

Prof. John N. Maina

Respiratory Morphology

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Academic Qualifications:

B.V.M. - University of Nairobi (1979)
Ph.D. - University of Liverpool (1982)
D.V.Sc. - University of Liverpool (1999)

Experience to Date:

1978: Tutorial Fellow: Department of Veterinary Anatomy University of Nairobi.
1979 - 1982: Assistant Lecturer: University of Liverpool
1982: Lecturer: University of Nairobi.
1983: Senior Lecturer: University of Nairobi.
1986: Associate Professor: University of Nairobi.
1988-1995: Chairman/Head: Department of Veterinary Anatomy, University of Nairobi.
1989: Visiting Fulbright Professor: Department of Anatomy, School of Veterinary Medicine, University of California, Davis.
1989: Professor: University of Nairobi
1991: Professor: University of Nairobi.
1991: Royal Society Visiting Senior Research Scholar: Department of Human Anatomy and Cell Biology, University of Liverpool
1993: Distinguished Visiting Hooker Professor: Department of Biology, McMaster University
1995: Distinguished Visiting Hooker Professor: Department of Biology, McMaster University
1995: Visiting Professor: Department of Zoology and Physiology, University of Wyoming
1996: Visiting Professor: Department of Veterinary Anatomy and Cell Biology, University of California, Davis
1997: National Research Foundation rating B3
2002: National Research Foundation rating B1.
2002 - 2003: Visiting Research Scientist: Department of Medicine, University of California, San Diego
Professor, Head, School of Anatomical Sciences, University of the Witwatersrand.
2007: National Research Foundation rating A2.
2009 - 2011: Honorary Professorial Research Fellow, School of Anatomical Sciences, University of the Witwatersrand
2009 - 2011: Visiting Professor, School of Anatomy, University of Sydney
2009 - present: Research Professor: University of Johannesburg

Post-graduate Students:

PhD-students:

R. McNeil: Molecular biology of the developing avian lung.

J.S. Adekunle: Structural failure of the blood-gas barrier of the avian lung.

MSc students:

A. Butera: Anatomic study of posterior arch and lateral mass of atlas and its relation to a safe posterior lateral mass screw fixation. (MMed).

M. Kietzmann: Morphometric study of the nasal passages of the South African ungulates.

D. Reddy: Development of the avian and reptilian lungs.

W. Fourie: The role of tensor fascia lata in postural adjustments of the human leg: a tensegrity system?

Research Interests:

My research interest and activity is in the area of *Comparative Functional Respiratory Morphology*. Adaptive respiratory structural aspects have been investigated in animals at different phylogenetic levels of development, embryonic stages of development, those that lead various behaviours and pursue different lifestyles and those inhabiting diverse ecological environments and habitats, especially the extreme ones. Broad approaches are adopted in order to seek out the most robust answers to the research question(s) posed. Microscopic, stereological, molecular, mathematical and computational modeling, and three-dimensional (3-D) computer reconstruction techniques are used.

The current research investigations include study of: the structural failure of the avian lung; the molecular aspects of the development of the avian lung, with particular emphasis on the roles of the vascular endothelial growth factor (VEGF) and the fibroblast growth factors 7 and 10 (FGF-7 and FGF-10); the functional morphology of the multicameral crocodylian lung (the closest evolutionary analogue to avian lung), and; the role of tensor fascia late as an integral part of the tensegrity system of the human body.

Investigations that are due to start are on: the cellular defence mechanisms of the avian lung with particular focus on the role of the nucleated avian red blood cells; the molecular aspects of the development of the air sacs of the avian lung; computational fluid dynamics (CFD) modeling of the expiratory aerodynamic valving as means of explicating the air flow dynamics of the avian lung; the handling of particulates, especially nanoparticles, by the avian lung; assessment of the levels harmful gaseous and particulates in South African mines, and; the respiratory adaptive strategies of the high alkalinity adapted tilapia fish, *Alcolapia grahmi*, of Lake Magadi, Kenya.

