Vol-07 Issue 10, October- 2023 ISSN: 2456-9348
Impact Factor: 6.736

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

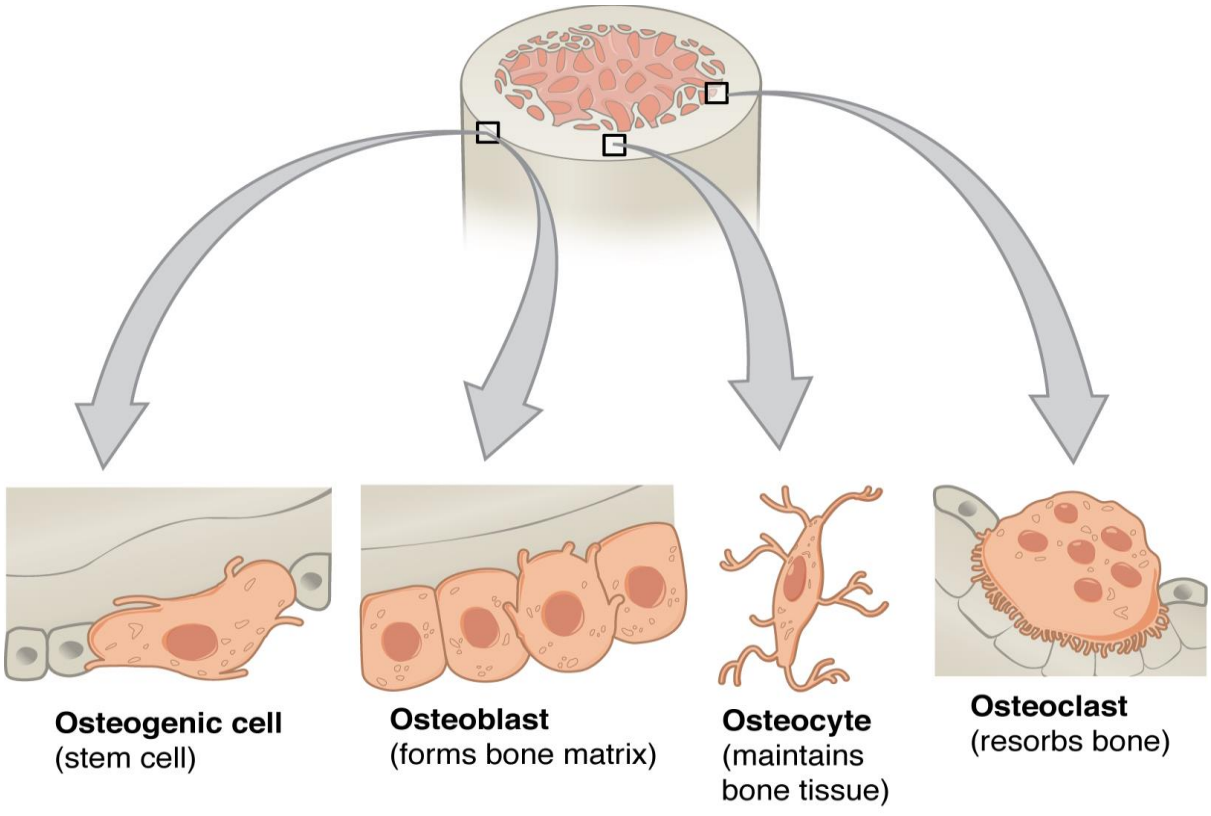
BONE STRUCTURE: TYPES TISSUES AND MEMBRANES

D.K.Awasthi[1]
Archana Dixit[2]
[1.]Department of chemistry Sri J.N.M.PG. College Lucknow U.P, India
[2] Department of chemistry DG PG College Kanpur U.P. India

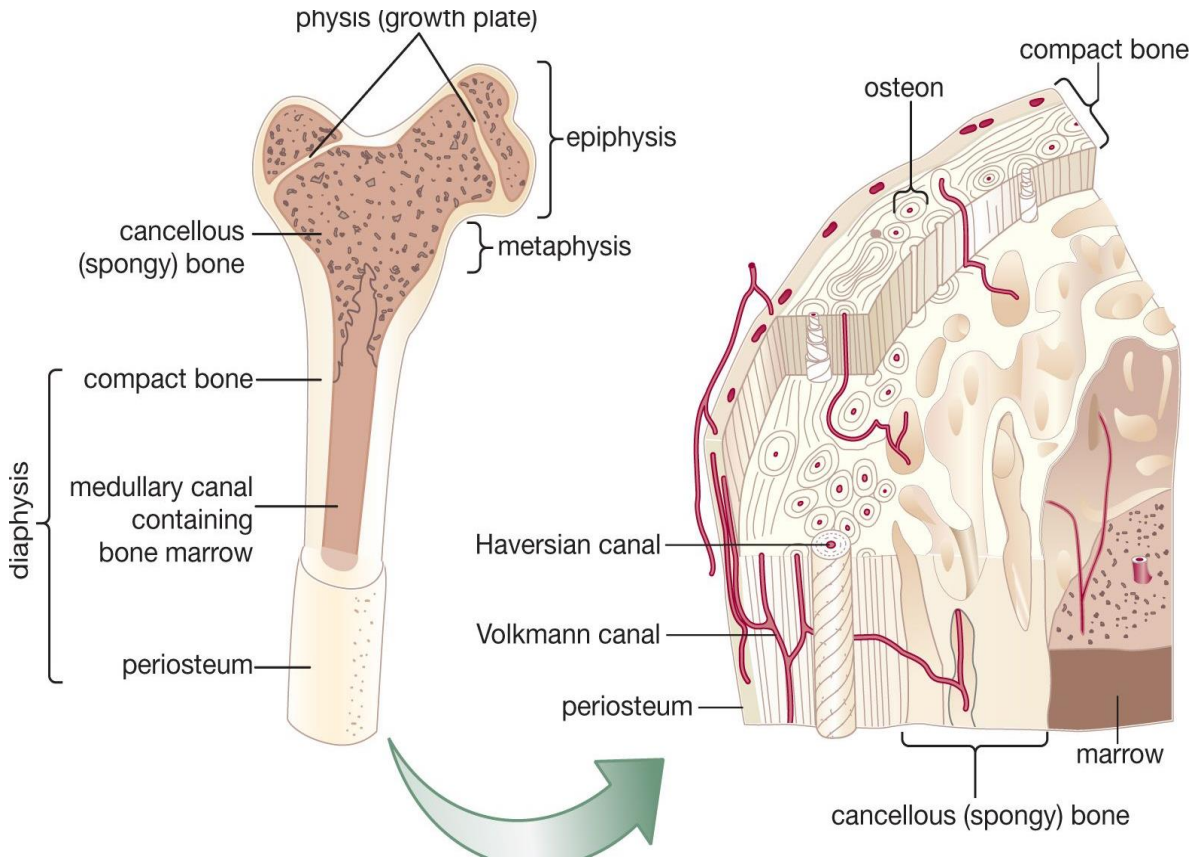
Abstract:
Bone tissue comes in two different varieties: spongy and compact. The names suggest that the two varieties are different in terms of tissue density, or how closely the tissue is packed. Three different cell types are involved in maintaining the balance of bones. Osteocytes are mature bone cells, osteoblasts are bone-forming cells, and osteoclasts resorb or destroy bone.

