

BIOPHYSICS IN AFRICA

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African Conference on Fundamental and Applied Physics (ACP2023)



African School of Fundamental
Physics and Applications



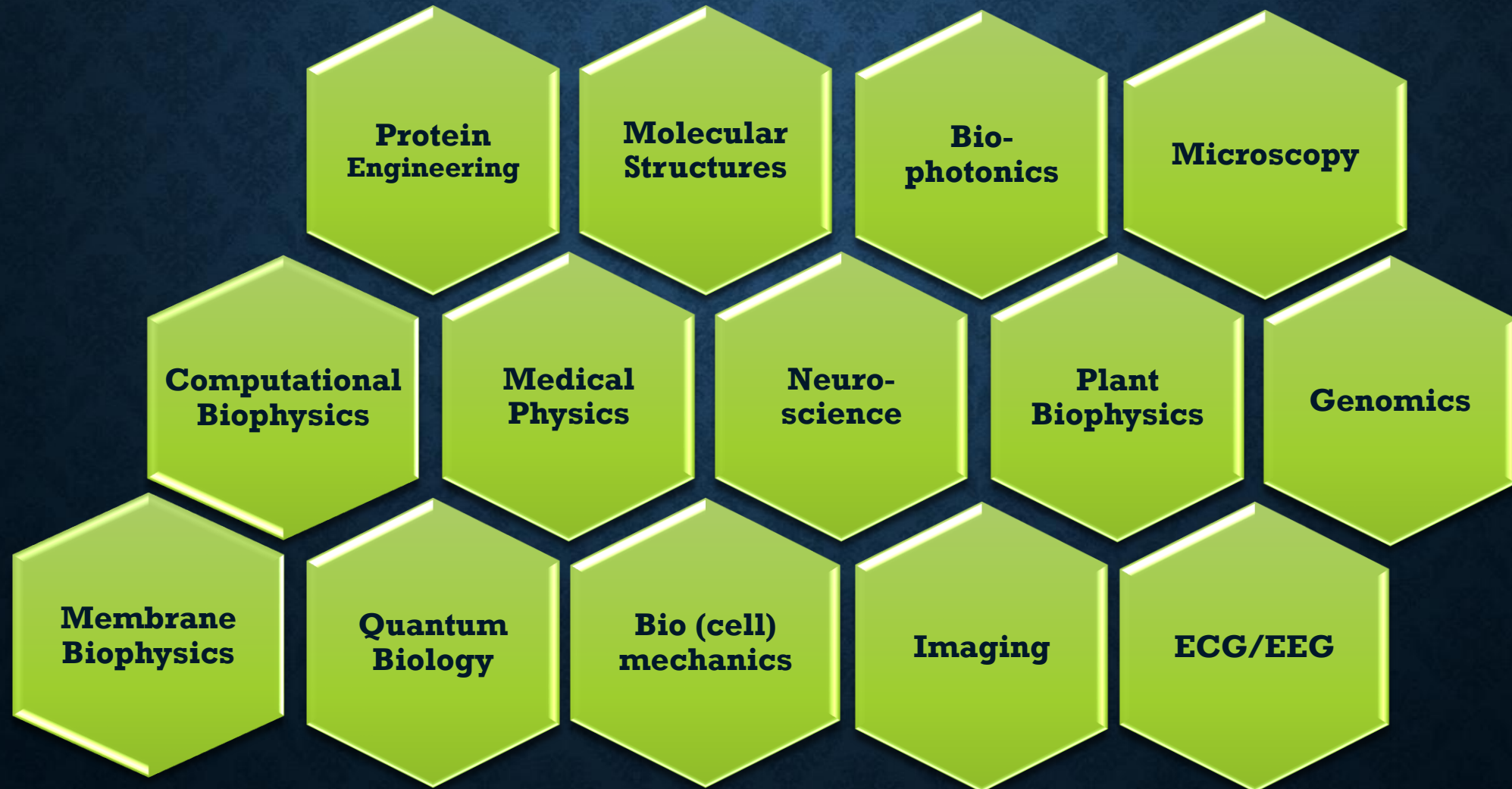
OUTLINE

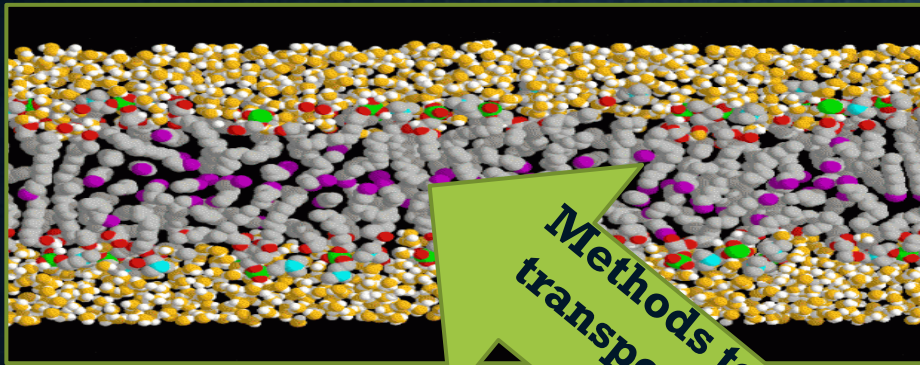
- Biophysics concepts
- Subfields of biophysics
- Facilities/Tools used in biophysics
- Africa in Brief/ Countries with active biophysics related research activities
- Impacts of biophysics to the society
- Current trends (research interest) in Biophysics
- Major challenges in Africa
- Roles of biophysicists in Africa
- Biophysics community and collaborative state in Africa
- Conclusion
- Acknowledgement

BIOPHYSICS DEFINITION/CONCEPT