Publications:

1. MAINA, J.N. (1981): Morphometry of the passerine and non-passerine lungs. Zentralblatt of Veterinary Medicine Series C, Anatomy, Histology, and Embryology, 9: 366-367.
2. MAINA, J.N. (1981): Morphometric study of the blood-gas barrier of the avian lung. Journal of Anatomy, London 133: 130.
3. ABDALLA, M.A. AND MAINA, J.N. (1981): Quantitative analysis of the exchange tissue of the avian lung (Galliformes). Journal of Anatomy, London 134: 677-680.
4. MAINA, J.N., HOWARD, C.V. AND SCALES, L. (1981): The determination of the length densities and size distribution of blood and air capillaries in the avian lung involving a log normal fitting procedure. Stereologica Yugoslavica, 3: 673-678.
5. MAINA, J.N. (1982): A morphometric comparison of the lungs of two species of birds of different exercise capacities. Journal of Anatomy, London 134: 604-605.
6. MAINA, J.N. AND NICHOLSON, T. (1982): The morphometric diffusing capacity of a bat *Epomophorus wahlbergi*. Journal of Physiology, London 325: 36-37.
7. MAINA, J.N. AND SETTLE, J.G. (1982): Allometric comparison of some morphometric parameters of avian and mammalian lungs. Journal of Physiology, London 330: 28.
8. MAINA, J.N. (1982): Relationship between pulmonary morphometric characteristics and energetic requirements in four avian orders. Journal of Anatomy, London 135: 825.
9. MAINA, J.N., HOWARD, C.V. AND SCALES, L. (1982): The length densities and size distributions of the air and blood capillaries of the paleopulmo and neopulmo regions of the avian lung. Acta Stereologica, 2: 101-107.
10. MAINA, J.N. (1982): A stereological analysis of the paleopulmo and neopulmo respiratory regions of the avian lung (*Streptopelia decaocto*). International Research Communication System, Biochemistry 10: 328.
11. ABDALLA, M.A., MAINA, J.N., KING, A.S., KING, D.Z. AND HENRY, J. (1982): Morphometrics of the avian lung. 1. The domestic fowl *G. gallus domesticus*). Respiration Physiology, 47: 267-278.
12. MAINA, J.N. AND KING, A.S. (1982): The thickness of the avian blood-gas barrier: Quantitative and quantitative observations. Journal of Anatomy, London 134: 553-562.

13. MAINA, J.N., ABDALLA, M.A. AND KING, A.S. (1982): Light microscopic morphometry of the lungs of 19 avian species. *Acta Anatomica*, 112: 264-270.
14. MAINA, J.N., KING, A.S. AND KING, D.Z. (1982): A morphometric analysis of the lungs of a species of bat. *Respiration Physiology*, 50: 1-11.
15. MAINA, J.N. (1982): A scanning electron microscopic study of the air and blood capillaries of the lung of the domestic fowl (*Gallus domesticus*). *Experientia*, 35: 614-616.
16. MAINA, J.N. AND KING, A.S. (1982): Morphometrics of the avian lung. 2. The wild mallard *Anas platyrhynchos*) and greylag goose (*Anser anser*). *Respiration Physiology*, 50: 299-313.
17. MAINA, J.N. (1982): Qualitative and Quantitative Observations on the Lungs of Aves with comments on the Lung of a Species of Chiroptera. A Morphological Study. Ph.D.Thesis, University of Liverpool.
18. MAINA, J.N., KING, A.S. AND KING, D.Z. (1983): Lung volume-body weight correlation in birds and mammals. *Zentralblatt of Veterinary Medicine Series C, Anatomy, Histology and Embryology*, 11:362.
19. MAINA, J.N. (1983): The bird lung. How is it made and how does it works? *East African Natural History Bulletin*, July/August 51-54
20. MAINA, J.N. AND KING, A.S. (1984): The structural functional correlation in the design of the bat lung. A morphometric study. *Journal of Experimental Biology*, 111: 43-63.
21. MAINA, J.N. (1984): Morphometrics of the avian lung. 3. The structural design of the passerine lung. *Respiration Physiology*, 55: 291-309.
22. KAMAU, J.M.Z., MAINA, J.N. AND MALOIY, G.M.O. (1984): The design and the role of the nasal passages in the temperature regulation in the dik-dik antelopes *Rhynchotragus kirkii*) with observations on the carotid rete. *Respiration Physiology*, 56: 183-194.
23. MAINA, J.N. (1984): Stereology: Versatile quantitative methods and their applications in biomedical researches. *International Journal of Primatology*, 5: 359.
24. HASSANALI, J., TARARA, R. AND MAINA, J.N. (1984): A preliminary report on the stereological analysis of the developing mid-brain of the baboon with some observations on the mesencephalic nucleus of the trigeminal nerve. *International Journal of Primatology*, 5: 346.
25. MAINA, J.N. AND MALOIY, G.M.O. (1985): The morphometry of the lung of the lungfish *Protopterus aethiopicus*): It's structural-functional correlations. *Proceedings of the Royal Society (London) B*, 244: 399-420.