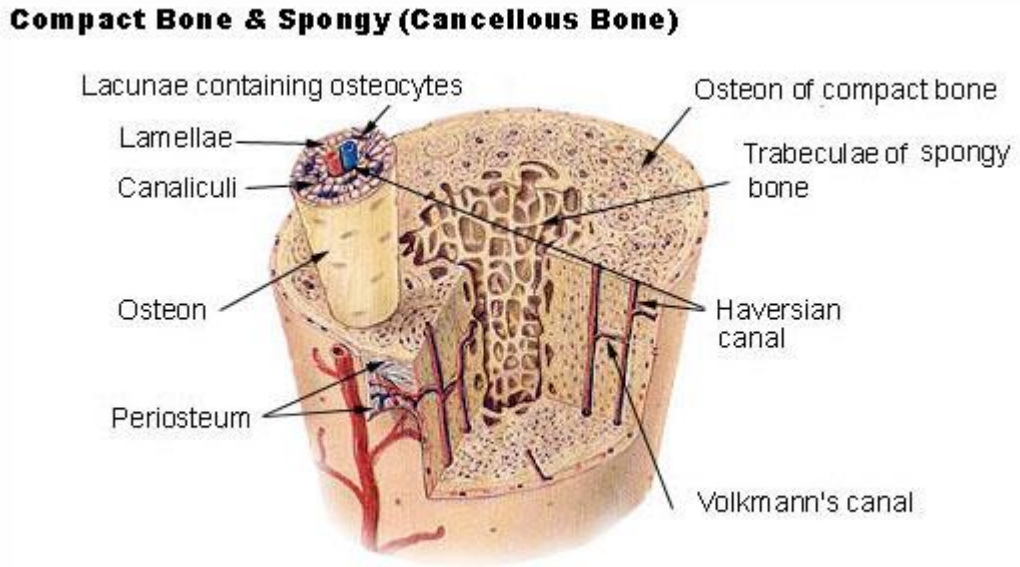
INTRODUCTION

Bone tissue is maintained by an equilibrium between osteoblasts and osteoclasts. Osteons or haversian systems are tightly packed together to form compact bone. The osteon is made up of concentric rings (lamellae) of matrix surrounding a central canal known as the osteonic (haversian) canal. The bone cells (osteocytes), which are situated between the rings of matrix, are found in regions known as lacunae. To offer passages in the dense matrix, tiny channels (canaliculi) sprout from the lacunae to the osteonic (haversian) canal. The haversian systems are packed closely together to resemble a solid mass in compact bone. Blood arteries in the osteonic canals run parallel to the long axis of the bone. Through perforating canals, these blood arteries link up with vessels on the surface of the bone.



iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

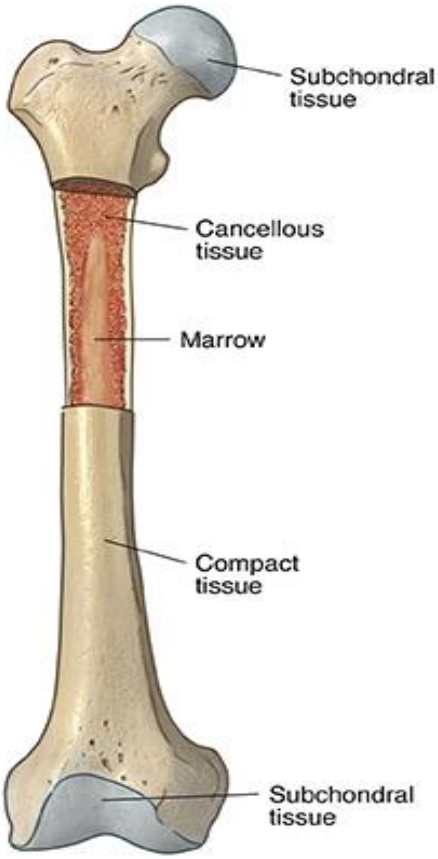




Bone that is flexible (cancellous) is less dense and lighter than bone that is rigid. Trabeculae, or plates of bone, and bars of bone are found next to tiny, irregular cavities that contain red bone marrow in spongy bone. Instead of a central haversian canal, the canaliculi obtain their blood supply from the nearby cavities. The trabeculae may appear to be stacked haphazardly, yet they are structured to give maximum strength, much as braces used to support a building. The trabeculae of spongy bone align themselves if the direction of stress changes and follow the lines of stress. Vertebrates are creatures with a spinal column or backbone, including humans. They

