryllus bimaculatus* (De Geer) |  |  |  |  |
|  |  |  |  | *Apis mellifera adansonii* (Lepeletier) |  |  |  |  |
|  |  |  |  | *Drosophila melanogaster* (Meigen) |  |  |  |  |
|  |  |  |  | Pteronemobius sp. |  |  |  |  |
|  |  |  |  | *Stagmatoptera biocellata* (Saussure) |  |  |  |  |
|  |  |  |  | *Chasmagnatus granulatus* (Türkay & Yang) |  |  |  |  |
|  |  |  |  | *Carcinus mediterraneus* (Czerniavsky) |  |  |  |  |
|  |  |  |  | *Chlamys farreri* (Müller) |  |  |  |  |
|  |  |  |  | *Squilla mantis* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Aplysia californica* (James Graham Cooper) |  |  |  |  |
|  |  |  |  | *Helix pomatia* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Lymnaea stagnalis* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Cepaea nemoralis* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Arion ater* |  |  |  |  |
|  |  |  |  | *Helix aspersa* (O. F. Müller) |  |  |  |  |
|  |  |  |  | *Mytilus edulis* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Octopus ocellatus* (Gray) |  |  |  |  |
|  |  |  |  | *Dugesia dorotocephala* |  |  |  |  |
|  |  |  |  | *Branchiostoma floridae* (Costa) |  |  |  |  |
|  |  |  |  | *Homo sapiens* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Mus musculus* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Canis lupus familiaris* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Bos taurus* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Monodelphis domestica* (Wagner) |  |  |  |  |
|  |  |  |  | *Gallus gallus* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Xenopus tropicalis* (Gray) |  |  |  |  |
|  |  |  |  | *Taricha granulosa* (Skilton) |  |  |  |  |
|  |  |  |  | *Danio rerio* (Hamilton-Buchanan) |  |  |  |  |
|  |  |  |  | *Oryzias latipes* (Temminck & Schlegel) |  |  |  |  |
|  |  |  |  | *Gasterosteus aculeatus* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Tetraodon nigroviridis* (Marion de Procé) |  |  |  |  |
|  |  |  |  | *Hydrophis cyanocinctus* (Daudin) |  |  |  |  |
|  |  |  |  | *Lapemis hardwickii* (Gray) |  |  |  |  |
|  |  |  |  | *Trachemys scripta elegans* (Wied-Neuwied) |  |  |  |  |
| 111 | Statocyst | (0) absent, (1) present | Ctenophora, Cnidaria, Crustacea, Platyhelminthes, Annelida, Gastropoda, Bivalvia, Cephalopoda, Echinodermata and Urochordata |  | Schmidt-Rhaesa, 2007; Giribet & Edgecombe, 2020 | 3 | 33 | 77 |
| 112 | Primary sensory cell | (0) absent, (1) present | Porifera, Cnidaria, Nematoda, Arthropoda, Crustacea, Myriapoda, Cephalopoda, Bivalvia, Gastropoda, Annelida, Ctenophora, Chelicerata | *Ephydatia muelleri* (Lieberkühn) | Crisp, 1971; Jouin et al. 1985; Arkett et al. 1988; Brandt, 1988; Schaefer, 2000; Fritzsch & Beisel, 2001; Lewis, 2006; Manley & Ladher, 2008; Adams, 2010; Ludeman et al. 2014; Leys, 2015; Foelix & Chu-Wang, 1973; Giribet & Edgecombe, 2020 | 1 | - | - |
|  |  |  |  | *Nucula nucleus* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Nassarius reticulatus* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Arenicola marina* (Linnaeus) |  |  |  |  |
