Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/10915
DOI URL: http://dx.doi.org/10.21474/IJAR01/10915

REVIEW ARTICLE

AN EFFECTIVE AND FUTURISTIC APPROACH TOWARDS BIOLOGICAL APPS OF SMARTPHONE'S

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Manuscript Info

Manuscript History
Received: 05 March 2020
Final Accepted: 07 April 2020
Published: May 2020

Key words:-
Mobile Apps, Navigation Units, Web Programs, Offline, Bio-Rad, Genetics, Biotechnology

Abstract

Smartphone's are implementing every pursuits of life. Cell phone users are progressively moving to utilize mobile applications to internet benefits instead of conventional web programs. Smartphone applications commercial centers, Apple's app store, Google's play store and Microsoft store, have made it alluring for developers to clutch applications and also made it easy for clients to find and begin utilizing numerous empowered applications rapidly. As the use of cell phone is increasing, the utilization of mobile apps with respect to education is growing. Utilizing smart phone applications has become commonplace for students, mentors and the overall population. The motivation behind this study was to provide knowledge and array of smart phone applications related to molecular biology, biochemistry, cell biology, genetics etc. The educational applications offer by commercial application centers provide deep insights for students and researchers in the field of molecular biology, biochemistry, cell biology, genetics etc. There is a need to develop a platform where all these apps are available for all users.

Introduction:-

Smartphone's and their apps are now used by millions of people worldwide and epitomize a powerful blend of sensors, information transference, and computing power that justifies better manipulation by ecological and evolutionary researchers. (Marshallet al,.2018). The first commerce cell phone was introduced in 1983, 10 years later a cell phone model was first presented on 3rd April, 1973 and first call was rated by Martin cooper, the manager of communication systems at Motorol (Lynnet al., 1998). Later on, as the demand of cell phone increased cell phone technology developed instantly. The development of cell phone technology consists of more effective and improved battery time, strong microprocessors, and bigger screen. On the other hand, due to advocacy of computer technology personal digital assistants (PDAs) developed in early 1990's as handled sized computers (Fette, 2006). Now a days, all features of cell phone has been imported in PDAs by production of smartphone's, which reduced the need to hold two separate devices. Thus, the smartphone's are merged form of PDAs and cell phones. In extension to general phone services smartphone's includes many other features like internet access, e-mail, camera and video, calendars and contact lists, Bluetooth and Wi-Fi and sub subjectivity etc (Keegan, 2005).

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From the evolution of microscope to microprocessor, technology has played very important role in biological sciences. All the developing technologies and reviews have transformed the way of study; in addition to this smartphone's are becoming more interesting, faster and more accessible for pocket occupation. Current smartphone's has enhanced data volumes that raise the broad assistance in quality matter, which are being forward with sensors definite, automatic confirmation tools, and authentication platforms employ that artist economist and concerted intelligence to build up the best level of quality. Data curveting and incomparability has been modified in the information age. This is important to accumulate the data at global extent to acquire the formats of standard data and classification (Ozcan, 2014).

A smartphone's is preferred over featured phone with high computing abilities and more advanced features like: digital cameras, compact media players, video cameras, steering and global positioning system, high-resolution touch screen and standard web browsers etc. Practically, smartphone's are the combination of PDA having the functions of mobile phone and progressive technological countenance, so the mobile phones are being used as mobile-information device pursue by PDAs. The term smartphone's are used for mobile phones on the other hand PDAs are devices that do not have phone capabilities (Pejovic and Musolesi, 2015).

According to a survey based research in Canada, 33% population were using smartphone's and this number is enhanced by 55% among the people having the age of 18 to 34 years, which indicated that the technology is more popular among youth. Young generation is more likely to be close with mobile phone technology. Mobile-learning brings a big revolution which changed the face of higher education. Staley and Trinkle stated that a big change that has become common in novel years, raising passion of international education among traditional and modern students as they are more passionate to complete their degrees from abroad. They are most hungry for better education than the traditional way of learning. There is a higher demand for the perceptibility of literature ease and holdings informally, from well out of learning and education in creative and radical ways. In higher education use of m-learning is considered as most appropriate tool and is more helpful (Griffin et al., 2013).

Mobile apps have enabled the researchers to learn things in a modern way in different circumstances, like PDAs, tablets and many other mini electronic devices that may be used easily anywhere. Mainly, these apps are used for self-assessment and improves student's creative thinking in science as well in all other field of life. The purpose of this study is that how much these apps are beneficial and handy for us, level of ease with tools and technology. (Payne et al., 2012).

There are many operating systems like android, Microsoft, iOS, but android and Microsoft have failed grab attention like iOS. The search was endeavored using key words related to subjects. Any application not the growing biological data conquest has thus both changed the way we read and, specifically, how we depend on new advancements to sort the data and to mine the online background all the more successfully. One such illustration is the transformation of the mobile phone into an effective workstation that permits scientists to stay aware of their inspecting on the go. The utmost current eras of mobile phones are gradually grasped as palmtop instead of as conventional mobile phones, because of their operative screen computing capability, substantial reminiscences, massive displays and open working frameworks that support application advancement (Wren, 2011).

Smartphone computing has penetrated into our customary lives to such a degree that many expectations to be online most of the time in a day, in any area. It is currently conceivable to utilize advanced programming applications in one's hand that only a couple of years earlier were confined to desktop computers. Handiness is no more anticipated that would be constrained to booting up a Tablet rather essentially opening a handheld gadget that is dependably on and always connected, whether it is a cell phone or tablet (Griffin et al., 2013).

Surely, iPhone, Android and Windows Phones are one of the best examples of success stories of this current era. In a generally short period of time, brilliant adaptable revolution has intruded in modern life, communicable to all assenters in developed countries, from school students to senior researchers. Such advancements are depending upon a long term use of these dedicated appliances, and a quick reception of adaptable specific devices that ongoing in the last part of this current century (Pejovic and Musolesi, 2015).