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

are supported by a strong internal framework that is built around a noticeable spine. The human skeletal system, which makes up 20% of the body weight, is made up of bones, cartilage, ligaments, and tendons. Muscles and bones collaborate as basic mechanical lever systems to create body movement.More calcium is found in bones than any other organ. Large quantities of calcium salts, the most significant of which is calcium phosphate, are present in the intercellular matrix of bone.Calcium is released from the bones when blood calcium levels fall below the normal range to ensure that there is a sufficient supply for metabolic requirements. The extra calcium is deposited in the bone matrix when blood calcium levels rise. Almost continually, the dynamic process of releasing and storing calcium occurs.The red marrow of the bones is where blood cells are primarily formed during the process of hematopoiesis.Red marrow is located in the bone cavities of babies. It is largely replaced with yellow marrow as we mature. Review: Membranes, Tissues, and CellsWhat we have discovered from cells, tissues, and membranes is as follows:



A cell essentially consists of three components: the cell membrane, the nucleus, and the cytoplasm in between.,The genetic material that makes up a cell's nucleus also controls how that cell behaves. It establishes the fundamental makeup of the cell and how it will operate.A cell's cytoplasm is where all of the processes for cell division, growth, and replication take placeA collection of cells with similar structures and functions is referred to as a tissue. Epithelial, connective, muscular, and nerve tissues are some of the main categories of bodily tissues.All bodily surfaces are covered by epithelial tissues, which also line body cavities and hollow organs.

Our bodies' living bones use oxygen and release waste products throughout metabolism. They have functional tissues that require nutrients, blood flow, and the ability to remodel or alter shape in response to changes in mechanical stress.

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

The skeleton, which is made up of bones, acts as a strong framework to support and shield the body's soft organs.The body is supported by the skeleton as it resists the pull of gravity. When standing, the trunk is supported by the massive bones of the lower limbsMembranes
Body membranes are incredibly thin tissue sheets that line body cavities, cover organs inside of hollow organs, and cover the body's surface. They can be divided into connective tissue membrane and epithelial membrane.
Epithelial tissue and the connective tissue to which it is linked make up epithelial membranes. The mucous membrane and the serous membrane are the two primary varieties of epithelial membranes.

MucousMembranes

The epithelial membranes that make up mucous membranes are made of epithelial tissue that is joined to a loose connective tissue beneath. The body cavities that open to the outside are lined with these membranes, also known as mucosae. Mucous membranes line the inside of the digestive tract. The reproductive, excretory, and respiratory tracts are more examples.Body cavities are lined with serous membranes. Mucous MembranesThe epithelial membranes that make up mucous membranes are made of epithelial tissue that is joined to a loose connective tissue beneath. The body cavities that open to the outside are lined with these membranes, also known as mucosae. Mucous membranes line the inside of the digestive tract. The reproductive, excretory, and respiratory tracts are more examples.Organs housed in body cavities that don't open up to the outside are covered by serous membranes that line the body cavities. The epithelium secretes a thin coating of serous fluid that coats serous membranes. When organs in the thoracic or abdominopelvic cavity move against one another or the cavity wall, serous fluid lubricates the membrane and lessens friction and abrasion. The names of serous membranes are unique.
Mucous membranes are epithelial membranes made up of epithelial tissue linked to a loose connective tissue underneath. These membranes, also known as mucosae, line the bodily cavities that have an external opening. Mucous membranes cover the whole digestive system. The respiratory, excretory, and reproductive pathways are some further examples.

Serous Membranes

Body cavities that don't open up to the outside are lined with serous membranes, and those organs are protected by those membranes. A thin layer of serous fluid, which is secreted by the epithelium, coats serous membranes. The membrane is lubricated by serous fluid, which also lessens friction and abrasion when the organs in the thoracic or abdominopelvic cavity move in contact with one another or the cavity wall. Serous membranes are known by unique names. Tissue Membranes Ive
Only connective tissue is present in connective tissue membranes. Meninges and synovial membranes fall within this category.

Membranes of the joint

Connective tissue membranes called synovial membranes border the spaces of joints that can move freely, including the shoulder, elbow, and knee. They line cavities that do not open to the outside, much like serous membranes. These membranes lack an epithelial layer, in contrast to serous membranes. Synovial membranes produce synovial fluid into the joint cavity, which lubricates the bone ends' cartilage and allows for friction-free, fluid motion.

Meninges

The meninges are the connective tissue that covers the brain and spinal cord within the dorsal cavity. They safeguard these important buildings. Meninges The meninges are the connective tissue that covers the brain and spinal cord within the dorsal cavity. They safeguard these

Conclusion: It is well known that canalicular fluid flow plays a crucial role in bone metabolism and activity, as well as in facilitating efficient cell-to-cell communication. Bone canaliculi are tiny canals that run through the dense matrix of the bone, containing the dendrites of osteocytes, and filled with an ion-rich interstitial fluid. Fluid flow and electrochemical phenomena coexist in very tiny (a few hundred nanometers in diameter) canals. In our earlier research, we created a multi-scale model that takes into consideration coupled chemical and hydraulic transport in the canalicular network. Unfortunately, modern experimental approaches can only really access a small portion of the physical and geometrical data that the model needs. This study's objective was to quantitatively evaluate the impact of the physical and material