|  |  |  |  | *Sphaeroma hookeri* (Leach) |  |  |  |  |
|  |  |  |  | *Aglantha digitale* (Muller) |  |  |  |  |
|  |  |  |  | *Necrophloeophagus longicornis* (Leach) |  |  |  |  |
|  |  |  |  | *Araneus diadematus* (Clerck) |  |  |  |  |
| 113 | Secondary sensory cell | (0) absent, (1) present | Chordata and Cephalopoda | *Botryllus schlosseri* (Pallas) | Fritzsch & Beisel, 2001; Burighel et al. 2003; Lacalli, 2004; Manley & Ladher, 2008 | 2 | 50 | 87 |
|  |  |  |  | *Botrylloides violaceus* (Oka) |  |  |  |  |
|  |  |  |  | *Branchiostoma floridae* (Costa) |  |  |  |  |
| 114 | Presence of immobile cilia in the sensory cell | (0) absent, (1) present | Cnidaria, Nematoda, Hexapoda, Crustacea, Chelicerata, Myriapoda, Annelida, Gastropoda, Bivalvia, Cephalopoda, Chordata |  | Fritzsch & Beisel, 2001; Manley & Ladher, 2008 | 1 |  |  |
| 115 | Condition of cilium during ontogeny | (0) absent, (1) present only the ontogeny | Aves and Mammalia |  | Manley & Ladher, 2008 | 2 | 50 | 0 |
| 116 | Microvillium present in mechanoreceptor sensory cells | (0) absent, (1) present | Cnidaria, Annelida, Gastropoda, Bivalvia, Urochordata, Vertebrata |  | Manley & Ladher, 2008 | 3 | 33 | 71 |
| 117 | Support cells in the mechanoreceptors | (0) absent, (1) present | Urochordata and Vertebrata |  | Fritzsch & Beisel, 2001; Manley & Ladher, 2008 | 1 | 100 | 100 |
| 118 | Afferent and efferent nerves connected to the cell or sensory organ | (0) absent, (1) present | Chordata |  | Manley & Ladher, 2008 | 2 | 50 | 88 |
| 119 | The presence of dome in mechanoreceptor organs | (0) absent, (1) present | Urochordata and Vertebrata |  | Fritzsch & Beisel, 2001; Manley & Ladher, 2008 | 1 | 100 | 100 |
| 120 | Brain ganglia | (0) absent, (1) present | Ecdysozoa, Platyhelminthes, Annelida, Gastropoda, Cephalopoda, Cephalochordata and Vertebrata |  | Schmidt-Rhaesa, 2007; Hill, 2016; | 2 | 50 | 50 |
| 121 | Position of the central nervous system | (0) subepidermal, (1) basiepithelial, (2) invaginations | Cnidaria, Deuterostomia and Protostomia |  | Schmidt-Rhaesa, 2007 | 2 | 100 | 100 |

**Table S3.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Gene name | Coding | Taxa | Name of the species used | ID genbank |
| 18S | - | Annelida | *Platynereis dumerilii* | EF117897.1 |
|  | - | Bivalvia | *Mytilus galloprovincialis* | L33452.1 |
|  | - | Cephalochordata | *Branchiostoma floridae* | M97571.1 |
|  | - | Choanoflagellata | *Monosiga brevicollis* | AF174375.1 |
|  | - | Cnidaria | *Hydra sp.* | DQ683368.1 |
|  | - | Crustacea | *Daphnia magna* | AM490278.1 |
|  | - | Ctenophora | *Pleurobrachia pileus* | AF293678.1 |
|  | - | Echinodermata | *Strongylocentrotus intermedius* | D14365.1 |
|  | - | Gastropoda | *Aplysia californica* | AY039804.1 |
|  | - | Hexapoda | *Drosophila melanogaster* | M21017.1 |
|  | - | Mammalia | *Homo sapiens* | X03205.1 |