With an apparently unlimited number of applications accessible, the cell phone can be a significantly helpful device. An expanding number of applications are focused to students, mentors and list of must-have applications for experts have grown. There are applications to quickly calculate DNA, RNA and protein concentration, melting and

annealing temperatures of primers, 3D view of biomolecules, DNA damage studies, lab timer for various lab experiments, videos and tutorials for the understanding of basic concepts in biological sciences and dictionaries etc (Beaty, 2016).

Cell phone applications as for biological sciences were gathered from three online application stores: Apple's containing information vital to course of topic was excluded in the study (Mosa, 2012). The given table 2.4 is showing history of inventions. It gives an idea about how with the passage of time man moves toward progress. This article is all about biological apps of smartphone's a need of everyone who somewhat engaged with education & technology.

Review Of Literature:-

With an apparently unlimited number of applications accessible, the cell phone can be a significantly helpful device. An expanding number of applications are focused to students, mentors and list of must-have applications for experts have grown. There are applications to quickly calculate DNA, RNA and protein concentration, melting and annealing temperatures of primers, 3D view of biomolecules, DNA damage studies, lab timer for various lab experiments, videos and tutorials for the understanding of basic concepts in biological sciences and dictionaries etc (Wren, 2011).

Surely, iPhone, Android and In Windows Phone are best examples of success of current decade. So in short time, brilliant handy revolution has intruded, grasping the all ages of sponsors in developed countries, from schooling to researchers. These developments have been depending on a long time of the exploitation of particular devices, and a quick reception of variety of unique tools that are ongoing in the previous part of the most modern era (Beaty, 2016).

In this report, the discussion is based on the educational related apps such as; biochemistry, molecular biology and genetics. Cell phone applications as for biological sciences were gathered from three online application stores: Apple's containing information vital to course of topic was excluded in the study (Mosa, 2012). These apps are categorized into main fields like molecular apps, cellular biology apps, lab apps and so on.

Apps for Molecular Biology:

There are many apps for molecular biology that are use now days. But here are some important and quick apps that are used by molecular biology students & recommended for other science students for making DNA sequencing, PCR process, Primer designing and many more.

Apple's Apps:

Primer Jot:

Primer Jot is developed by Venkatramanan Krishnamani for educational medical purposes. It is a free molecular biology app for perfect PCR mate, it track the oligos all in one place, based on standard set conditions calculate primer melting temperature (Tm) and provide physical location details. This app contain outstanding feature through which one can easily search primers based on sequence, melting temperature, name and project. It can also make favorite list of primers and can easily locate them on the fly.
(https://ios.lisisoft.com/a/primer-jot.html.)

MolBio:

MolBio is created by Thermo Fisher Scientific for educational and medical use. It is remarkable free app for molecular biologists. It can offer the guide for PCR/qPCR reagents, modifying and restriction enzymes, DNA and protein ladders, nucleic acid purification kits and other molecular biology products (https://itunes.apple.com/ae/app/biochemistry-and-molecular-biology-education/id1065834683?mt=8**).**

DNA Damage:

DNA Damage app is developed by the ASBMB (American Society for Biochemistry & Molecular Biology) Tristero Consulting. This is a unique and free app for education, action and games.. Everyone studying biochemistry or molecular biology is the part of ASBMB. This app include DNA repair mechanism by linking nucleotides, ligate the nucleotide bases on correct position on leading strand of DNA. Users can join the complementary bases and wrong combinations create mutations. It will not move on next stage if change rate is high.(https://itunes.apple.com/us/app/dna-damage/id448978584?mt=8**).**

MyGels:
MyGels is developed by Morten Bertz for educational and medical purposes. This is a free app can helps to analyze, quantify, annotate and organize the gels and blots results mostly used in molecular biology, like SDS-PAGE, agarose gels, western blots etc. It can work very simply, users can capture gel image, crop it to the desired region and then MyGels automatically recognize lanes and bands of the gel image. It can easily calibrate the gel to quantify band, determine molecular weight and export beautifully annotated gel images. (http://www.mygels.com).

Android apps:
Design Gene:
Design Gene is a free app developed by Jim He for Board and Games. The base pairing rule of DNA and RNA are the basis of this application. User move the falling blocks and place them according to base pairing rule. If all the pairs in two rows follow the rule then, these two rows will be disappeared and can get point. This application helps you to remember base pairing rule(http://developer.apple.com/design/**).** Table 1 below shows all apps for apple.

Window Apps:
DNA Sequence Converter:
DNA sequence converter is a free app for health and fitness developed by Giwrgos Ntakakis. It works on nitrogenous base complementarity principle. It can allow standard base pairing; reverse the DNA sequence, made compliment DNA sequence and reverse compliment DNA strand. By using this app students can get the basic knowledge of DNA base pairing. (http://cellbiol.com/scripts/complement/dna_sequence_reverse_complement.php).