- **Biophysics is an interdisciplinary field of study that involves the use of physics methods and tools to unravel the details and/or mechanism of operation of biological systems. The studies range from 'invisible' features in biological systems to features that are visible to human naked eyes. In biophysics, the functions, dynamics and structural organization of biological systems are revealed using basic and sophisticated physics-derived tools.**

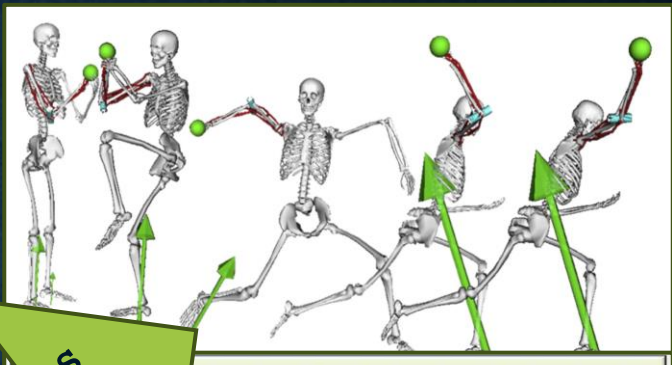
SUBFIELDS OF STUDY IN BIOPHYSICS: EXPERIMENT AND THEORETICAL





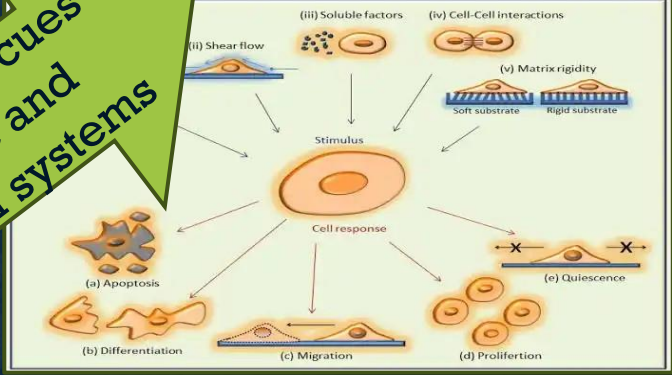
Methods to evaluate and control transport of molecular contents across the membrane

This involves the use high performance computing and simulation tools to conduct investigations in biological systems.



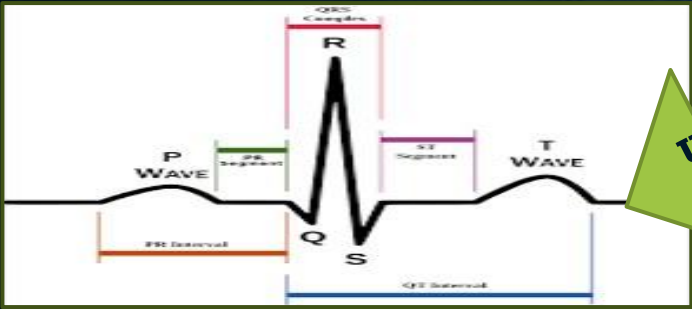
Mostly uses molecular dynamics to understand the structure, dynamics and the function of biomolecules