|  | - | Nematoda | *Xiphinema sp.* | AY687997.1 |
|  | - | Platyhelminthes | *Dugesia japonica* | AF013153.1 |
|  | - | Porifera | *Suberites ficus* | AJ627184.1 |
|  |  |  |  |  |
| Chordin e Sog |  | Amphibia | *Xenopus laevis* | L35764.1 |
|  |  | Aves | *Gallus gallus* | AF031230.1 |
|  |  | Cephalochordata | *Branchiostoma floridae* | DQ644539.1 |
|  |  | Chelicerata | *Ixodes scapularis* | XM\_029969250.1 |
|  |  | Chondrichthyes | *Rhincodon typus* | XM\_020528812.1 |
|  |  | Crocodilia | *Crocodylus porosus* | XM\_019532522.1 |
|  |  | Crustacea | *Artemia franciscana* | AB236149.1 |
|  |  | Hexapoda | *Drosophila melanogaster* | U18774.1 |
|  |  | Lepidosauria | *Protobothrops mucrosquamatus* | XM\_015827790.1 |
|  |  | Mammalia | *Mus musculus* | AF069501.1 |
|  |  | Nematoda | *Trichinella spiralis* | BG732136.1 |
|  |  | Actinopterygii | *Danio rerio* | AF034606.1 |
|  |  | Testudinata | *Chrysemys picta* | XM\_005314745.2 |
|  |  |  |  |  |
| Deg Enac |  | Amphibia | *Rana catesbeiana* | AF514846.1 |
|  |  | Aves | *Gallus gallus* | U58475.1 |
|  |  | Cnidaria | *Hydra magnipapillata* | HG422731.1 |
|  |  | Crocodilia | *Crocodylus porosus* | KU351662.1 |
|  |  | Crustacea | *Penaeus vannamei* | XM\_027366820.1 |
|  |  | Hexapoda | *Drosophila melanogaster* | NM\_057884.5 |
|  |  | Mammalia | *Ovis aries* | AF250862.1 |
|  |  |  |  |  |
| NomP |  | Amphibia | *Xenopus laevis* | AJ576027.1 |
|  |  | Crustacea | *Amphibalanus improvisus* | MK093193.1 |
|  |  | Hexapoda | *Periplaneta americana* | MK598065.1 |
|  |  | Nematoda | *Brugia malayi* | XM\_001894330.1 |
|  |  | Actinopterygii | *Danio rerio* | AY313897.1 |
|  |  |  |  |  |
| Prdm12 |  | Amphibia | *Xenopus tropicalis* | NM\_001079430.1 |
|  |  | Annelida | *Platynereis dumerilii* | LN811430.1 |
|  |  | Aves | *Corvus moneduloides* | XM\_032130946.1 |
|  |  | Cephalochordata | *Branchiostoma lanceolatum* | KP235486.1 |
|  |  | Cnidaria | *Hydra vulgaris* | HAAD01001133.1 |
|  |  | Crocodilia | *Crocodylus porosus* | XM\_019541136.1 |
|  |  | Chondrichthyes | *Rhincodon typus* | XM\_020536001.1 |
|  |  | Lepidosauria | *Protobothrops mucrosquamatus* | XM\_015820338.1 |
|  |  | Mammalia | *Mus musculus* | NM\_001123362.1 |
|  |  | Actinopterygii | *Anabas testudineus* | XM\_026356344.1 |
|  |  |  |  |  |
| Trpa1 |  | Amphibia | *Xenopus tropicalis* | NM\_001127962.1 |
|  |  | Aves | *Gallus gallus* | NM\_001318460.1 |
|  |  | Cnidaria | *Urticina eques* | LT600337.1 |
|  |  | Chondrichthtyes | *Rhincodon typus* | XM\_020521416.1 |
|  |  | Crocodilia | *Crocodylus porosus* | XM\_019543795.1 |
|  |  | Hexapoda | *Drosophila melanogaster* | NM\_001274673.1 |
|  |  | Mammalia | *Homo sapiens* | NM\_007332.3 |
|  |  | Actinopterygii | *Oncorhynchus kisutch* | XM\_031796945.1 |
|  |  | Platyhelminthes | *Schmidtea mediterranea* | MF818036.1 |
|  |  | Chelicerata | *Tropilaelaps mercedesae* | LC126329.1 |
|  |  | Lepidosauria | *Protobothrops jerdonii* | JN164328.1 |
