AUGUST

ነጋት NEGAT 2023

Next Generation Scientists for Africa's Transformation

Science Summer Camp Report

ADDIS ABABA UNIVERSITY

CDT AFRICA

Summary Report

Next Generation
Scientists for Africa's
Transformation

Table of Contents

Foreword

The next world changing medical breakthrough could come from the children who are now gracing the schools of Africa. Investing in Science and the Scientists of Tomorrow could turn this hope into a reality. NEGAT is one tiny experimental undertaking that CDT-Africa developed. The aim of NEGAT is to immerse young students, ages 13-15/grades 7-8, in drug discovery through highly practical 5-days program. In the process, we hoped to demystify drug discovery research, i.e., that these bright students can see themselves doing drug discovery research and development and help Africa become self-reliant for its health supply needs. This way we can begin building the medical discovery pipeline sustainably and create a society that engages with science as a way of life.

CDT-Africa just completed the initial 5-days pilot between August 14-18, 2023. Here we provide a report on our experience of this initial pilot so that other interested institutions have a template that they may be able to adapt and follow.

We share the detailed processes of the development and coordination, schedules, experiments, safety protocols and evaluations.

Background

The Centre for Innovative Drug Development and Therapeutic Trials for Africa (CDT-Africa) is a World Bank-supported Africa Centre of Excellence for medical discovery education and research under the Addis Ababa University, Addis Ababa, Ethiopia.

CDT-Africa was established to contribute to the sustainable development of Africa by addressing the development challenge posed by poor access to medicines (drugs, diagnostics, and vaccines) through high-quality research and regional training programs. To achieve this aim, careful pipeline building that leads to sustainable supply of medical discovery scientists is critical. It is also important to create a society that is aware of science as a way of life. The aim of NEGAT [(The Next Generation Scientists for Africa's Transformation)] is to immerse young students, ages 13-15/ grades 7-8, in drug discovery through highly practical 5-days program as part of a broader initiative of societal engagement in solutions-focused science. In the process CDT-Africa also hopes to influence and improve the quality of science education and the overall innovation ecosystem in the country.

We conducted a pilot implementation of the NEGAT program between August 14 and 18, 2023 to determine its feasibility, acceptability, and potential utility. We also wanted to carefully document the program structure, required inputs, preparations and the process of implementation to enable replication of the implementation by other interested institutions.

Broad Program Structure

The pilot NEGAT Science Summer Camp was organized from August 14 to 18, 2023, at the Sefere Selam Campus of Addis Ababa University, where CDT-Africa's Bio-Hub is located. Nine students, aged 13–14, participated in the 5-day summer camp. The major objective was to immerse these future scientists in intensive and hands-on drug discovery research using commonly used traditional medicinal plants and testing their antibacterial effects.