Influence of mechanical cues (forces) on structure and function of biological systems



Biophysics

Uses electrical impulses/signals for non-invasive test



Radiation for healthcare management



TOOLS USED IN BIOPHYSICS

Laboratory/institutional tools



SEM

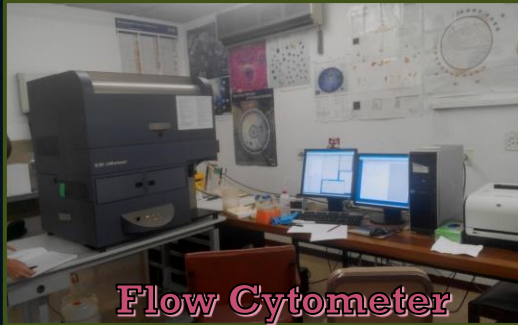


AFM



NMR

Reagents



Flow Cytometer



Spectrophotometer



Centrifuge

Crystallography
Microscopy/Imaging
Spectroscopy
Force manipulation techniques

SAIP

Huge/National/international facilities



Synchrotron radiation light source



Zeiss Microscope



BRIEF STATISTICS OF AFRICA

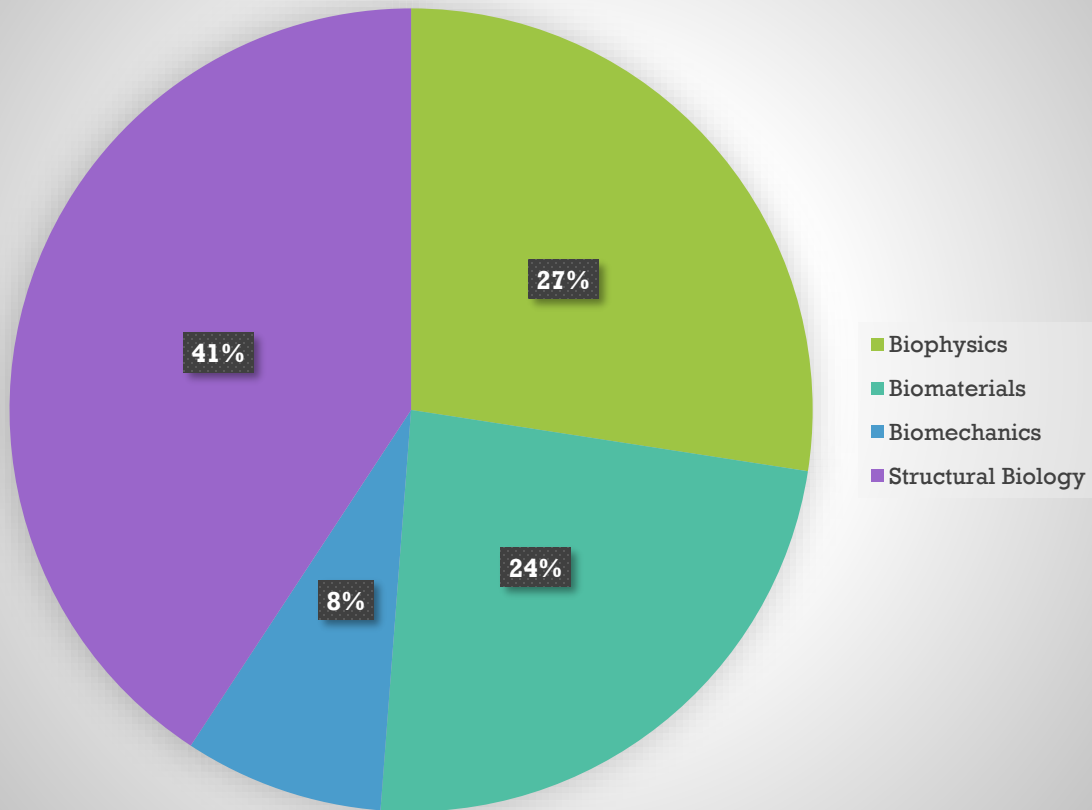
Population	1,419,360,415
Regions	5
Umbrella	African Union
Number of countries	54
Sources	https://www.worldometers.info/geography/how-many-countries-in-africa/Others https://data.worldbank.org/indicator/SP.POP.TOTL?locations=ZG