|  |  | Testudinata | *Terrapene carolina* | XM\_029913335.1 |
|  |  |  |  |  |
| Trpv1 |  | Amphibia | *Xenopus laevis* | HM015002.1 |
|  |  | Aves | *Gallus gallus* | NM\_204572.1 |
|  |  | Bivalvia | *Crassostrea gigas* | XM\_020070543.1 |
|  |  | Chondrichthyes | *Callorhinchus milii* | XM\_007896535.1 |
|  |  | Cnidaria | *Pocillopora damicornis* | XM\_027180696.1 |
|  |  | Crocodilia | *Crocodylus porosus* | XM\_019545744.1 |
|  |  | Hexapoda | *Stomoxys calcitrans* | XM\_013247311.1 |
|  |  | Lepidosauria | *Crotalus atrox* | GU562968.1 |
|  |  | Mammalia | *Rattus norvegicus* | NM\_031982.1 |
|  |  | Nematoda | *Caenorhabditis elegans* | AF031408.1 |
|  |  | Actinopterygii | *Salmo salar* | NM\_001140498.1 |
|  |  | Testudinata | *Chelonia mydas* | XM\_007057655.2 |
|  |  |  |  |  |
| Trpc3 |  | Amphibia | *Xenopus tropicalis* | XM\_002941893.5 |
|  |  | Aves | *Gallus gallus* | NM\_001257279.3 |
|  |  | Chondrichthyes | *Callorhinchus milii* | XM\_007908270.1 |
|  |  | Cnidaria | *Acropora millepora* | EZ036179.1 |
|  |  | Crocodilia | *Crocodylus porosus* | XM\_019534007.1 |
|  |  | Lepidosauria | *Protobothrops mucrosquamatus* | XM\_015825948.1 |
|  |  | Mammalia | *Homo sapiens* | NM\_001130698.2 |
|  |  | Actinopterygii | *Danio rerio* | NM\_001289884.2 |
|  |  | Testudinata | *Chrysemys picta* | XM\_005290277.2 |
|  |  |  |  |  |
| Trpm8 |  | Amphibia | *Xenopus tropicalis* | NM\_001161633.1 |
|  |  | Aves | *Gallus gallus* | NM\_001007082.1 |
|  |  | Bivalvia | *Crassostrea gigas* | XM\_011427266.2 |
|  |  | Chelicerata | *Limulus polyphemus* | XM\_022393899.1 |
|  |  | Cnidaria | *Exaiptasia pallida* | XM\_021039276.2 |
|  |  | Crocodilia | *Crocodylus porosus* | XM\_019554547.1 |
|  |  | Crustacea | *Hyalella azteca* | XM\_018169005.1 |
|  |  | Gastropoda | *Pomacea canaliculata* | XM\_025227811.1 |
|  |  | Hexapoda | *Folsomia candida* | XM\_022097930.1 |
|  |  | Lepidosauria | *Protobothrops mucrosquamatus* | XM\_015824215.1 |
|  |  | Mammalia | *Homo sapiens* | NM\_024080.5 |
|  |  | Actinopterygii | *Oncorhynchus kisutch* | XM\_020502951.2 |
|  |  | Testudinata | *Chelonia mydas* | XM\_007067689.2 |
|  |  |  |  |  |
| Piezo |  | Amphibia | *Nanorana parkeri* | XM\_018566479.1 |
|  |  | Aves | *Gallus gallus* | XM\_015292664.2 |
|  |  | Bivalvia | *Crassostrea virginica* | XM\_022489339.1 |
|  |  | Cephalopoda | *Octopus bimaculoides* | XM\_014926523.1 |
|  |  | Chelicerata | *Metaseiulus occidentalis* | XM\_029112534.1 |
|  |  | Chondrichthyes | *Rhincodon typus* | XM\_020518563.1 |
|  |  | Cnidaria | *Acropora digitifera* | XM\_015893665.1 |
|  |  | Crocodilia | *Crocodylus porosus* | XM\_019535454.1 |
|  |  | Ctenophora | *Beroe abyssicola* | KX853884.1 |
|  |  | Gastropoda | *Biomphalaria glabrata* | XM\_013228983.1 |
|  |  | Hexapoda | *Drosophila melanogaster* | JQ425255.1 |
|  |  | Mammalia | *Homo sapiens* | NM\_001142864.4 |
|  |  | Actinopterygii | *Erpetoichthys calabaricus* | XM\_028809744.1 |