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

References

1. Armstrong J F , Pritchard-Jones K , Bickmore W A , Hastie N D , Bard J B L . The expression of the Wilms' tumor gene, *WT-1*, in the developing mammalian embryo. Mech. Dev. 1992;40:85–97. [PubMed]
2. Ash P J , Loutit J F , Townsend K M S . Osteoclasts derived from haematopoietic stem cells. Nature. 1980;283:669–670. [PubMed]
3. Ballock R T , Reddi A H . Thyroxine is the serum factor that regulates morphogenesis of columnar cartilage from isolated chondrocytes in chemically defined medium. J. Cell Biol. 1994;126:1311–1318. [PMC free article] [PubMed]
4. Barasch J , 10 others Mesenchymal to epithelial conversion in rat metanephros is induced by LIF. Cell. 1999;99:377–386. [PubMed]
5. Bard J B L , Ross A S A . LIF, the ES cell inhibition factor, reversibly blocks nephrogenesis in cultured mouse kidney rudiments. Development. 1991;113:193–198. [PubMed]
6. Bard J B L , Davies J A , Karavanova, Lehtonen E , Sariola H , Vainio S . Kidney development: the inductive interactions. Semin. Cell Dev. Biol. 1996;7:195–202.
7. Bard J B L , Gordon A , Sharp L , Sellers W . The early stages of nephron formation in the developing mouse kidney. J. Anat. Zool. 2000;199(pt 4):385–392. [PMC free article] [PubMed]
8. Barnes G L , Hsu C W , Mariani B D , Tuan R S . Cloning and characterization of chicken *paraxis*: A regulator of paraxial mesoderm development and somite formation. Dev. Biol. 1997;189:95–111. [PubMed]
9. Baron R , Neff L , Louvard D , Courtoy P J . Cell mediated extracellular acidification and bone resorption: Evidence for a low pH in resorbing lacuna and localization of a 100-kD lysosomal membrane protein at the osteoclast ruffled border. J. Cell Biol. 1985;101:2210–2222. [PMC free article] [PubMed]
10. Baron R , Neff L , Roy C , Boisvert A , Caplan M . Evidence for a high and specific concentration of (Na^+,K^+) ATPase in the plasma membrane of the osteoclast. Cell. 1986;46:311–320. [PubMed]
11. Bellus G A , 8 others A recurrent mutation in the tyrosine kinase domain of fibroblast growth factor receptor 3 causes hypochondroplasia. Nature Genet. 1995;10:357–359. [PubMed]
12. Bishop-Calame S . Étude experimentale de l'organogenese du systéme urogénital de l'embryon de poulet. Arch. Anat. Microsc. Morphol. Exp. 1966;55:215–309. [PubMed]
13. Blair H C , Kahn A J , Crouch E C , Jeffrey J J , Teitelbaum S L . Isolated osteoclasts resorb the organic and inorganic components of bone. J. Cell Biol. 1986;102:1164–1172. [PMC free article] [PubMed]
14. Bloom, W. and D. W. Fawcett. 1975. *Textbook of Histology*, 10th Ed. Saunders, Philadelphia.
15. Boettiger D , Enomoto-Iwamoto M , Yoon H Y , Hofer U , Menko A S , Chiquet-Ehrismann R . Regulation of integrin a5b1 affinity during myogenic differentiation. Dev. Biol. 1995;169:261–272. [PubMed]
16. Brand-Saberi B , Wilting J , C., Ebensperger, Christ B . The formation of somite compartments in the avian embryo. Int. J. Dev. Biol. 1996;40:411–420. [PubMed]
17. Brill G , Kahane N , Carmeli C , von Schack D , Barde Y A , Kalcheim C . Epithelial-mesenchymal conversion of dermatome progenitors requires neural tube-derived signals: Characterization of the role of neurotrophin-3. Development. 1995;121:2583–2594. [PubMed]
18. Bruder S P , Caplan A I . Cellular and molecular events during embryonic bone development. Connect. Tissue Res. 1989;20:65–71. [PubMed]
19. Burgess R , Cserjesi P , Ligon K L , Olson E N . *Paraxis*: A basic helix-loop-helix protein expressed in paraxial mesoderm and developing somites. Dev. Biol. 1995;168:296–306. [PubMed]
20. Burgess R , Rawls., Brown D , Bradley A , Olson E N . Requirement of the *paraxis* gene for somite formation and musculoskeletal patterning. Nature. 1996;384:570–573. [PubMed]
21. Chen C -M , Kraut N , Groudine M , Weintraub H . I-mf, a novel myogenic repressor, interacts with members of the MyoD family. Cell. 1996;86:731–741. [PubMed]
22. Chen Q , Johnson D M , Haudenschild D R , Goetinck P F . Progression and recapitulation of the chondrocyte differentiation program: Cartilage matrix protein is a marker for cartilage maturation. Dev. Biol. 1995;172:293–306. [PubMed]