CHALLENGES IN AFRICA

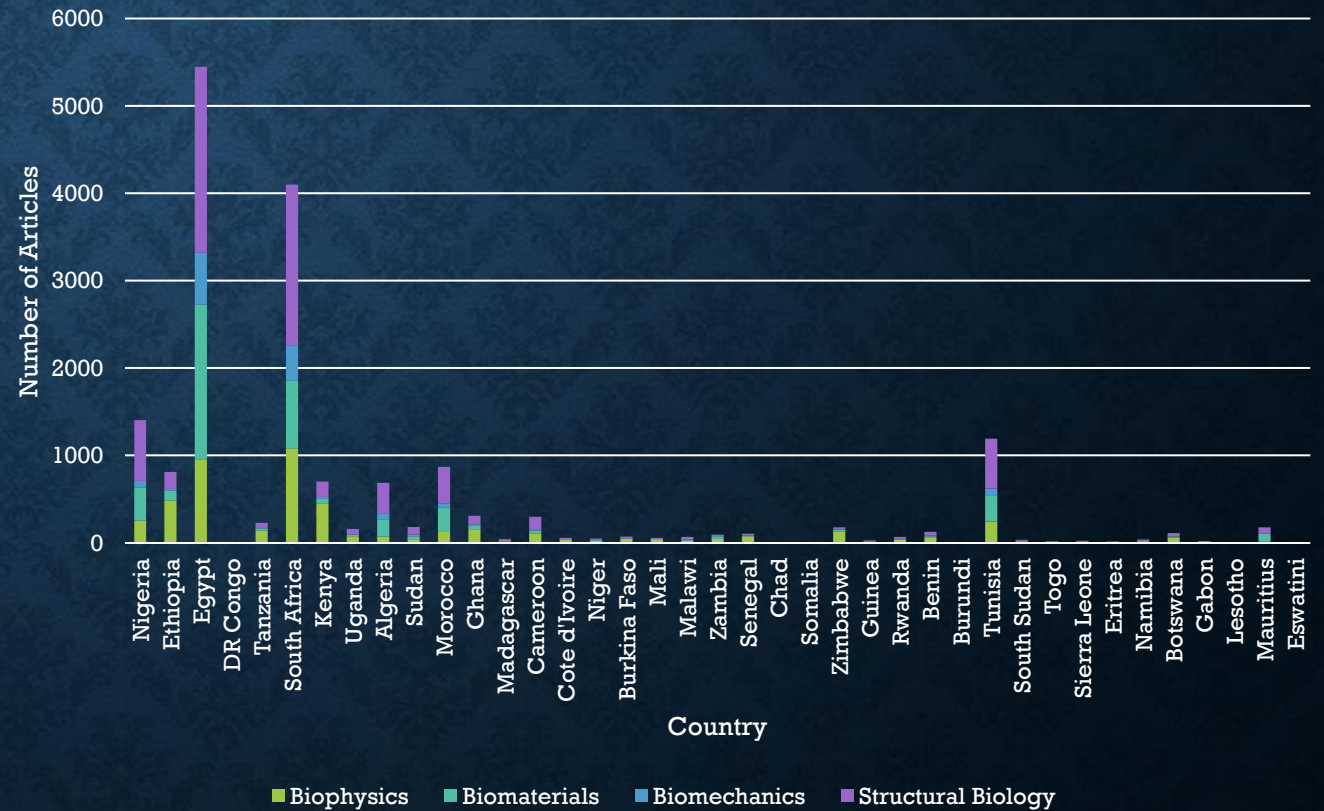
Challenge	Incidence (% world)	Fatality (% world)	Year	Source
Malaria	95	96	2021	W.H.O.
Cholera	21	80	2021	W.H.O.
HIV/AIDS	65.64	60.32	2022	W.H.O.
Tuberculosis	25	25	2016	World Bank
	Persons	Estimate (million)		
Food Crisis	1 in 5	140	2022	World Bank