|  |  | Porifera | *Amphimedon queenslandica* | XM\_019993751.1 |
|  |  | Testudinata | *Chrysemys picta* | XM\_005292228.2 |
|  |  |  |  |  |
| Pkd2 |  | Amphibia | *Xenopus tropicalis* | XM\_002938627.5 |
|  |  | Aves | *Corvus moneduloides* | XM\_032109117.1 |
|  |  | Chelicerata | *Cupiennius salei* | GBFC01000036.1 |
|  |  | Chondrichthyes | *Callorhinchus milii* | XM\_007892042.1 |
|  |  | Cnidaria | *Acropora millepora* | EZ002783.1 |
|  |  | Crocodilia | *Crocodylus porosus* | XM\_019553067.1 |
|  |  | Echinodermata | *Strongylocentrotus purpuratus* | NM\_214662.1 |
|  |  | Hexapoda | *Drosophila melanogaster* | NM\_135717.3 |
|  |  | Lepidosauria | *Pseudonaja textilis* | XM\_026698334.1 |
|  |  | Mammalia | *Homo sapiens* | NM\_000297.4 |
|  |  | Nematoda | *Caenorhabditis remanei* | XM\_003095136.1 |
|  |  | Actinopterygii | *Danio rerio* | AY618926.1 |
|  |  | Platyhelminthes | *Schmidtea mediterranea* | KT163777.1 |
|  |  | Testudinata | *Gopherus evgoodei* | XM\_030565088.1 |

**Table S4.**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Taxa | Species | Reference |
| Classic conditioning | Echinodermata | *Luidia clathrata* (Say) | Mcclintock & Lawrence, 1982. |
|  | Arthropoda | *Apis mellifera* (Linnaeus) | Bitterman et al. 1983. |
|  | Arthropoda | *Bombus terrestris L.* (Linnaeus) | Laloi et al. 1999. |
|  | Arthropoda | *Schistocerca gregaria* (Forsskål) | Simões et al. 2011. |
|  | Arthropoda | *Periplaneta americana* (Linnaeus) | Watanabe et al. 2003 |
|  | Arthropoda | *Bombus terrestris* (Linnaeus) | Colborn et al. 1999. |
|  | Arthropoda | *Microplitis croceipes* (Cresson) | Lewis & Tumlinson, 1988 |
|  | Arthropoda | *Drosophila melanogaster* (Meigen) | Quinn et al. 1974 |
|  | Arthropoda | *Phormia regina* (Meigen) | Nelson, 1971. |
|  | Arthropoda | *Battus philenor* (Linnaeus) | Weiss & Papaj, 2003. |
|  | Arthropoda | *Myrmica sabuleti* (Meinert) | Cammaerts, 2004. |
|  | Arthropoda | *Cataglyphis fortis* (Forel) *Melophorus bagoti* (Lubbock) | Schwarz & Cheng, 2010 |
|  | Arthropoda | *Chasmagnathus granulatus* (Dana) | Dimant & Maldonado, 1992 |
|  | Arthropoda | *Chasmagnathus granulatus* (Dana) | Fustinana et al. 2013. |
|  | Arthropoda | *Procambarus clarkii* (Girard) | Arzuffi et al. 2000 |
|  | Arthropoda | *Panulirus argus* (Latreille) | Fine-Levy et al. 1988 |
|  | Arthropoda | *Phidippus princeps* (Peckham & Peckham) | Jakob et al. 2007. |
|  | Arthropoda | *Hasarius adansoni* (Audouin) | Nakamura & Yamashita, 2000. |
|  | Arthropoda | *Phrynus marginemaculatus* (C. L. Koch) | Santer & Hebets, 2009. |
|  | Mollusca | *Octopus vulgaris* (Cuvier) | Sutherland, 1957. |
|  | Mollusca | *Sepia officinalis* (Linnaeus) | Cole & Adamo, 2005 |
|  | Nematoda | *Caenorhabditis elegans* (Maupas) | Wen et al. 1997. |
|  | Nematoda | *Caenorhabditis elegans* (Maupas) | Morrison, 1999 |
|  | Annelida | *Macrodella ditetra* | Henderson, 1972 |
|  | Annelida | *Hirudo medicinalis* (Linnaeus) | Sahley et al. 1994. |