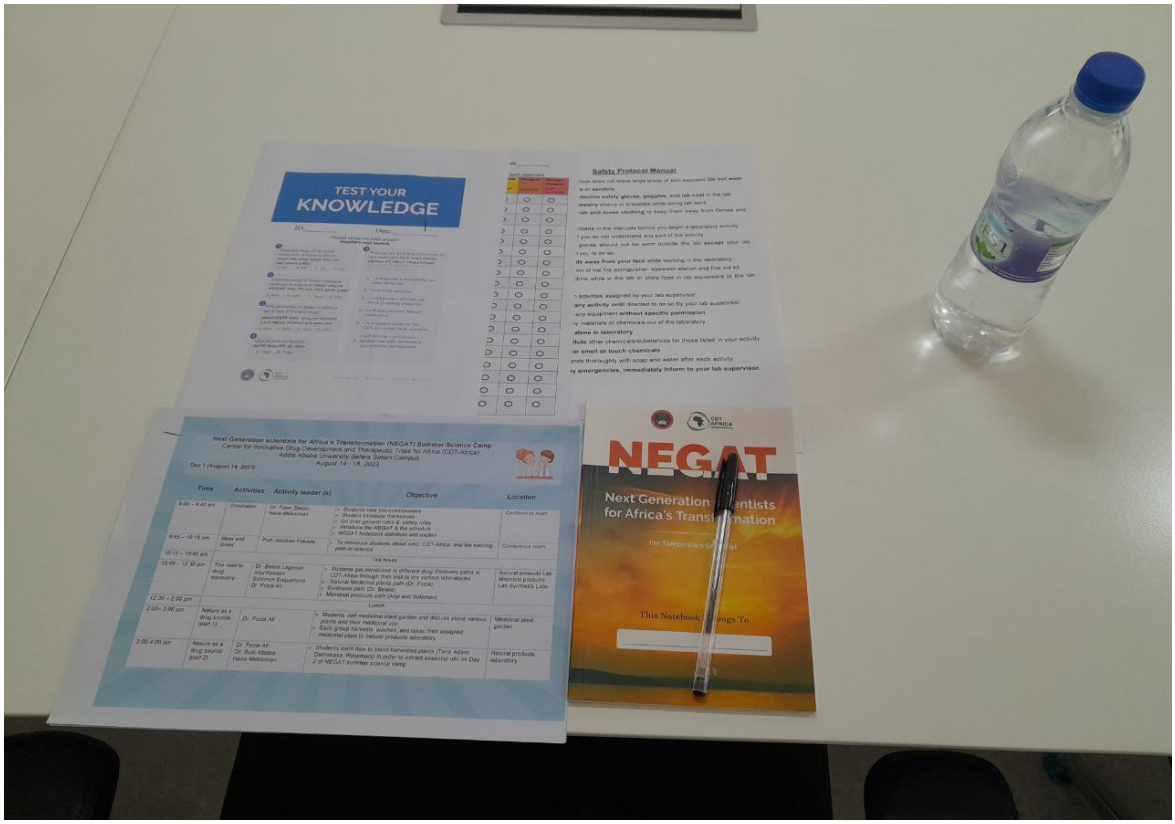
Three medicinal plants were selected for the discovery research:

1. Tenadam - Ruta chalepenesis/ **ጤና አዳም**
2. Damakese - Ocimum lamiifolium/ **ዳማከሴ**
3. Rosemary - Rosemarinus officinalis/ **ሮዝመሪ/ ስጋ መጥበሻ**

In addition to the primary drug development task, the summer camp included structured opportunities for students to interact with scientists at CDT-Africa and learn about the personal journey of excellence. They were able to explore approaches of accessing global knowledge, learn about sharing their knowledge by doing. Various engaging games and refreshments were incorporated to encourage interaction, maintain enthusiasm and enjoyment.

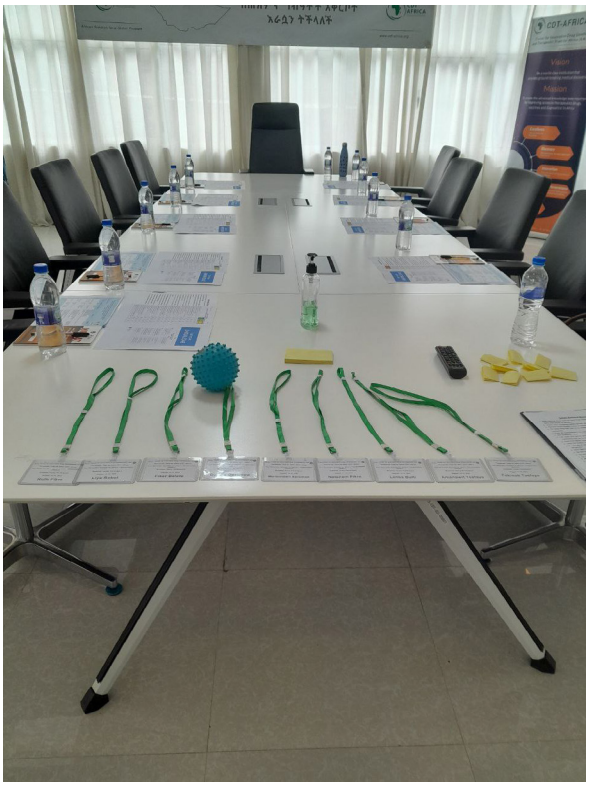
Preparation

A senior scientist and a coordinator with previous experience of teaching science were assigned to lead the preparation and implementation. The preparation took about two months of focused work. During this period, the organizing team developed iteratively the schedule, content and the implementation and evaluation of the summer camp. The preparation included a mock run of the laboratory activities to make sure all the required equipment and consumables are in place and also determine the time required and the general feasibility of the planned laboratory activities.