COUNTRIES WITH ACTIVE BIOPHYSICS RESEARCHERS

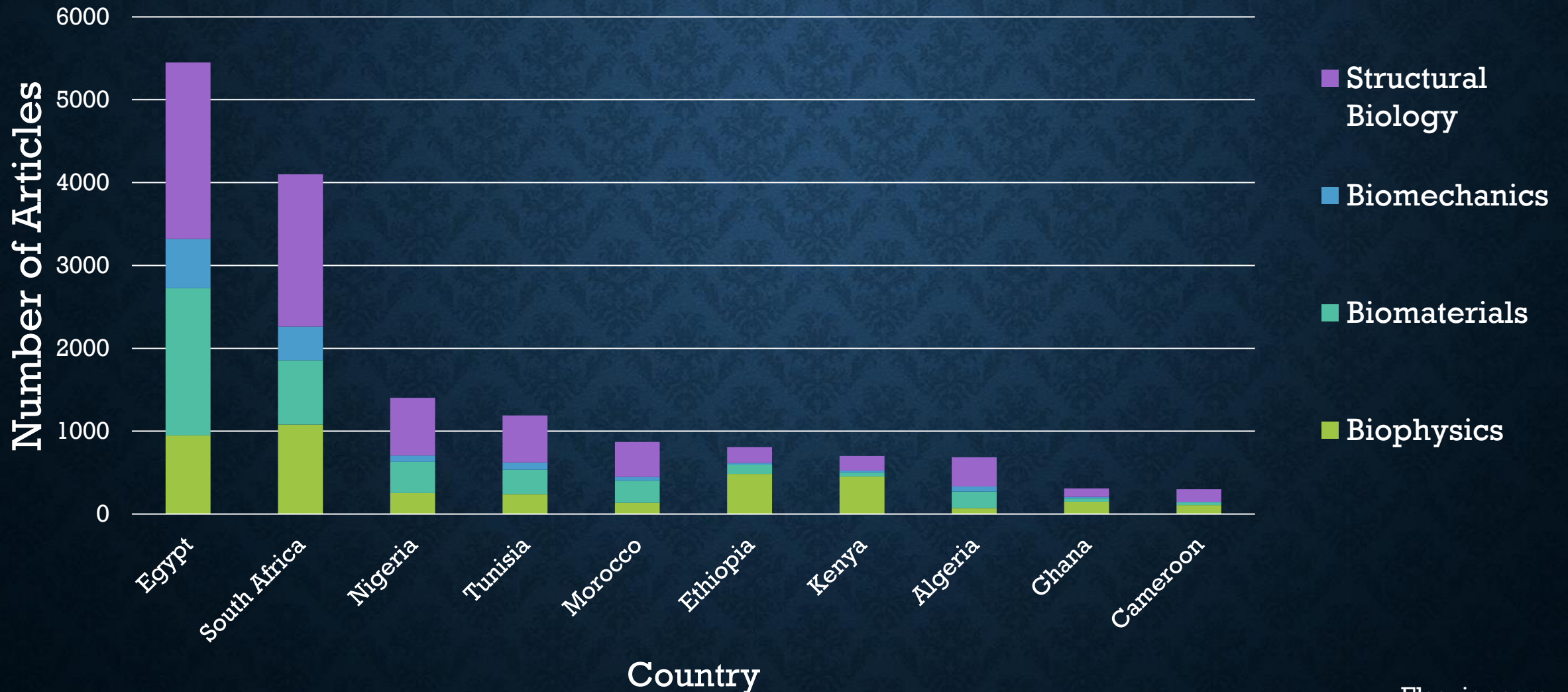
Distribution of Elsevier Articles



Biophysics Related Articles in Elsevier with at least one African Author



Major countries with Biophysics related research output (2013 - 2023)



AREAS OF FOCUS/APPLICATIONS/RELEVANCE

- Environment
- Agriculture (Plant Photosynthesis)
- Biology (Immunology, microbiology)
- Medicine and Dentistry
- Chemistry/Biochemistry/Genetics/Genomics
- Energy/Bioenergy
- Social sciences

IMPACT OF BIOPHYSICS IN HEALTH CARE MANAGEMENT

- Discovery/Application/Modification of X-rays for medical imaging
- Structure of DNA using X-ray diffraction techniques
- Electron microscopes for studying microstructures
- Virus invasion in cells
- Motion/movements of motor proteins
- Development and/or production of vaccines / drugs

CURRENT TREND IN BIOPHYSICS (IN AFRICA)

- How environmental plants harness the energy from the sunlight for food production?
- Mobility and the invasive nature of viruses and/or cells within and outside their microenvironment.
- How does protein synthesis occur?
- Rate (speed) of transmission of signals by the neural impulses
- How do cells interact/communicate and send signals between one another?
- What is the Quantum nature of biological architectures?