|  | Annelida | *Lumbricus terrestres* (Linnaeus) | Herz et al. 1967. |
|  | Mollusca | *Aplysia californica* (James Graham Cooper) | Lechner, 2000. |
|  | Mollusca | *Aplysia californica* (James Graham Cooper) | Carew et al. 1981. |
|  | Mollusca | *Lymnaea stagnalis* (Linnaeus) | Kemenes et al. 1997. |
|  | Mollusca | *Limax maximus* (Linnaeus) | Sahley et al. 1981. |
|  | Platyhelminthes | *Dugesia dorotocephala* | Block & Mcconnell, 1967. |
|  | Platyhelminthes | *Dugesia japonica, Dugesia dorotocephala e Schmidtea mediterranea* | Shomrat & Levin, 2013. |
|  | Cnidaria | *Cribrina xanthogrammica* (Brandt) | Haralson & Groff, 1975. |
|  | Mammalia | *Mus musculus* (Linnaeus) | Bouslama et al. 2005. |
|  | Squamata | Amplo no grupo | Powers, 1990. |
|  | Testudinata | Amplo no grupo | Powers, 1990. |
|  | Actinopterygii | *Oncorhynchus mykiss* | Nordgreen et al. 2010 |
|  | Arthropoda | Apis mellifera (Linnaeus) | VERGOZ, Vanina et al. Aversive learning in honeybees revealed by the olfactory conditioning of the sting extension reflex. PloS one, v. 2, n. 3, 2007. |
|  | Mollusca | *Aplysia californica* (James Graham Cooper) | WALTERS, Edgar T.; CAREW, Thomas J.; KANDEL, Eric R. Associative learning in Aplysia: Evidence for conditioned fear in an invertebrate. Science, v. 211, n. 4481, p. 504-506, 1981. |
|  | Hexapoda | *Gryllus bimaculatus* (De Geer) | AWATA, Hiroko et al. Knockout crickets for the study of learning and memory: Dopamine receptor Dop1 mediates aversive but not appetitive reinforcement in crickets. Scientific reports, v. 5, p. 15885, 2015. |
|  | Chelicerata | Discocyrtus invalidus (Piza) | DOS SANTOS, Gilson Costa; HOGAN, Jerry A.; WILLEMART, Rodrigo Hirata. Associative learning in a harvestman (Arachnida, Opiliones). Behavioural processes, v. 100, p. 64-66, 2013. |
|  | Actinopterygii | Danio rerio | Sison et al. 2010 |
|  | Hexapoda | *Apis sp.* | Nargeot & Bedecarrats, 2019. |
|  | Gastropoda | *Aplysia sp.* | Nargeot & Bedecarrats, 2019. |
|  | Gastropoda | Hermissenda sp. | Nargeot & Bedecarrats, 2019. |

**Table S5.**

|  |  |  |  |
| --- | --- | --- | --- |
| Operant conditioning | Taxa | Species | Reference |
|  | Arthropoda | *Apis mellifera* (Linnaeus) | Kisch & Erber, 1999. |
|  | Arthropoda | *Bombus terrestris* (Linnaeus) | Leadbeater & Chittka, 2009. |
|  | Arthropoda | *Schistocerca americana* (Drury) | Forman, 1984. |
|  | Arthropoda | *Periplaneta americana* (Linnaeus) | Eisenstein & Carlson,1994. |
|  | Arthropoda | *Drosophila melanogaster* (Meigen) | Brembs & Heisenberg, 2000. |
|  | Arthropoda | *Drosophila melanogaster* (Meigen) | Wustmann et al. 1996. |
|  | Arthropoda | *Protophormia terrae novae* (Robineau Desvoidy) | Sokolowski et al. 2010. |
|  | Arthropoda | *Manduca sexta* (Linnaeus) | Cammaerts Tricot et al. 2012. |
|  | Arthropoda | *Carcinus maenas* (Leach) | Abramson & Feinman, 1987. |
|  | Arthropoda | *Carcinus maenas* (Leach) | Abramson & Feinman, 1990. |