26. MAINA, J.N. (1985): A scanning and transmission electron microscopic study of the bat lung. *Journal of Zoology*, London 205B: 19-27.
27. MAINA, J.N. (1985): The comparative morphometry of the respiratory organs of the East African air breathing fish: the catfish (*Clarias mossambicus*) and the lungfish (*Protopterus aethiopicus*). In: *Proceedings of the IV European Symposium for Stereology* (B. Karlson, R. Warren and J. Wassen eds.). Chalmers University of Technology Press: Goteborg, pp. 101-104.
28. MAINA, J.N. AND MALOIY, G.M.O. (1985): The morphometry of the respiratory organs of the air-breathing catfish (*Clarias mossambicus*). *Proceedings of the XIIth International Anatomical Congress*. Book Production Consultants, Cambridge, 426.
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31. KOKWARO, E.D. AND MAINA, J.N. (1986): The morphology of the lungs of some East African Vertebrates, the monitor lizard (*Varanus exanthematicus*) and pancake tortoise (*Malacochersus tornieri*). *ICIPE Annual Report 1986*: p. 72.
32. MAINA, J.N. (1986): The morphology of the insect respiratory system: An evolutionary comparison with the avian lung air-sac system. *Proceedings of an International Conference on Tropical Entomology*, Nairobi - Kenya. p. 35.
33. MAINA, J.N. (1986): The structural design of the bat lung. *Myotis*, 23: 71-77.
34. MAINA, J.N. (1987): The morphology and morphometry of the adult normal baboon lung *Papio anubis*. *Journal of Anatomy*, London 150: 229-245.
35. MAINA, J.N. (1987): Morphometrics of the avian lung. 4. The structural design of the charadriiform lung. *Respiration Physiology*, 68: 99-119.
36. MAINA, J.N. (1987): The morphology of the lung of the African lungfish, *Protopterus aethiopicus*: A scanning electron microscopic study. *Cell and Tissue Research*, 250: 191-196.
37. BHATTACHARJEE, J. AND MAINA, J.N. (1987): Morphometric estimation of pectineal blood volume in the cormorant (*Phalacrocorax carbo*): A preliminary study. *Acta Anatomica*, 130: 37.

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41. MAINA, J.N. (1988): The morphology and morphometry of the normal lung of the adult vervet monkey *Cercopithecus aethiops*. *American Journal of Anatomy*, 183: 258-267.
42. MAINA, J.N. AND MALOIY, G.M.O. (1988): A scanning and transmission electron microscopic study of the lung of a caecilian *Boulengerula taitanus*. *Journal of Zoology, London* 215: 739-751.
43. HART, B.L., HART, L.A. AND MAINA, J.N. (1988): Alteration in vomeronasal system anatomy in alcelaphine antelopes: Correlation with alteration in chemosensory investigation. *Physiology and Behaviour*, 42: 155-162.
44. MAINA, J.N. (1988): The morphology of the lung of the vervet monkey. *International Journal of Primatology*, 8: 484.
45. MAINA, J.N. (1989): The morphology of a tropical terrestrial slug *Trichotoxon copleyi*-Verdcourt, Mollusca: Gastropoda: Pulmonata. A scanning and transmission electron microscopic study. *Journal of Zoology, London* 217: 355-366.
46. HART, B.L., HART, L.A. AND MAINA, J.N. (1989): The functional and structural basis of flehmen behaviour in some African angulates. *Symposium of the Zoological Society of London*, 61: 197-215.
47. MAINA, J.N. AND KING, A.S. (1989): The lung of the emu, *Dromaius novaehollandiae*: A microscopic and morphometric study. *Journal of Anatomy, London* 163: 67-74.
48. MAINA, J.N. (1989): A scanning and transmission electron microscopic study of the tracheal-air sac system in a grasshopper (*Chrotogonus senegalensis*) (Kraus) - Orthoptera: Acrididae: Pygomorphinae. *Anatomical Record*, 223: 393-405.
49. MAINA, J.N., KING, A.S. AND SETTLE, J.G. (1989): An allometric study of the pulmonary morphometric parameters in birds, with mammalian comparison. *Philosophical Transactions of the Royal Society (London) B*, 326: 1-57.