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

23. Christ B , Ohrdahl C P . Early stages of chick somite development. Anat. Embryol. 1995;191:381–396. [PubMed]
24. Cossu G , Kelly R , Tajbakhsh S , Di Donna S , Vivarelli E , Buckingham M . Activation of different myogenic pathways: *myf-5* is induced by the neural tube and MyoD by the dorsal ectoderm in mouse paraxial mesoderm. Development. 1996a;122:429–437. [PubMed]
25. Cossu G , Tajbakhsh S , Buckingham M . How is myogenesis initiated in the embryo? Trends Genet. 1996b;12:218–223. [PubMed]
26. Cserjesi P , 7 others A basic helix-loop-helix protein that prefigures skeletal formation during mouse embryogenesis. Development. 1995;121:1099–1110. [PubMed]
27. David J D , See W M , Higginbotham C A . Fusion of chick embryo skeletal myoblasts: Role of calcium influx preceding membrane union. Dev. Biol. 1981;82:297–307. [PubMed]
28. Davies J A , Lyon M , Gallagher J , Garrod D R . Sulphated proteoglycan is required for collecting duct growth and branching but not nephron formation during kidney development. Development. 1995;121:1507–1517. [PubMed]
29. Deng C , Wynshaw-Boris A , Zhou F , Kuo A , Leder P . Fibroblast growth factor receptor-3 is a negative regulator of bone growth. Cell. 1996;84:911–921. [PubMed]
30. Dickman S . No bones about a genetic switch for bone development. Science. 1997;276:1502. [PubMed]
31. Dietrich S , Schubert F R , Healy C , Sharpe P T , Lumsden A . Specification of hypaxial musculature. Development. 1998;125:2235–2249. [PubMed]
32. Ducy P , Zhang R , Geoffroy V , Ridall A L , Karsenty G . Osf2/Cba1: A transcriptional activator of osteoblast differentiation. Cell. 1997;89:747–754. [PubMed]
33. Dudley A T , Lyons K M , Robertson E J . A requirement for bone morphogenesis protein-7 during development of the mammalian kidney and eye. Genes Dev. 1995;9:2795–2807. [PubMed]
34. Durbin L , 8 others Eph signaling is required for segmentation and differentiation of the somites. Genes Dev. 1998;12:3096–3109. [PMC free article] [PubMed]
35. Ekblom P , Thesleff, Saxén L , Miettinen A , Timpl R . Transferrin as a fetal growth factor: Acquisition of responsiveness related to embryonic induction. Proc. Natl. Acad. Sci. USA. 1983;80:2651–2655. [PMC free article] [PubMed]
36. Ekblom P , 8 others Role of mesenchymal nidogen for epithelial morphogenesis in vitro. Development. 1994;120:2003–2014. [PubMed]
37. Fan C M , Tessier-Lavigne M . Patterning of mammalian somites by surface ectoderm and notochord: Evidence for sclerotome induction by a hedgehog homolog. Cell. 1994;79:1175–1186. [PubMed]
38. Gluecksohn-Schoenheimer S . The morphological manifestations of a dominant mutation in mice affecting tail and urogenital system. Genetics. 1943;28:341–348. [PMC free article] [PubMed]
39. Grobstein C . Induction interaction in the development of the mouse metanephros. J. Exp. Zool. 1955;130:319–340.
40. Grobstein C . Trans-filter induction of tubules in mouse metanephrogenic mesenchyme. Exp. Cell Res. 1956;10:424–440. [PubMed]
41. Hall B K . The embryonic development of bone. Am. Sci. 1988;76:174–181.
42. Hall B K , Miyake T . Divide, accumulate, differentiate: Cell condensations in skeletal development revisited. Int. J. Dev. Biol. 1995;39:881–893. [PubMed]
43. Hästbacka J , de la Chapelle A , Mahtani M M . The diastrophic dysplasia gene encodes a novel sulfate transporter: Positional cloning by fine-structure linkage disequilibrium mapping. Cell. 1994;78:1073–1087. [PubMed]
44. Hatini V , Huh S O , Herzlinger D , Soares V C , Lai E . Essential role of stromal morphogenesis in kidney morphogenesis revealed by targeted disruption of winged helix transcription factor, BF-2. Genes Dev. 1996;10:1467–1478. [PubMed]
45. Hatori M , Klatte K J , Teixeira C C , Shapiro I M . End labeling studies of fragmented DNA in avian growth plate: Evidence for apoptosis in terminally differentiated chondrocytes. J. Bone Miner. Res. 1995;10:1960–1968. [PubMed]
46. Hatta K , Takagi S , Fujisawa H , Takeichi M . Spatial and temporal expression of N-cadherin cell adhesion molecule correlated with morphogenetic processes of chicken embryo. Dev. Biol. 1987;120:218–227. [PubMed]

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

47. Horton W A . The biology of bone growth. Growth Genet. Horm. 1990;6(2):1–3.
48. Huang R , Zhi Q , Schmidt C , Wilting J , Brand-Saberi B , Christ B . Sclerotomal origin of the ribs. Development. 2000;127:527–532. [PubMed]
49. Ikeya M , Takada S . Wnt signaling from the dorsal neural tube is required for the formation of the medial dermomyotome. Development. 1998;125:4969–4976. [PubMed]
50. Johnson R L , Laufer E , Riddle R D , Tabin C . Ectopic expression of *Sonic hedgehog* alters dorsal-ventral patterning of somites. Cell. 1994;79:1165–1173. [PubMed]
51. Jouve C , Palmeirim, Henrique D , Beckers J , Gossler A , Ish-Horowicz D , Pourquié O . Notch signalling is required for cyclic expression of the hairy-like gene HES1 in the presomitic mesoderm. Development. 2000;127:1421–1429. [PubMed]
52. Kahn A J , Simmons D J . Investigation of cell lineage in bone using a chimaera of chick and quail embryonic tissue. Nature. 1975;258:325–327. [PubMed]
53. Kaplan S L , Grumbach M M . Pathophysiology and treatment of sexual precocity. J. Clin. Endocrinol. Metab. 1990;71:785–789. [PubMed]
54. Karavanov A A , Karavanova, A., Perantoni, Dawid I B . Expression pattern of the rat *Lim-1* homeobox gene suggests a dual role during kidney development. Int. J. Dev. Biol. 1998;42:61–66. [PubMed]
55. Karavanova I D , Dove L F , Resau J H , Perantoni A O . Conditioned medium from a rat ureteric bud cell line in combination with bFGF induces complete differentiation of isolated metanephric mesenchyme. Development. 1996;122:4159–4167. [PubMed]
56. Kato N , Aoyama H . Dermamyomal origin of the ribs as revealed by extirpation and transplantation experiments in chick and quail embryos. Development. 1998;125:3437–3443. [PubMed]
57. Kieny M , Mauger A , Segel P . Early regionalization of somitic mesoderm as studied by the development of the axial skeleton of the chick embryo. Dev. Biol. 1972;28:142–161. [PubMed]
58. Kispert A , Vainio S , Shen L , Rowitch D R , McMahon A P . Proteoglycans are required for maintenance of Wnt-11 expression in the ureter tips. Development. 1996;122:3627–3637. [PubMed]
59. Kispert A , Vainio S , McMahon A P . Wnt-4 is a mesenchymal signal for epithelial transformation of metanephric mesenchyme in the developing kidney. Development. 1998;125:4225–4234. [PubMed]
60. Knudsen K A . The calcium-dependent myoblast adhesion that precedes cell fusion is mediated by glycoproteins. J. Cell Biol. 1985;101:891–897. [PMC free article] [PubMed]
61. Knudsen K A , McElwee S A , Myers L . A role for the neural cell adhesion molecule, N-CAM, in myoblast interaction during myogenesis. Dev. Biol. 1990;138:159–168. [PubMed]
62. Komori T , 14 others Targeted disruption of *Cba1* results in a complete lack of bone formation owing to maturational arrest of osteoblasts. Cell. 1997;89:755–764. [PubMed]
63. Konigsberg I R . Clonal analysis of myogenesis. Science. 1963;140:1273–1284. [PubMed]
64. Koseki C , Herzlinger D , Al-Auqati Q . Apoptosis in metanephric development. J. Cell Biol. 1992;119:1327–1333. [PMC free article] [PubMed]
65. Kreidberg J A , Sariola H , Loring J M , Maeda M , Pelletier J , Housman D , Jaenisch R . WT-1 is required for early kidney development. Cell. 1993;74:679–691. [PubMed]
66. Langman, J. 1981. *Medical Embryology*, 4th Ed. Williams & Wilkins, Baltimore.
67. Lash, J. W. and K. M. Yamada. 1986. The adhesion recognition signal of fibronectin: A possible trigger mechanism for compaction during somitogenesis. *In* R. Bellairs, D. H. Ede and J. W. Lash (eds.), *Somites in Developing Embryos.* Plenum, New York, pp. 201–208.
68. Lassar A B , Buskin J N , Lockshon D , Davis R L , Apone S , Hauschka S D , Weintraub H . MyoD is a sequence-specific DNA binding protein requiring a region of *myc* homology to bind to the muscle creatine kinase enhancer. Cell. 1989;58:823–831. [PubMed]
69. Le Douarin N , Tiellet M -A . Experimental analysis of the migration and differentiation of neuroblasts of the autonomic nervous system and of neuroectodermal derivatives, using a biological cell marking technique. Dev. Biol. 1974;41:162–184. [PubMed]
70. Lehtonen E , Virtanen, Saxén L . Reorganization of the intermediate cytoskeleton in induced mesenchyme cells is independent of tubule morphogenesis. Dev. Biol. 1985;108:481–490. [PubMed]
71. Li Y , 16 others A fibrillar collagen gene, *Col11a1*, is essential for skeletal morphogenesis. Cell. 1995;80:423–430. [PubMed]