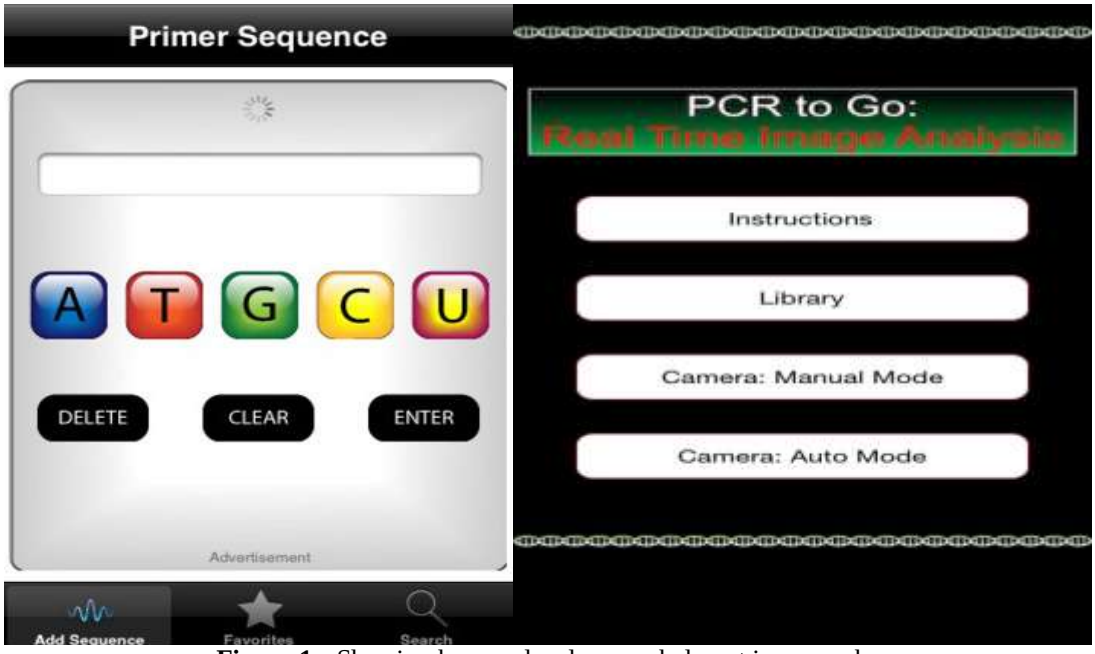

Figure 1:- Showing how molecular apps help out in research.

Apps for cellular biology:
The study of structural and functional unit of life is called cell biology.It gives detail knowledge about tissues and organisms that makeup a cell. There are many apps developed in smartphone's. These apps are equally helpful for student and teachers.

Apple's Apps:
Virtual Cell Animations:
Virtual cell animation is a free educational app. This applications comprises animatronics, descriptions, and satisfied puzzles. Brief description of different cellular process like respiration, RNA and protein expression, meiosis, mitosis are present in it. The app is developing to help the learning of basic conceptions in science for all age groups by visualizing tools. For the review of concepts one quiz also included at the end of each section.
(https://itunes.apple.com/us/app/virtual-cell-animations/id427893931?mt=8**).**

Video Science
Video science is a free educational app developed by Object Enterprises. This app gives hands on scientific knowledge for both students and mentors. Video science provides video clips which showcheap and informal to restore experiments those are intended to encourageand motivate teenagers.
(https://itunes.apple.com/us/app/videoscience/id333284085?mt=8**).**

Core Biology:
Core biology is not a free app; users have to pay $2.99 to access this app for education. It is very useful and intuitive app for students in biology. Users can easily access to about 2000 real exam questions. It covers the core biology concepts and allows students to access their knowledge in biology. Additionally this app provides quiz session where students answer the random questions of biology and also show their performance. (https://play.google.com/store/apps/details?id=com.learnersbox.a.level.biology**).**

Cell World:
Cell World is a free app for educational devotions, developed by Virtual Immersive Educational World Inc. This app provide mysterious world of the cell. Anyone can explore the details of each cell part by navigating in game like fashion to the nucleus, ribosomes, nucleus and more. The 3D component of learning about the cell is ideal for students. Students are also being able to read and listen to the explanations.
(https://play.google.com/store/apps/details?id=com.VIEW.CellWorld).

3D Cell Simulation and Stain Tools:
It is an open app for educational purposes developed by Invitrogen Corporation. This app is considered as a to 5 higher education app by Apple. It allows to create own cell image, explore a 3D cell view and also email this image creation to the colleagues. By using this app users will able to see 3D structure of cell by using this handy tool. It also gives full depiction about how organelles of cells interact with eachother.
(https://itunes.apple.com/us/app/3d-cell/id402252996?mt=8**).**

The Cell:
The Cell is a free app for medical field, developed by The System Biology Institute. It can provide 3D scale and broad model of animal cell with description of their organelles. The size of cell is depending upon the size of cell organelles. A scale bar also appears by pressing a known button.
(https://itunes.apple.com/us/app/3d-cell/id402252996?mt=8**).**

Enzymatic:
Enzymatic is a free educational app developed by Brett Baughman. Enzymes are essential for every biological process and extremely important in biology. It is an amazing and interactive app, students may able to get knowledge about enzymes through different means like execution of effective research and playing games. This is a great way to go over the main points of enzymes in a fun way. The quizzes are great and reflect the information discovered in the mini lessons and reinforced in the game.
(http://www.enzymatic.biz/applications/).

iPathways:
iPathways is a free medical app developed by The System Biology Institute that allows exploring biological pathways on the palm. iPathways is best app in understanding the biological complexity of living systems in both disease and healthy states. The Systems Biology Institute of Tokyo develops this app. It can also provide access to molecular maps constructed by Cell Designer.
(https://www.i-pathways.org/**).**

Cell imaging:
Cell Imaging is a free educational app & it is also created by Invitrogen Corporation. The purpose of this app is to assist students to get fluorescents colors, chemical reagents and protocols associated fluorescence and microscopy. This application help in choosing scientific protocol for marking cell organelle and their physiology such as; Cytoplasm, Golgi apparatus, Mitochondria, lysosomes and so on.
(https://itunes.apple.com/ca/app/cell-imaging/id474504116?mt=12**).**

Science 360:
Science 360 is a free educational app developed by National Science Foundation. It is a best app for all science students, it also gives easy access to biological and engineering descriptions, videos and latest updates specially through NSF funded institutes. The contents of this app are gathered by NSF centers, scientists and different universities. It can allow saving favorite images and videos with a single touch. Moreover, users can also share app contents on their Facebook and twitter accounts.
(https://itunes.apple.com/us/app/science360/id439928181?mt=8**).**

Android apps:
iCell:
iCell app developed by Hudson Alpha Institute is free app for Biotechnology, it is very important and useful app for students and teachers involve in biology. It can also provide useful information about various parts of the cell. Students can easily compare the plant, animal and bacterial cells and their structures by using intuitive tool.
This app allows one touch tap on various parts of cell to zoom in and out for better view of cellular organelles.
(https://play.google.com/store/apps/details?id=org.hudsonalpha.icell).