|  | Arthropoda | *Procambarus elarkii* (Girard) *Cambarus diogenes* (Girard) | Stafstrom & Gerstein, 1977. |
|  | Arthropoda | *Procambarus clarkii* (Girard) | Kawai et al. 2004. |
|  | Arthropoda | *Homarus americanos* (H. Milne-Edwards) | Tomina & Takahata, 2010. |
|  | Mollusca | *Octopus cyanea* (Gray) | Papin & Bitterman, 1991. |
|  | Mollusca | *Octopus cyanea* (Gray) | Crancher et al. 1972. |
|  | Mollusca | *Aplysia californica* (James Graham Cooper) | Brembs, 2003. |
|  | Mollusca | *Lymnaea stagnalis* (Linnaeus) | Lukowiak et al, 1996. |
|  | Mollusca | *Lymnaea stagnalis* (Linnaeus) | Kobayashi, 1998. |
|  | Testudinata | *Aldabrachelys gigantea* (Schweigger) | Gutnick et al. 2019. |
|  | Crocodilia |  | Murphy, J. B., Evans, M., Augustine, L., & Miller, K. (2016). Behaviors in the Cuban Crocodile (Crocodylus rhombifer). Herpetological Review. |
|  | Lepidosauria | *Bassiana duperreyi* (Gray) | Clark et al. 2014. |

**Table S6.**

|  |  |  |  |
| --- | --- | --- | --- |
| Mechanical stimuli | Taxa | Species | Reference |
| Nematoda | *Caenorhabditis elegans (Maupas)* | Tobin & Bargmann, 2004. |
| Ctenophora | *Mnemiopsis leidyi (Agassiz)* | Kreps et al., 1997. |
| Ctenophora | *Euplokamis dunlapae (Mills)* | Mackie et al., 1992. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Milinkeviciute et al., 2012. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Tracey, 2017. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Johson & Carder, 2012. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Im & Galko, 2012. |
| Crustacea | Crustacea geral | Lenz & Hartline, 2014. |
| Annelida | *Hirudo medicinalis (Linnaeus)* | Smith & Lewin, 2009. |
| Annelida | *Hirudo medicinalis (Linnaeus)* | Tracey, 2017. |
| Gastropoda | *Aplysia californica (James Graham Cooper)* | Crook et al., 2011. |
| Echinodermata | Amplo (várias espécies) | Garm, 2017 |
| Peixes osseos | *Oncorhynchus mykiss (Walbaum)* | Smith & Lewin, 2009. |
| Amphibia | Amphibia | Webb, 2013. |
| Mammalia | *Mus musculus (Linnaeus)* | Sneddon, 2017. |
| Mammalia | *Rattus norvegicus (Berkenhout) Mus musculus (Linnaeus)* | Tracey, 2017. |
| Reptilia | *Alligator mississippiensis (Daudin)* | Smith & Lewin, 2009. |
| Cephalopoda | *Doryteuthis pealeii (Lesueur)* | Crook et al., 2013. |
| Gastropoda | *Aplysia californica (James Graham Cooper)* | Illich & Walters, 1997. |
| Cnidaria | *Calliactis parasitica (Couch)* | Passano & Pantin,1955. |
| Nematoda | *Caenorhabditis elegans (Maupas)* | Wong & Rankin, 2019. |
| Porifera | Amplo | Mah & Leys, 2017 |
| Cephalochordata | Amphioxus | Lacalli, 2004. |
| Urochordata | Classe Thaliacea | Madin, 1995. |
| Amniota | Todos os amniotas | Muller et al., 2018. |
| Cephalopoda | *Sepia officinalis (Linnaeus)* | Carere et al., 2015. |
| Chelicerata | *Limulus* | Kaplan et al 1976 |
| Polyplachophora | Polyplachophora | Crook & Walters, 2011. |