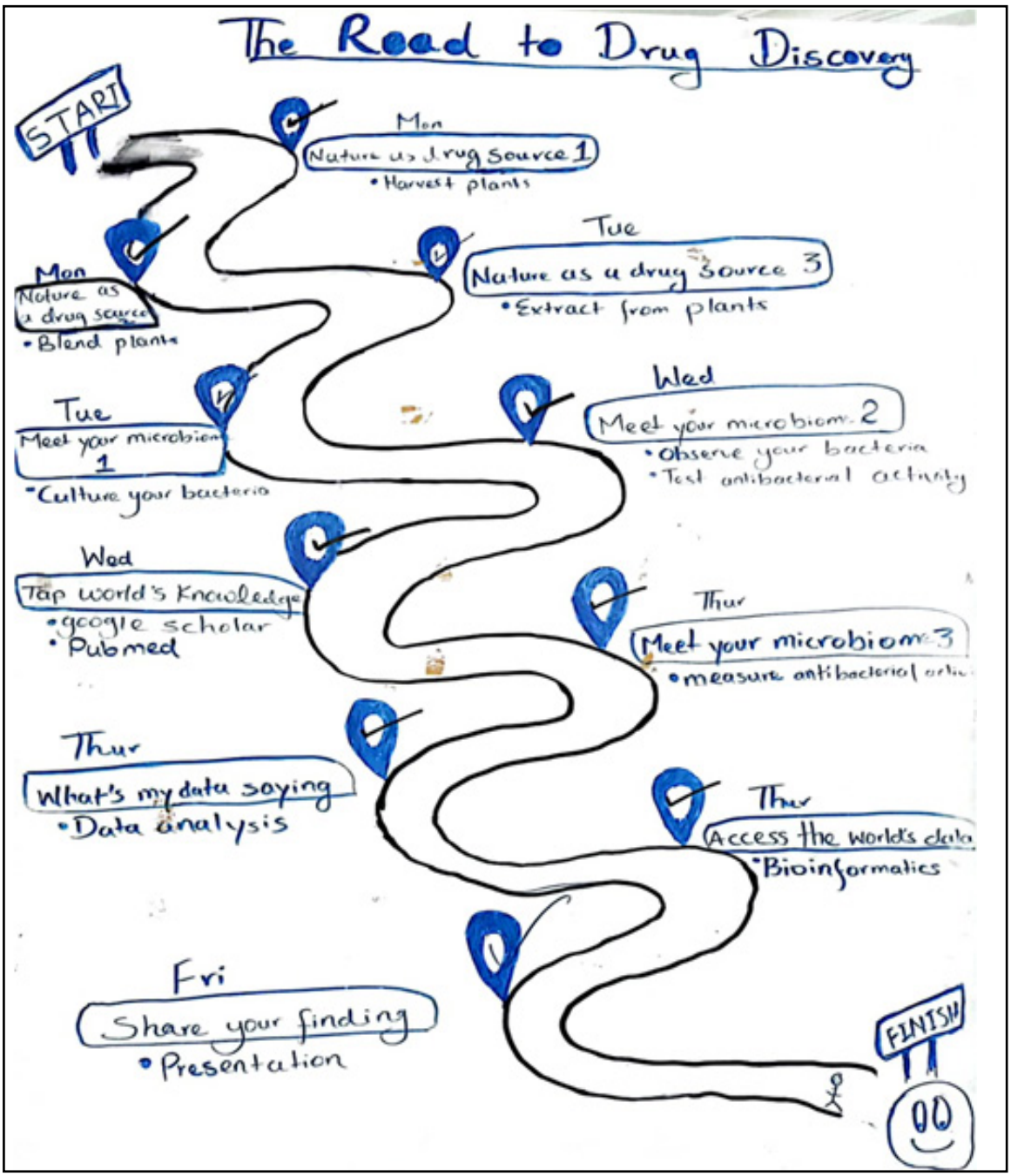
Extractions and yields were estimated for all three herbs. Laboratory protocols and safety procedures were defined with the amount of time and plant predetermined and all required equipment and chemicals ready for the summer camp. Procedures that required more time to process, such as agar preparation, were completed during this preparatory period. Evaluation questionnaires, notebooks, certificates, badges, and t-shirts were all ready. Letters were sent out to parents with detailed specifications of times, safety procedures, contacts, etc.