AC Biology: Identifying Cancerous Cell
This is a paid app for educational devotions, developed by Christan Maxwell focused on very important issue in biology which is cancer. By using this app anyone can examine healthy and cancerous cells through an interactive exercise. It can also provide the cause of cancerous cells and particularly symptoms of lungs cancer. The prominent feature including recognition of abnormal cells in the cell cycle. Study the structure, organization and formation of cells. Identify the three leading causes of the lungs cancer.(http://www.microsoft.com/en-us/store/p/ac-biology-identifying-cancerous-cells/9wzdncrdrkww).

Cellular Biology:
Cellular Biology is a free educational app developed by Learners Box. This is an Android app free apk created by Deep Powder Software download from Google Play and install Cellular Biology app on mobile phones and tablets. Appendix comprehends different terms, descriptions, infections, and symptoms relating to Cellular Biology.
(https://play.google.com/store/apps/details?id=com.infoland.cell_biology).

Figure 2: showing the internal structure of cell

Apps for Genetics:
Study of genes and inheritance is called genetics. Flow of genes from parents to offspring is referred as heredity. To understand genetics, there are many apps in smartphone's; some of them are described below.

Apple's apps:
Genetics365:
Genetics365 is free medical and reference app, developed by Bayesssoft Inc. It is a powerful tool for scientific research and decision making in the development and delivery of personalized medicine. It provides the exciting

data how single nucleotide polymorphism (SNP) relates to different disease and traits in new ways. Genetics365 get a quick overview of SNP trait associations by disease or chromosome and quickly filter down to a particular SNP. (http://appshopper.com/reference/genetics365**).**

Cootie Genetics:
It is a free educational app developed by Cootie Genetics lab, University of Arizona Biotech project. This app provides practical review based work that empowers researchers to get an understanding about law of inheritance. Cootie Genetics is powerful tool for students and teachers to learn how dominant and recessive traits combine in the offspring. In addition it can also provide the tools necessary to construct Punnett squares.
(http://biotech.bio5.org/cooties**).**

Genetic Code:
Genetics Code is a free app for educational purpose & developed by ivayna. It is powerful application used by both scholars and researches. This app gives a better understanding about all amino acids, their abbreviations and genetic code of life. This app has four different ways to represents codon table. In codon picker, anyone can choose a specific codon, so to get knowledge about its structure and name of the corresponding amino acids. In codon table, genetic codes represents in table form(https://itunes.apple.com/us/app/genetic-code/id346512503?mt=8).

Android apps:
Genetics Dictionary:
Genetics Dictionary is a free app developed by Top Apps Power. This app is intended to provide the learning process as well as to refresh the basic genetics knowledge. Particularly this app will be useful to students and geneticist alike. There is no need for an active internet connection, it work offline and it is powerful feature of this app. It can provide semantic and dictionary search and keep up to date with latest terms and genetics news feed (https://itunes.apple.com/us/app/talking-glossary-of-genetics/id428340581?mt=8**).**

Genetics Calculator:
Genetics calculator is a paid app developed by Eddie Strong Jr designed to calculate the probability of genetic traits in the offspring. The calculator is very simple, easy to use and displays the results in less than a second. It can calculate up to six different traits for a possibility of seven hundred and twenty nine different outcomes. It must have apps for students particular in the field of molecular biology (https://itunes.apple.com/us/app/genetics-and-evolution/id650401749?mt=8**).**Table 2 below shows review of Android apps.

Apps name	Ratings	Current version	Compatible Device	Developer	Free/ paid	Category
Chemcal	**182**	**6.9**	**8.1**	**productivity**	**Free**	**Everybody all the time**
Labmama	**4.0**	**1.1**	**2.2**	**Qupia**	**$(1.63)**	**Tools**
Protocolpedia	**1.000++**	**3.3**	**3.0+**	**Hue Digital LLC**	**Free**	**Books&Refeerence**
Xplore RNA	**4/85**	**1.1.1**	**2.1**	**Exiqon A/S**	**Free**	**Medical**
Genetic risk assessment	**5./ 38,088**	**4.0**	**4.0.1**	**Transition Technologies s.a**	**Free**	**For All**
Evolution	**3.7/175**	**4.2.2**	**4.4**	**Wagmob**	**($ 0.96)**	**Reference**
Genetic code	**4.2/895**	**1.2**	**4.0.2**	**Victor Ginnakouris**	**Free**	**Educational**
Genetics calculator	**2.8/5**	**v5**	**2.3.4+**	**Eddie strong JR.**	**($1.00)**	**Tools**
Genetics	**4.3/5**	**0.0.4**	**0.4**	**Top apps power**	**Free**	

dictionary						**Education, Medical**
Cellular biology	**3.9/53**	**5.0**	**4.0.3**	**Learners box**	**Free**	**Educational**
ICell	**3.9/1.510**	**3.1**	**2.0.1**	**Hudsonalpha institute for biotechnology**	**Free**	**Education**
Design gene	**4+/0**	**1.0**	**2.2**	**Jim He**	**Free**	**Board and Games**

Table No 1:- Android Apps

Genetic Code:
Genetic code app is an educational app developed by ivaynafor students involve in the field of biological sciences. It is an easy and quick way to improve basic knowledge of transcription and translation processes. By using this app users can just enter required DNA sequence in the text box and press transcript button to generate RNA sequence and to get amino acid sequence by just press translate button. The main features of this app is transcription and translation processes.
(https://play.google.com/store/apps/details?id=de.damageinc.geneticcode**).**