| Thermal stimuli | Nematoda | *Caenorhabditis elegans (Maupas)* | Tobin & Bargmann, 2004. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Smith & Lewin, 2009. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Tracey, 2017. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Johnson & Carder, 2012. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Im & Galko, 2012. |
| Platyhelminthes | *Schmidtea mediterrânea (Puccinelli & Del Papa)* | Arenas et al., 2017. |
| Annelida | *Hirudo medicinalis (Linnaeus)* | Smith & Lewin, 2009. |
| Annelida | *Hirudo medicinalis (Linnaeus)* | Tracey, 2017. |
| Peixes osseos | *Oncorhynchus mykiss (Walbaum)* | Smith & Lewin, 2009. |
| Amniota | Todos os amniotas | Muller et al., 2018. |
| Mammalia | *Mus musculus (Linnaeus)* | Sneddon, 2017. |
| Mammalia | *Rattus norvegicus (Berkenhout) Mus musculus (Linnaeus)* | Tracey, 2017. |
| Crustacea | *Procambarus clarkii* | Puri & Faulkes, 2015 |
| Gastropoda | *Lymnaea auricularia* | Rossetti & Cabanac, 2006. |
| Nematoda | *C. elegans (Maupas)* | Wong & Rankin, 2019; Bargmann et al., 1990; Hilliard, 2002. |
| Chemical stimuli | Cnidaria | *Hydra vulgaris (Pallas)* | Malafoglia et al., 2016. |
| Echinodermata | *Luidia clathrata* | Mcclintock et al., 1984. |
| Echinodermata | Amplo | Garm, 2017 |
| Nematoda | *Caenorhabditis elegans (Maupas)* | Smith & Lewin, 2009. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Sneddon, 2017. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Tracey, 2017. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Johnson & Carder, 2012. |
| Arthropoda | *Drosophila melanogaster (Meigen)* | Im & Galko, 2012. |
| Platyhelminthes | *Schmidtea mediterranea (Puccinelli & Del Papa)* | Arenas et al., 2017 |
| Annelida | *Hirudo medicinalis (Linnaeus)* | Smith & Lewin, 2009. |
| Annelida | *Hirudo medicinalis (Linnaeus)* | Tracey, 2017. |
| Polyplachophora | Polyplachophora | Crook & Walters, 2011. |
| Peixes osseos | *Oncorhynchus mykiss (Walbaum)* | Smith & Lewin, 2009. |
| Amphibia | *Rana pipiens (Schreber)* | Smith & Lewin, 2009. |
| Amphibia | *Rana pipiens (Schreber)* | Sneddon, 2017. |
| Mammalia | *Mus musculus (Linnaeus)* | Sneddon, 2017. |
| Mammalia | *Rattus norvegicus (Berkenhout) Mus musculus (Linnaeus)* | Tracey, 2017. |
| Chondrichthyes | *Raja clavata* | Whitear & Moate, 1994 |
| Amniota | Todos os amniotas | Muller et al., 2018. |
| Crustacea | *Panulirus argus* | Kozma et al., 2018. |
| Crustacea | Crustacea geral | Lenz & Hartline, 2014. |
| Porifera | Amplo | Mah & Leys, 2017 |
| Gastropoda | *Megalobulimus abbreviatus* | Kalil-Gaster et al., 2007. |
| Bivalvia | *Crassostrea gigas* e *Mytilus trossulus* | Levinton et al., 2002. |
| Polyplachophora | *Lepidopleurida* | Sigwart et al., 2014 |
| Chelicerata | *Limulus* | Barber, 1956 |
| Cephalopoda | Gênero *Octopus* | Mather, 2008. |
| Cephalochordata | Amphioxus | Lacalli, 2004. |
| Urochordata | Classe Thaliacea | Madin, 1995. |
| Reptilia | *Alligator mississippiensis (Daudin)* | Smith & Lewin, 2009. |