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

72. Luo G , Hofmann C , Bronckers A L J J , Sohocki M , Bradley A , Karsenty G . BMP-7 is an inducer of nephrogenesis and is also required for eye development and skeletal patterning. Genes Dev. 1995;9:2808–2820. [PubMed]
73. Manolagas S , Jilka R L . Bone marrow, cytokines, and bone remodeling. N. Engl. J. Med. 1995;332:305–310. [PubMed]
74. Marcelle C , Stark M R , Bronner-Fraser M . Coordinate actions of BMPs, Wnts, Shh, and Noggin mediate patterning of the dorsal somite. Development. 1997;124:3955–3963. [PubMed]
75. Maroto M , Reshef R , Münsterberg A E , Koester S , Goulding M , Lassar A B . Ectopic Pax-3 activates *MyoD* and *Myf-5* expression in embryonic mesoderm and neural tissue. Cell. 1997;89:139–148. [PubMed]
76. Medvinsky A , Dzierzak E . Definitive hematopoiesis is autonomously initiated by the AGM region. Cell. 1996;86:897–906. [PubMed]
77. Mencken H L . Exeunt omnes. Smart Set. 1919;60:138–145.
78. Menko A S , Boettiger D . Occupation of the extracellular matrix integrin is a control point for myogenic differentiation. Cell. 1987;51:51–57. [PubMed]
79. Merimee T J , Zapf J , Hewlett B , Cavalli-Sforza L L . Insulin-like growth factors in pygmies: The role of puberty in determining final stature. N. Engl. J. Med. 1987;316:906–911. [PubMed]
80. Mintz B , Baker W W . Normal mammalian muscle differentiation and gene control of isocitrate dehydrogenase synthesis. Proc. Natl. Acad. Sci. USA. 1967;58:592–598. [PMC free article] [PubMed]
81. Moore M W , 9 others Renal and neuronal abnormalities in mice lacking GDNF. Nature. 1996;382:76–79. [PubMed]
82. Müller U , Wang D , Denda S , Menesis J , Pedersen R , Reichardt L . Integrin alpha-8/beta-1 is critically important for epithelial-mesenchymal interactions during kidney morphogenesis. Cell. 1997;88:603–613. [PMC free article] [PubMed]
83. Mundlos S , 13 others Mutations involving the transcription factor CBFA1 cause cleiocranial dysplasia. Cell. 1997;89:773–779. [PubMed]
84. Münsterberg A E , Kitajewski J , Bumcroft D A , McMahon A P , Lassar A B . Combinatorial signaling by sonic hedgehog and Wnt family members induce myogenic bHLH gene expression in the somite. Genes Dev. 1995;9:2911–2922. [PubMed]
85. Nakamura T , Okuda S , Miller D , Ruoslahti E , Border W . Transforming growth factor-β (TGF-β) regulates production of extracellular matrix (ECM) components by glomerular epithelial cells. Kidney Int. 1990;37:221. [PubMed]
86. Nameroff M , Munar E . Inhibition of cellular differentiation by phospholipase C. II. Separation of fusion and recognition among myogenic cells. Dev. Biol. 1976;49:288–293. [PubMed]
87. Nilsson A , Isgaard J , Lindahl A , Dahlström A , Skottner A , Isaksson O G P . Regulation by growth hormone of number of chondrocytes containing IGF-I in rat growth plate. Science. 1986;233:571–574. [PubMed]
88. Nowicki J L , Burke A C . Testing *Hox* genes by surgical manipulation. Dev. Biol. 1999;210:228.
89. Oberlender S A , Tuan R S . Expression and functional involvement of N-cadherin in embryonic limb chondrogenesis. Development. 1994;120:177–187. [PubMed]
90. Ordahl, C. P. 1993. Myogenic lineages within the developing somite. *In* M. Bernfield (ed.), *Molecular Basis of Morphogenesis.* Wiley-Liss, New York, pp. 165–170.
91. Ordahl C P , Le Douarin N . Two myogenic lineages within the developing somite. Development. 1992;114:339–353. [PubMed]
92. Ordahl C P , Williams B A . Knowing chops from chuck: Roasting MyoD redundancy. BioEssays. 1998;20:357–362. [PubMed]
93. Ostrovsky D , Cheney C M , Seitz A W , Lash J W . Fibronectin distribution during somitogenesis in the chick embryo. Cell Differ. 1983;13:217–223. [PubMed]
94. Otto F , 11 others *Cba1*, a candidate gene for cleidocranial dysplasia syndrome, is essential for osteoblast differentiation and bone development. Cell. 1997;89:765–771. [PubMed]
95. Palmeirim I , Henrique D , Ish-Horowicz D , Pourquié O . Avian *hairy* gene expression identifies a molecular clock linked to vertebrate segmentation and somitogenesis. Cell. 1997;91:639–648. [PubMed]