The team made sure that all the lab activities were interconnected with clear path. Each major path was designated with catchy phrases so that students were enticed to explore and engage.



The Summer Camp Journey

Core topics, which were to be covered during the Summer Camp were drawn on a long whiteboard (Figure 2), which was displayed in the seminar room, where students engage in brief interactive talks, review and reflect every morning on their progress, experience and the highlights of their learning. The drawing was simple and informative helping the students to view the whole process in an integrated way.



Student Selection

Considering the safety and security requirements needed when using the various laboratory equipment and chemicals, it was decided to limit the number of students and set the minimum age or grade in this pilot NEGAT Summer Science Camp program. Accordingly, only nine children in grades 7 and 8 were selected to participate.

Implementation

Day 1, August 14, 2023

At the start of the summer camp, students were given questionnaires to assess their general knowledge regarding biodiversity, health issues, and access to medicines in Africa. This was followed by a very interactive self-introduction process where students shared their names, which school they were attending, and the subject matter they were interested in.

The Head of CDT-Africa welcomed the students and gave a brief introduction about NEGAT, AAU, CDT-Africa, and the exciting path of medical discovery research and development. He also informed them about the drug discovery paths (natural medicinal plants path, synthesis path, and microbial products path) that are followed in CDT-Africa. This was followed by an orientation about the general safety rules, program schedule, and group arrangements. Further orientation about the drug discovery path was provided by Dr Belete Adefris, a synthetic chemist and senior postdoctoral fellow.

Later, students visited the different laboratories at CDT-Africa Bio-Hub, where further orientation was given to them regarding the equipment and machinery the scientists are using during their research.

The students then visited the experimental plant garden, where they were given a brief introduction regarding each plant's medicinal value. The exciting aspect of the day was when students were split into three groups (Tenadam, Damakese, and Rosemary groups) and led to harvest their assigned medicinal plants and blend them at the natural products laboratory to make them ready for the essential oil extraction process the next day.

Students visiting the experimental garden and harvesting their assigned plants.

Blending of and weighting harvested plant leaves

Day 2, August 15, 2023

Day two started with students sharing their day 1 experience. They gave feedback about the previous day's activities, how they felt about the day, what their major highlights were, and what improvements they would like to see. This was then followed by day-two planned activities.

Students continued working in their assigned groups and began the process of extracting the essential oils from the blended medicinal plants (Tena Adam, Damakese and Rosemery) using the hydro-distillation method. The extraction process took about three hours, and while the extraction was going on, they moved to prepare culture at the microbial laboratory. Here, the students prepared Mueller Hinton broth, took an oral swab sample from their mouth, and inoculated it into their assigned test tubes.

Oil extraction and agar broth preparation

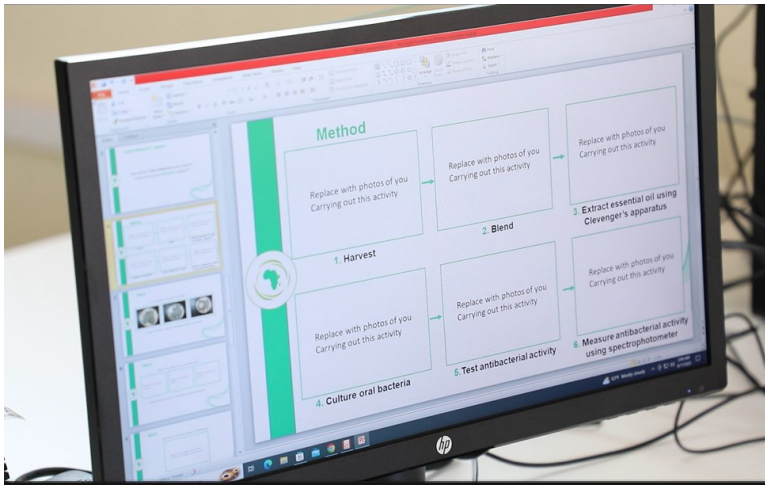
Spreading oral bacteria onto the agar medium plate

Day 3, August 16, 2023

Day three activities began, like Day 1 and 2, after reflecting on the experiences from day two. During their reflection, students highlighted the exciting experience of the extraction process and their interaction with the scientists who were helping them in their scientific adventure. After they were briefed about the outline of day 3 activities, students went through a speed-engagement exercise with the CDT-Africa scientists (Figure 7). During this activity the students held a series of five minutes conversations with nine scientists asking questions they had prepared. In addition to answering their specific questions, the scientists shared their career paths and what they were doing at CDT Africa. The students greatly appreciated the inspiring interaction and discussion with the scientists.