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51. MAINA, J.N. (1989): The morphology of the lung of the East African tree frog *Chiromantis petersi* with observations on the skin and the buccal cavity as secondary gas exchange organs: A TEM and SEM study. *Journal of Anatomy*, London 165: 29-43.
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53. MAINA, J.N. (1990): A study of the morphology of the gills of an extreme alkalinity and hyperosmotic adapted teleost *Oreochromis alcalicus grahami* (Boulenger) with particular emphasis on the ultrastructure of the chloride cells and their modifications with water dilution: A SEM and TEM study. *Anatomy and Embryology*, 181: 83-98.
54. MAINA, J.N. (1990): The morphology of the gills of the African freshwater crab *Potamon niloticus*-Ortmann (Crustacea: Brachyura: Potamonidae): A scanning and transmission electron microscopic study. *Journal of Zoology*, London, 221: 499-515.
55. THOMAS, S.P., MAINA, J.N. AND HYDE, D.M. (1990): Relationship between lung morphology and function in two species of bats. *FASEB Journal* 4: 730.
56. MAINA, J.N. (1990): The morphology and morphometry of the lung of the lesser-bushbaby *Galago senegalensis*. *Journal of Anatomy*, London 172: 129-144.
57. MAINA, J.N., THOMAS, S.P. AND HYDE, D.M. (1990): A preliminary allometric analysis of the relationships between VO_{2max} and the morphometric characteristics of the bat lung. *Physiologist*, 33: 45.
58. LATIF A.A., MAINA, J.N., DHADIALLA, T.S. AND S. NAKOE (1990): Histological reactions of bites of *Ambryostoma variagatum* fed simultaneously on naive or sensitized rabbits. *Journal of Medical Entomology*, 27:316-323.
59. MAINA, J.N. (1991): A morphometric analysis of chloride cells in the gills of the teleosts *Oreochromis alcalicus* and *O. niloticus* and a description of presumptive urea excreting cells in *Oreochromis alcalicus*. *Journal of Anatomy*, London 175: 131-145.
60. MAINA, J.N. (1991): Stereology: Quantitative methods and their applications in biophysical researches. *Science News*, 2: 109-112.

61. MAINA, J.N., THOMAS, S.P. AND HYDE, D.M. (1991): A morphometric study of bats of different size: Correlations between structure and function of the chiropteran lung. *Philosophical Transactions of the Royal Society (London) B*, 333:31-50.
62. NGUHIU-MWANGI, J.A., MBIUKI, S.M. AND MAINA, J.N. (1991): Complications, management and prognoses of distal limb wounds. *Bulletin of Animal Health and Production, Africa*, 39: 299-305
63. MAINA, J.N., MALOIY, G.M.O. AND MAKANYA, A.N. (1992): The morphology and morphometry of the lungs of two East African fossorial rodents: The mole rats *Tachyoryctes splendens* and *Heterocephalus glaber* (Rodentia: Rhizomyidae : Bathyergidae). *Zoomorphology*, 112: 167-179.
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66. MAKANYA, A.N. AND MAINA, J.N. (1994): Comparative morphology of the gastrointestinal tract of fruit and insect eating bats. *African Journal of Ecology*, 32: 158-168.
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68. WOOD, C.M., BERGMAN, H.L., LAURENT, P., MAINA, J.N., NARAHARA, A.B. AND WALSH, P.J. (1995): Urea production, acid base regulation and their interactions in the Lake Magadi tilapia, a unique teleost adapted to highly alkaline environment. *Journal of Experimental Biology*, 189: 13-26.
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70. LAURENT, P., MAINA, J.N., WOOD, C.M., WALSH, P.J., BERGMAN, H.L. AND NARAHARA, A.B. (1995): The morphology of the gills of

Oreochromis alcalicus grahami a fish that lives in an alkaline pH water. Canadian Journal of Zoology, 73:1170-1181.

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- (Crustacea: Decapoda: Potamonidae): possible implications of diffuse, morphologically congruous cell lineage. *Tissue and Cell*, 30: 562-572.
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