Evolution:
WAGmob brings you simple and easy learning app for Evolution. It is designed for both students and teachers. This app provides a quick summary of essential concepts in evolution like adaption, cooperation, coexistence and extinction.
(https://play.google.com/store/apps/details?id=com.koramgame.ggplay.elsword**).**

Window Apps:
Foundation Genetics:
The Foundation Genetics is a paid app developed by AppMachine B.A allows searching and selecting the best sire for animal breeding purposes. The app includes a Twitter Feed, Facebook Feed, Events Calendar, Straw Scanner, and Products Shop. People involve in dairy business get benefit from this app and also in contact with dairy experts. (https://itunes.apple.com/us/app/2017-acmg-annual-clinical-genetics-meeting/id1198373746?mt=8**).**

Genetics:
Genetics is paid educational app developed by Neelgangrade. This app will give latest updates regarding best genetic engineering research process, stem cells work out, new developments in genetics and stem cells area. This app is really helpful for students involved in genetic engineering research.
(https://www.studyblue.com/subject/igenetics**).**

Genetics Explorer:
Genetics explorer is a free app developed by Iqbal Shajol. It is very useful app for all genetics students and teachers. It can provide basic knowledge about genetics terms and one can also search new trends in the field of genetics. By searching new topics users can also open research journals and read research articles.
(https://itunes.apple.com/us/app/genetics-and-evolution/id650401749?mt=8**).**

Genetic Risk Assessment:
Genetic Risk Assessment is a free app for all, developed by Transition Technologies S>A. It is computer based expert scanning system for all type of hereditary cancer screening including ovarian, colon, stomach and lungs. This app is purely dedicated for family doctors, cancer genetics clinics and patients. It also include patient questionnaire in which patient may add their personal and contact data and as well as history regarding to their any mutation or disease in their family.
(https://www.gocanvas.com/mobile-forms-apps/3257-Risk-Assessment-Checklist**).**

Figure 3:- Genetics Calculator.

Apps for Medical students:
A medical school or College is an educational institution or that teach medicine, and award a specialized degree for physicians and surgeons. Smartphone's are playing a very central role in helping medical students and junior doctors.

Onscreen Retrovirus:
The actual purpose of this app is to provide deep understanding of viral genome without prior knowledge of molecular biology. This app included basic knowledge of retroviruses, how it actually replicate in the host machinery, minus strand, primer binding site (PBS) and long terminal repeats (LTR) etc. The special feature of this app is 3D nucleic acid models to make memorable the crucial steps by which the reverse transcriptase enzyme complex of a retrovirus uses nucleotide building blocks of the host cell to copy the viral genome. This app shows every step of DNA synthesis (3D double helix forming process), RNA degradation and DNA dependent DNA synthesis. OnScreen Retrovirus app has background material on viruses, nucleic acids and enzymes as well as commentary on each step.
(http://onscreen-scientist.com/?p=556**).**

Blood Group Genes:
A blood group gene is basic app for all the smart phone users. Blood of a baby can be determined by the blood group of both the parents. This application makes an attempt to approximate blood group of a baby by taking input blood group of parents. **(**http://www.microsoft.com/en-us/store/p/blood-group-genes/9wzdncrdqkm2**).**

Xplore RNA:
Xplore RNA is developing for scientists engaged in transcriptomics studies. It can include all the major functional genomics databases like Ensemble, miRBase etc. All the databases are completely and cross annotated and regularly updated by advance text mining of the literature. Researchers can easily access to information on DNA, RNA, miRNA-mRNA interactions etc.
(https://play.google.com/store/apps/details?id=com.exiqon.xplorerna**).**

Surgeon Stimulator:
Surgeon Simulator is an effective app for complex surgeries and transplants, on an unlucky simulated patient. By using this app, medical students can control on surgical instruments with their fingers, students can perform operations by using their iPhone or iPad, working to save the life of virtual patient. The app also includes an animated alien, on which they can do alien autopsies, and transplant fictional organs. There is also a multiplayer feature, allowing you to compare surgical abilities with your friends.
(https://itunes.apple.com/us/app/surgeon-simulator/id814977594?mt=8**).**

3D Brain

3D Brain explore 29 different interactive brain structures, which are providing information on what each region does, and what happens when different areas become damaged. This app also tells us how different structures can be involved in mental illness providing a number of related case studies. By using this, one can also investigate the brain further through links to the latest peer-reviewed research.
(https://itunes.apple.com/us/app/3d-brain/id331399332?mt=8). Table 2 below shows review of some important apple apps.

Table No 2: Apple Apps

Apps Name	Rating	Current version	Required device	Developer	Free/ paid	Category
MolBio	**4+/0**	**6.2.4**	**5.1**	**thermo fisher scientific**	**Free**	**Educational**
DNADamage	**4+/8**	**1.0**	**4.0**	**Tristero consulting**	**Free**	**Educational**
PCR TO GO	**4+/0**	**2**	**6.0**	**Aashishpriye**	**Free**	**Educational**
MYGELS	**4+/7**	**2.0.1**	**8.1**	**Morten bertz**	**Free**	**Educational**
Virtual cell animations	**4+/125**	**1.4.0**	**4.3**	**VCell productions**	**Free**	**Educational**
Promega	**4+/8**	**1.5**	**9.0**	**Promega corporation**	**Free**	**Educational**
Amino acids structure	**4+/19**	**1.1**	**4.1**	**Andrysolovyev**	**($0.99)**	**Educational & Games**
Molecule world DNA binding lab	**4+/0**	**1.1.1**	**7.0**	**Digital world biology LLC.**	**Paid ($2.99)**	**Educational & Medical**
Onscreen retrovirus	**4+/0**	**1.1.1**	**6.0**	**Onscreen science, INC.**	**Paid ($3.99)**	**Education and Medical**
Video science	**4+/0**	**4.0.0**	**6.0**	**Object enterprises**	**Free**	**Education**
Core biology	**12+/35**	**1.0.5**	**4.0**	**Log on science**	**($2.99)**	**Education**
Cell world	**4+/0**	**1.0.0.1**	**4.0**	**virtual immersive Educational worlds INC.**	**Free**	**Education**
D cell simulation and stain tools	**4+/502**	**3.5**	**8.0**	**Invitrogen corporation**	**free**	**Educational**
The cell	**4+/0**	**1.1.1**	**7.0**	**lte-ib-unicamp**	**Free**	**Education**
Enzymatic	**4+/27**	**1.0**	**5.1**	**Brett Baughman**	**Free**	**Education**
iPathways	**4+/32**	**1.2.1**	**4.3**	**The systems biology**	**Free**	**Educational**