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

96. Park W -J , Bellus G , Jabs E W . Mutations in fibroblast growth factor receptors: Phenotypic consequences during eukaryotic development. Am. J. Hum. Genet. 1995;57:748–754. [PMC free article] [PubMed]
97. Penttinen R P , Kobayashi S , Bornstein P . Transforming growth factor-β increases mRNA for matrix proteins in the presence and in the absence of the changes in mRNA stability. Proc. Natl. Acad. Sci. USA. 1988;85:1105–1108. [PMC free article] [PubMed]
98. Perantoni A O , Dove L F , Karavanova I . Basic fibroblast growth factor can mediate the early inductive events in renal development. Proc. Natl. Acad. Sci USA. 1995;92:4696–4700. [PMC free article] [PubMed]
99. Pichel J G , 11 others Defects in enteric innervation and kidney development in mice lacking GDNF. Nature. 1996;382:73–76. [PubMed]
100. Piette J , Bessereau J -L , Huchet M , Changeaux J -P . Two adjacent MyoD1-binding sites regulate expression of the acetylcholine receptor α-subunit gene. Nature. 1990;345:353–355. [PubMed]
101. Pourquié O , 9 others Lateral and axial signals involved in somite patterning: A role for BMP4. Cell. 1996;84:461–471. [PubMed]
102. Pritchard-Jones K , 11 others The candidate Wilms' tumour gene is involved in genitourinary development. Nature. 1990;346:194–197. [PubMed]
103. Qiao J , Uzzo R , Obara-Ishihara T , Degenstein L , Fuchs E , Herzlinger D . FGF-7 modulates ureteric bud growth and nephron number in the developing kidney. Development. 1999;126:547–554. [PubMed]
104. Rajpurohit R , Mansfield K , Ohyama K , Ewert D , Shapiro I M . Chondrocyte death is linked to development of a mitochondrial membrane permeability transition in the growth plate. J. Cell. Physiol. 1999;179:287–296. [PubMed]
105. Ritvos O , Tuuri T , Erämaa M , Sainio K , Hilden K , Saxén L , Gilbert S F . Activin disrupts epithelial branching morphogenesis in developing murine kidney, pancreas, and salivary gland. Mech. Dev. 1995;50:229–245. [PubMed]
106. Rothenpieler U W , Dressler G R . Pax-2 is required for mesenchyme-to-epithelium conversion during kidney development. Development. 1993;119:711–720. [PubMed]
107. Sainio K , Raatikainen-Ahokas A . Mesonephric kidney: A stem cell factory. Int. J. Dev. Biol. 1999;43:435–439. [PubMed]
108. Sainio K , Nonclercq D , Saarma M , Palgi J , Saxén L , Sariola H . Neuronal characteristics of embryonic renal stroma. Int. J. Dev. Biol. 1994;38:77–84. [PubMed]
109. Sainio K , 10 others Glial cell derived neurotrophic factor is required for bud initiation from ureteric epithelium. Development. 1997;124:4077–4087. [PubMed]
110. Sánchez M P , Silos-Santiago, Frisén J , He B , Lira S A , Barbacid M . Renal agenesis and the absence of enteric neurons in mice lacking *GDNF*. Nature. 1996;382:70–73. [PubMed]
111. Santos O F P , Baras E J G , Yang X -M , Matsumoto K , Nakamura T , Park M , Nigam S K . Involvement of hepatocyte growth factor in kidney development. Dev. Biol. 1994;163:525–529. [PubMed]
112. Sariola, H., P. Ekblom and L. Saxén. 1982. Restricted developmental options of the metanephric mesenchyme. *In* M. Burger and R. Weber (eds.), *Embryonic Development,* Part B: *Cellular Aspects.* Alan R. Liss, New York, pp. 425–431. [PubMed]
113. Sariola H , Holm-Sainio K , Henke-Fahle S . The effect of neuronal cells on kidney differentiation. Int. J. Dev. Biol. 1989;33:149–155. [PubMed]
114. Saxén L . Failure to demonstrate tubule induction in heterologous mesenchyme. Dev. Biol. 1970;23:511–523. [PubMed]
115. Saxén, L. 1987. *Organogenesis of the Kidney.* Cambridge University Press, Cambridge.
116. Saxén L , Sariola H . Early organogenesis of the kidney. Pediatr. Nephrol. 1987;1:385–392. [PubMed]
117. Schuchardt A , D-Agati V , Pachnis V , Constantini F . Renal agenesis and hypodysplasia in *ret*-k$^-$ mutant mice result from defects in ureteric bud development. Development. 1996;122:1919–1929. [PubMed]
118. Shainberg A , Yagil G , Yaffe D . Control of myogenesis in vitro by Ca^{2+} concentration in nutritional medium. Exp. Cell Res. 1969;58:163–167. [PubMed]

iJETRM
International Journal of Engineering Technology Research & Management
www.ijetrm.com