Thereafter, students tested the antibacterial activity of the extracted oils by using the culture they prepared the day before. And the day was concluded with a new learning experience in which students learned how to access global scientific knowledge from online literature databases.

Students (Young scientists) talking with CDT Africa scientists



Preparing group presentations

Day 4, August 17, 2023

Similarly, day 4 started with feedback of students on their experience of day 3 and the plan for day 4. Following the review and reflection, one of the key activities on day 4 was the discussion on the important journey of personal excellence. They were introduced to the concept of personal excellence and how it helps them achieve their goals in the future. Invited individuals shared inspiring stories of personal excellence and were encouraged to set their personal goals and work towards achieving them. The importance of discipline, clear goals, and continuous effort for improved performance has been emphasized during this session.

Later, students observed their own microbiomes, learned about the different types of bacterial colonies, and compared and contrasted the growth of their bacterial colonies with that of their peers. Then, they used a spectrophotometer to observe and measure the effects of the crude medicinal products they prepared from the medicinal plants on the growth of bacteria. This was followed by orientation to record and analyze their data and make a PowerPoint presentation of their findings. This was a very interesting experience that helped students understand and discuss the flow of exercises they did over the previous four days.

Journey of personal excellence

Observing bacterial colonies and the effect of the crude medicinal products

Day 5, August 18, 2023

Day five began with collecting feedback regarding day four. Then students were left to finalize their presentations. Parents, guests from AAU, and members of the CDT-Africa management team were invited to attend the occasion. Students presented their findings and shared their learning from their engagement in the summer camp. This was followed by a celebration of what the students had achieved during their summer camp in the presence of their parents. Certificate of completion of the training was distributed.

Prof. Eyasu Makonnen, Deputy Center Leader of CDT-Africa, giving closing remarks and Dr. Abebe Assefa, Director of Community Services of Addis Ababa University awarding the certificates

Celebrating the achievement of the students

Impact of Program

Results of the pre- and post-assessment

The pre- and post-evaluation questionnaire that was used to test their general knowledge about biodiversity, access to medicines in Africa, and their perceptions regarding bacteria revealed a significant improvement in the understanding and learning of the students. Most of them had developed a positive attitude towards scientific research and entrepreneurship and were interested in contributing to finding new medicines and investing in production activities. Although quantitative data analysis is not presented in this report due to the small sample size, the overall result shows the major impact the summer camp had in terms of new knowledge and experience gained as well as shift in attitude (Questionnaires annexed). They also appreciated the initiative taken by CDT-Africa to inspire students to engage in science and medical discovery research and development activities.

The qualitative reflections with the students were focused on finding out how much the activities were engaging, if they had learned anything new, their favorite activity, what else they would like to see included in the program, a difficult task they faced, and their thoughts about the refreshments provided at recess time. These daily review and reflection sessions with students were instrumental in getting their timely feedback, which helped to make progressive improvements and ensure their enthusiasm for interactive learning. Their major comments were about the difficult scientific words the facilitators were using and the need to stand for long time in the laboratories during some of the laboratory procedures. They recommended that some of the lectures and scientific names need to be revisited to make them easier to understand. Overall, they expressed great joy for having this new experience and knowledge about medicinal plants, bacteria culturing, and laboratory equipment. They highlighted the hands-on experience in oil extraction, preparation of nutrient agar, and learning about PowerPoint slide preparation as major takeaways from the summer camp. They also liked the games and the ride to and from the camp, which gave them time to interact with their new friends. They commented that these travel times were filled with joyous moments and great laughter. They suggested additional game options, such as basketball, tennis, and football, be added to the program.