				institute		
Cell imaging				**Invitrogen corporation**	**Free**	**Medical**
Science 360	**4+/825**	**1.3.5**	**8.0**	**National science foundation**	**Free**	**Education**
Talking glossary of genetics	**4+/17**	**1.0.3**	**4.0**	**national human genome research institute**	**Free**	**Educational**
Genetics365	**4+/58**	**1.2**	**6.0**	**Bayesssoftinc.**	**Free**	**Medical, Reference**
	5.5/1.23 5	**1.1.0**	**5**	**Futch Production syndicate Pl.**		
Cootie genetics	**4+/0**	**1.5**	**7.0**	**Ivayna**	**Free**	**Educational**
3DBrain	**4+/ 546**	**1.1.2**	**8.0**	**DNA Learning Centre**	**Free**	**Educational**
BrainPOP	**4+/ 86**	**5.0.1**	**4.0**	**BrainPop**	**Free**	**Educational**
Lab timer	**4+/1082**	**4.0**	**3.0**	**Oxoc**	**Free**	**Productivit y & Utilities**
Labofficer	**4+/155**	**3.1.1**	**9.0**	**Morph bioinformatics**	**Free**	**Productivit y & Utilities**
Cell culture	**4+/ 567**	**1.1.1**	**4.3**	**https://itunes.apple.com/il/app/cell-culture/id585332692?mt=8**	**Free**	**Education & Medical**
Fast counter	**5+/887**	**1.1.3**	**9.0**	**https://itunes.apple.com/us/app/fast-counter/id529461202?mt=8**	**Paid ($3.99)**	**Education**
Chemtrix	**4+/212**	**5.0.1**	**6.0**	**black rhino software**	**($3.99)**	**Education**
Mastermix	**4+/0**	**11.1.2**	**7.0**	**Luis Avila**	**Free**	**Educational & Utilities**

BrainPOP:
BrainPOP provides a very different animated short film everyday quizzing you on what you've learnt. All of the videos are subtitled, allowing students to absorb the facts as they go. The films encompass a huge range of subjects, including math, biology, physics, engineering, medicine and music. BrainPOP is a great science app for kids and students looking for a fun and interactive way to learn (https://itunes.apple.com/us/app/brainpop-featured-movie/id364894352?mt=8**).**

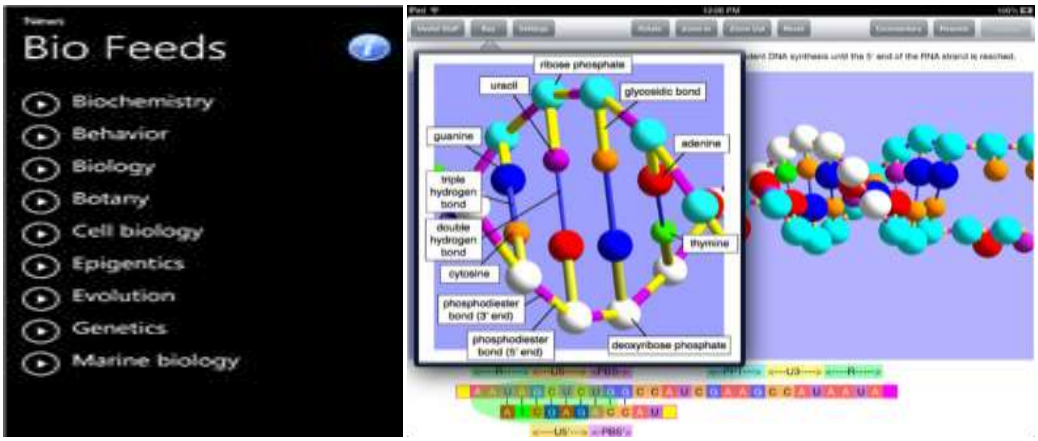

Figure 4:- Showing Blood Group Genes and structure of Retrovirus.

Apps for biochemistry labs:
There are many apps use for biochemistry labs, some of them are given below.

Lab Timer:
This app includes count-up, alarming count-down and multi timer facility. It can provide quick access to count-down timers and repeat runs. It is not only for lab use but also convenient for daily routine works like medication timing, working outs and child timeouts etc. OxOc provide numerous features in this app like four timers, large display, projected finish time, alarm for one minute etc. Although Lab Timer is free app but its new version Lab Timer-PhD, a pay app with identical features (https://itunes.apple.com/us/app/labtimer/id292202454?mt=8**)**

LabOfficer:
LabOfficer can provide a comprehensive toolbox for biologists. It includes In-Silico genetic engineering experiments helpful for students and researchers. It can provide paired sequence alignment, buffer checker, codon table, viewing sequence file in FASTA format, Clone Manager and Snapgene files. (https://itunes.apple.com/us/app/template-lab-templates-for-pages/id402662285?mt=12**).**