119. Shapiro I , DeBolt K , Funanage V , Smith S , Tuan R . Developmental regulation of creatine kinase activity in cells of the epiphyseal growth plate. J. Bone Miner. Res. 1992;7:493–500. [PubMed]
120. Sharpe R M . Do males rely on female hormones? Nature. 1997;390:447–448. [PubMed]
121. Smith C A , Tuan R S . Functional involvement of Pax-1 in somite development: Somite dysmorphogenesis in chick embryos treated with *Pax-1* paired-box antisense oligonucleotide. Teratology. 1996;52:333–345. [PubMed]
122. Smith E P , 8 others Estrogen resistance caused by a mutation in the estrogen-receptor gene in a man. N. Engl. J. Med. 1994;331:1056–1061. [PubMed]
123. Smith, H. 1953. *From Fish to Philosopher.* Little, Brown, Boston.
124. Sosic D , Brand-Saberi B , Schmidt C , Christ B , Olson E . Regulation of *paraxis* expression and somite formation by ectoderm- and neural tube-derived signals. Dev. Biol. 1997;185:229–243. [PubMed]
125. Stark K , Vainio S , Vassileva G , McMahon A P . Epithelial transformation of metanephric mesenchyme in the developing kidney regulated by Wnt-4. Nature. 1994;372:679–683. [PubMed]
126. Stern H M , Brown A M C , Hauschka S D . Myogenesis in paraxial mesoderm: Preferential induction by dorsal neural tube and by cells expressing Wnt-1. Development. 1995;121:3675–3686. [PubMed]
127. Tajbakhsh S , Spörle R . Somite development: Constructing the vertebrate body. Cell. 1998;92:9–16. [PubMed]
128. Tajbakhsh S , Rocancourt D , Cossu G , Buckingham M . Redefining the genetic hierarchies controlling skeletal myogenesis: Pax-3 and Myf-5 act upstream of MyoD. Cell. 1997;89:127–138. [PubMed]
129. Tavormina P L , 9 others Thanatophoric dysplasia (types I and II) caused by distinct mutations in fibroblast growth factor receptor 3. Nature Genet. 1995;9:321–328. [PubMed]
130. Thayer M J , Tapscott S J , Davis R L , Wright W E , Lassar A B , Weintraub H . Positive autoregulation of the myogenic determination gene *MyoD1*. Cell. 1989;58:241–248. [PubMed]
131. Toivonen S . Uber die Entwicklung der Vor- und Uriniere beim Kaninchen. Ann. Acad. Sci. Fenn. Ser. A. 1945;8:1–27.
132. Tondravi M M , McKercher S R , Anderson K , Erdmann J M , Quiroz M , Maki R , Teitelbaum S L . Osteopetrosis in mice lacking haematopoietic transcription factor PU.1. Nature. 1997;386:81–84. [PubMed]
133. Tuan R . Mechanisms and regulation of calcium transport by the chick embryonic chorioallantoic membrane. J. Exp. Zool. [Suppl.] 1987;1:1–13. [PubMed]
134. Tuan R S , Lynch M H . Effect of experimentally induced calcium deficiency on the developmental expression of collagen types in chick embryonic skeleton. Dev. Biol. 1983;100:374–386. [PubMed]
135. Vainio S , Lehtonen E , Jalkanen M , Bernfield M , Saxén L . Epithelial-mesenchymal interactions regulate the stage-specific expression of a cell surface proteoglycan, syndecan, in the developing kidney. Dev. Biol. 1989;134:382–391. [PubMed]
136. Vainio S , Jalkanen M , Bernfield M , Saxén L . Transient expression of syndecan in mesenchymal cell aggregates of the embryonic kidney. Dev. Biol. 1992;152:221–232. [PubMed]
137. van Adelsberg J , Chamberlain S , D'Agati V . *Polycystin* expression is temporally and spatially regulated during renal development. Am. J. Physiol. 1997;272:F602–F609. [PubMed]
138. van Heyningen V , 11 others Role for Wilms tumor gene in genital development? Proc. Natl. Acad. Sci. USA. 1990;87:5383–5386. [PMC free article] [PubMed]
139. Venters S J , Thorsteindöttir S , Duxton M J . Early development of the myotome in the mouse. Dev. Dyn. 1999;216:219–232. [PubMed]
140. Ward C J , 8 others Polycystin, the polycystic kidney disease protein, is expressed by epithelial cells in fetal, adult, and polycystic kidney. Proc. Nat. Acad. Sci. USA. 1996;93:1524–1528. [PMC free article] [PubMed]
141. Watanabe Y , Duprez D , Monsoro-Burq A -H , Vincent C , Le Douarin N . Two domains in vertebral development: Antagonistic regulation by SHH and BMP4 proteins. Development. 1998;125:2631–2639. [PubMed]
142. Webster M K , Donoghue D J . Constitutive activation of fibroblast growth factor receptor 3 by the transmembrane domain point mutation found in achondroplasia. EMBO J. 1996;15:520–527. [PMC free article] [PubMed]

143. Weintraub H , Tapscott S J , Davis R L , Thayer M J , Adam M A , Lassar A B , Miller D . Activation of muscle-specific genes in pigment, nerve, fat, liver, and fibroblast cell lines by forced expression of MyoD. Proc. Natl. Acad. Sci. USA. 1989;86:5434–5438. [PMC free article] [PubMed]
144. Wilkie A O M , Morriss-Kay G M , Jones E Y , Heath J K . Functions of fibroblast growth factors and their receptors. Curr. Biol. 1995;5:500–507. [PubMed]
145. Wintour E M , Butkus A , Earnest L , Pompolo S . The erythropoietin gene is expressed strongly in the mammalian mesonephric kidney. Blood. 1996;88:3349–3353. [PubMed]
146. Woolf A S , 8 others Roles of hepatocyte growth factor/scatter factor and the Met receptor in the early development of the metanephros. J. Cell Biol. 1995;128:171–184. [PMC free article] [PubMed]
147. Wright E , 8 others The Sry-related gene *Sox9* is expressed during chondrogenesis in mouse embryos. Nature Genet. 1995;9:15–20. [PubMed]
148. Wu L N , Genge B R , Dunkelberger D G , LeGeros R Z , Concannon B , Wuthier R E . Physiochemical characterization of the nucleational core of matrix vesicles. J. Biol. Chem. 1997;272:4404–4411. [PubMed]
149. Yaffe D , Feldman M . The formation of hybrid multinucleated muscle fibres from myoblasts of different genetic origin. Dev. Biol. 1965;11:300–317. [PubMed]
150. Yagami-Hiromasa T , Sato T , Kurisaki T , Kamijo K , Nabeshima Y -I , Fujisawa-Sehara A . A metalloprotease-disintegrin participating in myoblast fusion. Nature. 1995;377:652–656. [PubMed]