BIOPHYSICS COMMUNITY AND COLLABORATIVE STATE AMONG AFRICAN RESEARCHERS

- African Physics Strategy (Biophysics group)
- South African Institute of Physics
- *Presently, no active continental community that is exclusive for Biophysics research activities.*

The screenshot shows a Twiki page for the 'Biophysics Working Group'. The browser address bar is 'twiki.cern.ch/twik'. The page content includes a navigation menu on the left with categories like DOCUMENTS, SUPPORTS, ORGANIZATION, PHYSICS GROUPS, and ENGAGEMENT. The main content area has a title 'Biophysics Working Group' and a description: 'This is the working group on Biophysics in Africa. The group is convened by three experts and may be subdivided into subgroups for a more efficient management'. It lists a mailing list 'ASFAP-Biophysics[at]cern.ch' and a table of group conveners. The table has columns for NAME, AFFILIATION, EMAIL, Gender, and African origin/Diaspora. Below the table, there are sections for DOCUMENTS and REGISTRATION.

NAME	AFFILIATION	EMAIL	Gender	African origin/Diaspora
Dr. Elsie Effah Kaufmann	University of Ghana	eeffahkaufmann[at]ug.edu.gh	F	Ghana
Prof. Tjaart Kruger	University of Pretoria	tjaart.kruger[at]up.ac.za	M	South Africa
Dr. Emmanuel Nji	BioStruct-Africa	emmanuel.nji[at]biostructafrica.org	M	

CURRENT CHALLENGES FACING BIOPHYSICS RESEARCH



Awareness



Access to funds



Mobility



Access to facilities



Mentoring

MENTORING

Availability of mentors



Willing mentors



Access to mentors



Mentee's Responsibility



NEED FOR MENTORING, CONTINUING EDUCATION AND COLLABORATION

- **Mentoring of early career scientists by established researchers in biophysics**
 - “.....standing on the shoulder of giants.” : Sir Issac Newton
- **Regular meetings on current and relevant topics in biophysics**
 - **Training on the use of biophysics research tools and software**
 - **Use of novel techniques in biophysics**
 - **Analysis of technical biophysics results/data**
- **Sharing of research facilities**

COLLABORATION IN SOLVING NATIONAL OR REGIONAL CHALLENGES

The screenshot shows a TWiki page titled "Biophysics Working Group" on the twiki.cern.ch website. The page is part of the "AfricanStrategy Web" and "WebLeftBar" sections. It includes a navigation menu on the left with categories like DOCUMENTS, SUPPORTS, ORGANIZATION, PHYSICS GROUPS, and ENGAGEMENT. The main content area contains a description of the working group, a mailing list (ASFAP-Biophysics[at]cern.ch), and a table of group conveners. The table lists three members: Dr. Elsie Effah Kaufmann (University of Ghana), Prof. Tjaart Kruger (University of Pretoria), and Dr. Emmanuel Nji (BioStruct-Africa). The page also includes links for registration, documents, and a registration section.

NAME	AFFILIATION	EMAIL	Gender	African origin/Diaspora
Dr. Elsie Effah Kaufmann	University of Ghana	eeffahkaufmann[at]ug.edu.gh	F	Ghana
Prof. Tjaart Kruger	University of Pretoria	tjaart.kruger[at]up.ac.za	M	South Africa
Dr. Emmanuel Nji	BioStruct-Africa	emmanuel.nji[at]biostructafrica.org	M	

- conferences/
- workshops

MOBILITY

- **Visa restrictions/constraints**
 - **Exclusive visas for Academics/Researchers**
- **Cultural differences**

CONCLUSION

- Biophysicists have a huge role to play in the development of Africa.
- This cannot be done alone and all must work as a team.
- There are various aspects of biophysical research that need to be explored.
- Biophysics researchers in Africa should start actively translation of their works from laboratory to the society.

CONCLUSION

Together, we can make a better and greater Africa

APPRECIATION/ACKNOWLEDGEMENT

Sentech

Sentech radiation
biology group

WITS/NUCLEAR
MEDICINE

UJ/MECHANICAL,
THE BUILD
ENVIRONMENT

AFRICAN
SCHOOL OF
PHYSICS

CONFERENCE
ORGANIZERS
(LOC/IOC)

**THANK YOU ALL FOR LISTENING.
QUESTIONS, COMMENTS, ETC?**