During the post-implementation discussion with parents and program leaders, they shared their feedback about the summer camp. One parent expressed, “My son changed a lot in five days…he developed a strong bond with his new friends.” Another parent mentioned, “My son feels a sense of maturity and his behavior has improved. It makes me feel happy that he spent his vacation time on this program.” A third parent added, “My daughter was happy to meet the children as well as the scientists”. Furthermore, another parent pointed out, “Seeing the laboratory equipment brought him joy. He was initially afraid to present in front of people, but now he has shown interest in practicing”. These positive experiences and improvements in their children’s behavior and attitudes emphasize the success of the summer camp. As a result, parents recommended the continuity of the program and suggested extending it to a two-week format with additional content on soft skills development.

Reflections of the Implementation Team

The implementation team believes, based on the feedback of the parents, students and experience of implementation that the Summer Science camp was very successful. The critical ingredients in the success were the time taken for preparation, ongoing evaluation of the implementation, the high level of dedication of the coordination and implementation teams.

The long preparation and mock runs of the laboratory activities had helped the summer camp to run in a fairly seamless manner. During this preparation period, numerous changes of schedule and activities were made. The preparation and discussion had helped to improve the content, allocate appropriate resources, and identify those activities that needed prior preparation and arrangement.

Daily evaluation during the implementation of the Summer Science Camp was also an important instrument for gauging students' level of interest and participation, as well as to make timely improvements and adjustments to the program.

The major challenge for the activity leaders and scientists was how to bring down the sophisticated and difficult language of science to the level of middle school students so that they not only understand the subject matter they are learning but also get excited and inspired by the experience. This was one of the areas that the students suggested needs improvement in the future. This needs further development work and partnership with other experts. Although international learnings from other similar camps were considered, additional learning and partnership would be beneficial.

Figure 14: Game time

Conclusion

NEGAT Summer Science Camp is an ambitious venture that aims to create a movement among educational and research institutions to inspire young children to engage in science and scientific discoveries, particularly in the areas of drug, diagnostics and vaccines. The implementation team has demonstrated that such an endeavor is feasible and useful with much promise of impact. CDT-Africa believes that a generation that does not make serious investments in its children has no future and will be sidelined more and more as science and technology rapidly advances. This small pilot summer science camp has demonstrated that it is possible to design and implement an engaging and effective medical discovery summer camp. If scaled up, such programs have the potential to benefit the youth nationally and elevate science institutions.
We hope that the details provided, including the primary documents annexed, will guide other interested institutions to engage in a similar activity. While cognizant of its limited capacity, CDT-Africa is committed to support any institution that is interested in conducting similar science camps.

Acknowledgement

- The main facilitator and leader of the development of the NEGAT schedule and content was Dr. Tsion Minas, Fulbright U.S. Scholar and Adjunct Staff at CDT-Africa.
- Ms. Hana Mekonnen was responsible for coordinating the program on a full time basis.
- The research scientists at CDT-Africa led all the practical trainings

Meet NEGAT science summer camp participants and share in their exciting experiences.

Fiker Belete
Grade 8
I want to be an astronaut.
"What I liked most was observing the antibacterial activity of the extracted oils"

Mariamawit Debebe
Grade 8
I want to be an architect
"I learned about different laboratory equipment"

Amanawit Tesfaye
Grade 8
I want to be a photo model and singer
"The life experiences of the CDT Africa Scientists taught me about tackling problems in our community and the importance of identifying our passions early on"

Ruth Fikre
Grade 8
"I didn't expect to participate in so many hands-on activities, (.....) the program exceeded my expectations"

Liya Robel
Grade 7
I want to be a medical doctor and a minster
"I was fascinated by the process of culturing bacteria and oil extraction from medicinal plants"

Lensa Bulti
Grade 8
I want to be an Architect
"The preparation of nutrient agar was what I enjoyed the most"

Dagme Geremew
Grade 7
I want to be a computer scientist
"I learned about how bacteria reproduce and grow"

Natanem Fikre
Grade 7
I want to be a football player
"I enjoyed playing games, and culturing bacteria"

Fekreab Tesfaye
Grade 6
I *want to be an Astronaut and a football player*
"I enjoyed both the extraction of oil from medicinal plants, and the games"

NB. All pictures used here with parental permission and the agreement of the students.