Protocolpedia:
This app can offer offline access to hundreds of molecular biology and biochemistry protocols at one place. It can maintain your lab methods for easy, quick and convenient access. Unique features of this app include offline bio-calculator, complete protocols of different fields, molarity, dilution, oligo re-suspension and PCR master mix. (https://play.google.com/store/apps/details?id=com.tenx.mj.protocolpedia**).**

Molecule World DNA Binding Lab:
Molecule World DNA Binding Lab is the first bioinformatics laboratory investigation app on the iPad developed with the funding from National Science Foundation. This app offers molecular modeling laboratory that helps students to learn about the structure of DNA and explore the diverse type of molecules (Proteins) that bind to DNA. This app includes complete laboratory instructions, how protein, restriction enzymes and anti-cancer drugs bind to the major and minor grooves of DNA. This app is designed for both high school and college level students. (https://itunes.apple.com/us/app/molecule-world-dna-binding-lab/id880738455?mt=8**).**

Promega:
The Promega App includes basic laboratory tools for life scientists. This app is design to provide tools for use at the bench like different protocols, calculator, and solutions recipes and also covers key topics of cell and molecular biology. Protocols including basic cell, molecular biology and DNA analysis procedures like restriction enzyme tools. This app also contain biomath calculator which can easily and quickly calculate molarity, DNA and protein concentration and melting temperature etc. Additionally, multimedia section of Promega app provides video protocols and animated demos. For these obvious reasons it is very useful for teaching and brain storming. (https://itunes.apple.com/us/app/promega-protocols/id947048912?mt=8**).**

MasterMix:
A MasterMix calculator app is developed especially for routine PCR master mix calculations in all molecular biology laboratories. It is quick, easy and free app which is use to customize your PCR master mix with a fully editable recipe and also time saving.

LabMama:
LabMama is optimized for use in molecular biology lab and it can take care of the arithmetic's. It can be used to save different reagents and you can easily calculate the amount of each reagent needed for a given number of the particular solution. The calculations are made with extreme precision in this tool. LabMama is optimized for use in molecular biology lab. (https://play.google.com/store/apps/details?id=com.qupla.labmamalite**).**

CloningBench:
This app is developed by life Technologies Corp, CloningBench app helps molecular biologists with calculators to get the volume, concentration and ratios of their cloning vector. The app boasts a double digestion finder and of course nestled links of life's plethora of products. This app nicely implemented effective equally among the students of molecular biology and researchers (https://itunes.apple.com/us/app/cloningbench-by-invitrogen/id458617777?mt=8).

Cell Culture:
Cell culture is an excellent app for those who work with cultured cell. It combines with four counts down/ counts up timers; cell counter, many calculators (Dilutions, passage cell, doubling time) and analysis of culture growth and assessment of doubling time. The data collection can be sent via email for desktop analysis or graph preparations. (https://itunes.apple.com/il/app/cell-culture/id585332692?mt=8)

Fast Counter:
An effective app that helps in counting growth of bacteria/yeast colonies on petri dish plates. The app boasts manual and automatic counting methods and the data can be exported to email for further analysis and interpretations. (https://itunes.apple.com/us/app/fast-counter/id529461202?mt=8).

Figure 5:- Showing the Home page of lab apps.

Apps for proteins:
Proteins are huge biomolecules or macromolecules comprising of at least one long chains of amino acids buildups. Proteins play out a huge range of capacities inside living being, including catalyzing metabolic responses, DNA Replication, reacting to boosts and moving particles starting with one area then onto the next. In Smartphone's, apps are present for amino acid sequencing, structure and function, these are given below.

Amino Acids for A:
Amino Acids for A are collaborative effort of Prof. Alexander Casanas and Prof. Luis Vazquez and it is for every student. If you do not know anything about the amino acids, do not worry, this app will provide you basic knowledge about biochemistry and amino acids. You can get information about amino acids their structure and biological functions.
(http://www.microsoft.com/en-us/store/music/album/tau-rine/amino-acids/8d6kgwx2zc5r**.).**

SMol:
SMol permits you to view, search and download and 3D protein structures from Protein Data Bank. 3D models are optimized for viewing on the phone screen and can be manipulated via multi-touch or simply by tilting your phone. It can provide basic knowledge about chemical structure and visual effects describe their possible functions.
(http://www.microsoft.com/en-us/windows/windows-10-apps**).**

Amino acids:
This app will helps you for quickly look up the structure of any of the 20 amino acids. This is a must have app for all students, researchers and lab technicians involved in molecular and cell biology research. It can provide a detailed view of each amino acids, abbreviations, molecular weight and pKa. Genetic code chart in this app provide more details about each amino acids.
(http://www.microsoft.com/en-us/store/music/album/tau-rine/amino-acids/8d6kgwx2zc5r**).**

Amino Acids Structure:
This app is developed for everyone studying biological science. It can provide necessary information about names and structures of amino acids that are building blocks of proteins and peptides. This app provide the most easiest, quick and efficient way to learn names, codes, structures and properties of 20 amino acids and their related compounds. It also include some extra features like one and three letter codes of amino acids, flash cards, quiz section, colorful structures, isoelectric points and classification of amino acids.
(https://itunes.apple.com/us/app/amino-acids-structure-essential-acid-from-phenylalanine/id807763847?mt=8).