Students celebrating the end of their training with their parents and staff

About CDT-Africa

CDT Africa

Who We Are

Established by Addis Ababa University, with financial support from the World Bank, as an Africa Higher Education Centre of Excellence (ACE):

- To deliver high quality postgraduate education.
- To build collaborative research capacity to address the development challenge posed by poor access to medicines (drugs, vaccines and diagnostics).

Why We Exist

We exist to contribute to the sustainable development of Africa through discovery & development of drugs, vaccines, diagnostics and complex interventions.

Our Vision

To be an Africa-based, world-class institute for ground-breaking medical discovery and development.

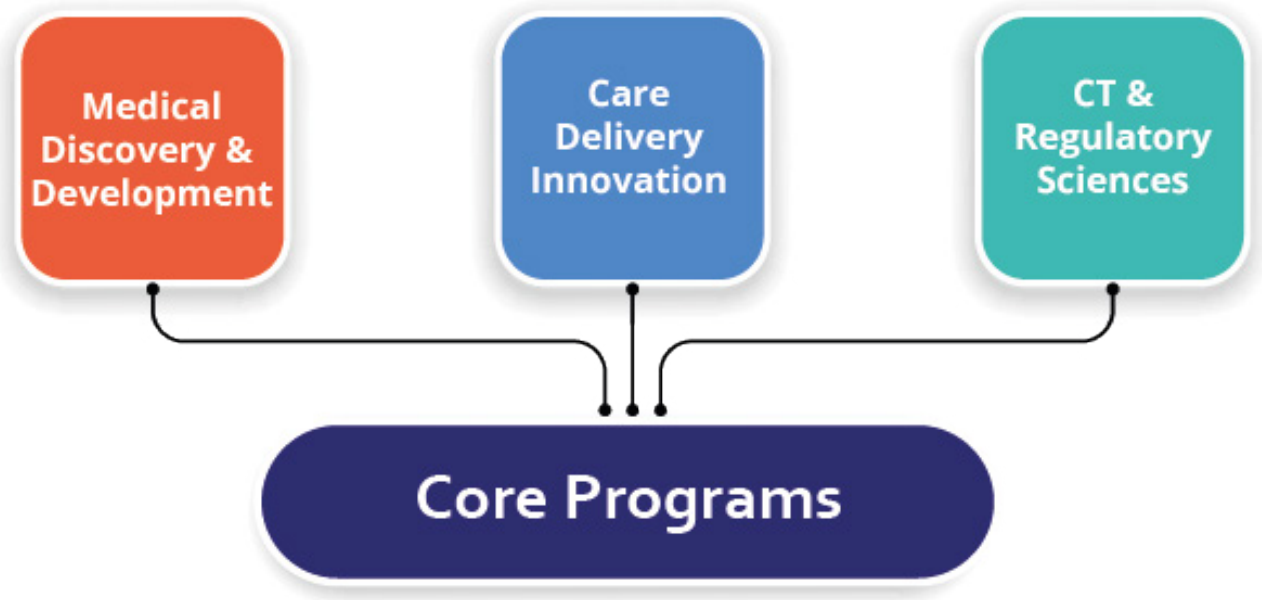
Our Mission

To contribute to the sustainable development of Africa by creating the advanced knowledge base for improving access to medicines (drugs, vaccines and diagnostics).

Our Values

Core Function

Building Africa's medical discovery and development capabilities



Priority & Programs

Disease focus area are those with high unmet need in Africa that are under-addressed by the global biomedical research and pharmaceutical R&D ecosystem. Cancer included as a neglected disease in the region.

- 1 MSc programme, 3 PhD fellowship tracks, 3 postdoctoral fellowship tracks
- 1 Virtual training short course on Moodle platform
- 10 skills based short courses
- Grassroots initiatives to improve innovation and science leadership
- 25 Research Projects

Operating Environment

CDT-Africa enjoys semi-autonomous status and the full support of the Addis Ababa University as well as the Ministry of Education. We value all partners and treat them with utmost respect, and work with them for mutually beneficial outcomes. We ensure public accountability and transparency through scientific and public feedback and stringent activity, financial and procurement auditing and reporting mechanisms.

Summary Report 2023

CDT-Africa

Phone : +251118 787311
Mobile : +251118 787720
Email : info@cdt-africa.edu.et
Facebook : cdt-africa
Twitter : @cdt-africa
Youtube : cdt-africa