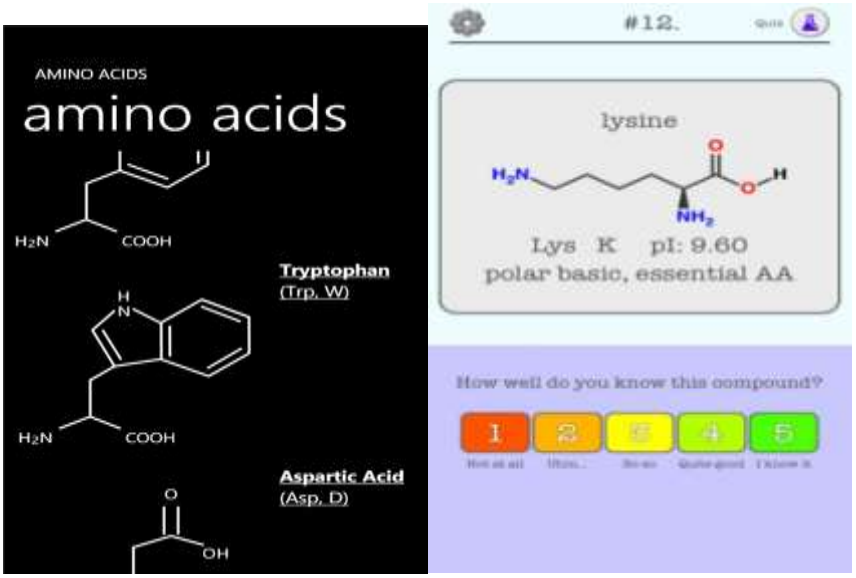

Figure 6: Showing structures of amino Acids

Apps for chemistry & Biochemistry:
There are many apps for chemistry and biochemistry in smartphone's.

ChemTrix:
ChemTrix is a powerful calculator for common chemical problems. It is easy to use, intuitive, and exactly most useful app for chemistry students. It is super helpful, saving time when doing tiresome equations. This app provide

you molar mass, exact mass, most probable mass, percentage composition by mass, isotopic mass distribution and moles-volume concentration etc (https://itunes.apple.com/us/app/chemtrix-chemistry-calculator/id549708598?mt=8**).**

ChemCal:
ChemCal provide a platform where we can create a library of media, complex solutions and buffers recipes. It is recipe book for chemical solution calculations in the lab. We can also add notes to any recipe as a reminder before doing to mix it (http://www.uswaterservices.com/chemcal-website-redirect**.).**

MasterMix:
A MasterMix calculator app is developed especially for routine PCR master mix calculations in all molecular biology laboratories. It is quick, easy and free app which is use to customize your PCR master mix with a fully editable recipe and also time saving. (http://www.mastermixdj.com/**).**Table 3 below shows review of microsoft windows apps.

Table No 3:- Microsoft Window apps.

Apps names	Rating	Current version	Required device	Developers	Free/ paid	Category
DNA sequence converter	4+/18	8.1 or 10	10/6	Giwrgos Ntakakis	Free	Health and Fitness
I Genetics	4+/13	varies	8.1	Neelgangrade	($0.99)	Education
Foundation Genetics	4.3/61	1.7.00	8.1/10	AppMachine B.V	Free	Business
Genetics Explorer	2.6/8	1.7.00	8.1	Iqbal Shajol	Free	Education
Blood Group Genes	3.5/45	1.7.0.	8.1/8	AppGrate	Free	Health and Fitness
Amino Acids for A	4+/ 778	varies	8.1	Amarilysm	Free	Education
SMol	4+/ 96	1.0.4	10	Roman Snytsar	($2.87)	Education
Amino Acids	5/ 67	1.0	8.1	EnghLabs, LLC	($0.99)	Book & References
Bio Feeds	3.5/42	1.0.4	8.1	Maq LLC	($ 0.96)	Education
Educational Corinth micro plant	4+/ 768	1.1.0	8.1 or 10	Cornith S.R.O	Free	Education
i-lectures biotechnology	5+/ 859	1.4.3	8.0	Brian N. Mpafe	Free	Education
Ac biology: identifying cancerous cell	3.5/ 78	1.7.1	10	Christan Maxwell	1.99$	Educational

Bio Feeds:
Bio Feeds gives information about the plant and animal kingdom. You can get information about botany, zoology, genetics etc. It is very helpful and powerful app for all life science students; they can get information relating to plants and animals and get aware with latest knowledge (http://www.microsoft.com/en-us/store/p/windows-10-news-feed/9nblggh1rg36**).**

Educational Corinth Micro Plant:
It is purely educational application it takes the students into microscopic world of plant molecular biology. By using this app you can explore magnified images of 3D models of plant, animal and bacterial cells and their different parts. It can also provide fascinating 3D environment of plant viruses and it can also connect with Wikipedia (http://www.microsoft.com/en-us/store/p/corinth-micro-plant/9wzdncrdrmr5).

i-Lectures Biotechnology:
In this app student learn basic concepts of biotechnology. It can provide video lessons about general biotechnological concepts and tools at no cost. This app is equally important for both teacher and students in the field of biotechnology and molecular biology (https://www.appannie.com/apps/windows-store/app/i-lectures-biotechnology/**).**

Figure 7:- Shows how Chemical buffer are formed.

Conclusion:-

Not only at a time when the phones are used for conversing with computers and run other software applications. Indispensable the structure of a mobile phone has become a tool in the computer is in the laboratory, which developed into a violent misstated to the tens of thousands of lectures and scientific gatherings and conferences. However, researchers can be seen talking on the phone to the PC using currently running on the field and what is sometimes robust software program.This change is in the open in a little room, the one on the iPhone on the mobile computing era. The voice of a new breed of investors of wolves, and that the smartphone is common, that they should not only in public, but that is, to the ubiquitous among scientists. The phones like to achieve, but the advent of iOS's App Store in 2008 presented many adventurous apps. When the avowedly infinite apps are available, that is why iPhone is being fairlyconvenient instrument. An increasing number of scientists and researchers apps are targeted lists of must-have for apps are increased. It seemed to prepare a solution of the enzyme to be diminished in order to calculate how the data. There are the apps, search databases papers and store them online for the downloaded papers. Well-known purveyor products for the apps for the iPhone, and his acts, first and Research Biological Laboratory is to let them go. Google's operating systems of Android Smartphone's app store with tens of

thousands of applications, but not got attraction as iPhones.The emergence of smart watches have great renovation in the field of research and make it much easier than smartphone's.

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