

2019 Summer Scholars Program at WFIRM

Monday, June 3rd to Thursday, August 8th, 2019

*Multidisciplinary Undergraduate Summer Research
Experiences in Translational Regenerative Medicine*

WELCOME PACKET

Program Schedule, Key Dates and Deadlines



Introducing the 2019 WFIRM Summer Scholars

Summer Scholar	Primary Faculty Mentor(s)	Broad Research Focus
Honour Adewumi Jarvis Christian College Chemistry and Biology, Junior	Shay Soker, PhD Professor	<i>Remodeling of the Lung Extracellular Matrix Creates a Pre-Metastatic Niche</i>
James Bennett Bucknell University Biomedical Engineering, Junior	Anthony Atala, MD Professor and Director of WFIRM	<i>Organ/Body on a Chip</i>
Olivia Cain Spelman College Biology, Freshman	Steve J. Walker, PhD Associate Professor	<i>Characterization of Urothelial Cells from IC/BPS Patients</i>
James Day North Carolina State University Chemical Engineering, Sophomore	Thomas Shupe, PhD Assistant Professor	<i>Characterizing Cells Across Several Passages in our Universal Medium</i>
Joselyn De Jesus Gonzalez University of Puerto Rico – Rio Piedras Cell and Molecular Biology, Junior	Graca Almeida-Porada, MD, PhD Professor and Christopher Porada, PhD Associate Professor	<i>Cell and Gene Therapy for Hemophilia A</i>
Anna Deal Georgia Institute of Technology Biochemistry, Junior	Anthony Atala, MD Professor and Director of WFIRM	<i>RM for Wounded Warriors Area</i>
Lauren Drake University of Pennsylvania Bioengineering, Junior	Emmanuel Opara, PhD Professor	<i>Effect of Matrix Stiffness on Encapsulated Cell Viability and Function</i>
Anushka Gerald University of Maryland Bioengineering, Junior	Sang Jin Lee, PhD Associate Professor	<i>DLP-based Bioprinting for In Vitro Tissue Models</i>
Caterina Grasso Rice University Bioengineering, Sophomore	Anthony Atala, MD Professor and Director of WFIRM	<i>NIH Center for Engineering Complex Tissues: Topic TBD</i>
Albert Han Rice University Bioengineering, Junior	James Yoo, MD, PhD Professor	<i>NIH Center for Engineering Complex Tissues: Topic TBD</i>
Jada Jackson Tuskegee University Chemical Engineering, Sophomore	Giuseppe Orlando, MD, PhD Marie Curie Fellow and Assistant Professor	<i>Biophysical Characterization of Human Derived Extracellular Matrix</i>
Anna Jones University of North Carolina Biology, Junior	Giuseppe Orlando, MD, PhD Marie Curie Fellow and Assistant Professor	<i>ECM and its Biological Function in Human Pancreatic Islets</i>

Summer Scholar	Primary Faculty Mentor(s)	Broad Research Focus
Brandon Kassouf Georgia Institute of Technology Biomedical Engineering, Freshman	Yuanyuan Zhang, MD, PhD Associate Professor	<i>Role of Exosomes from Human Urine-Derived SCs in the Recovery of Erectile Function by Promoting Endothelial Function in Diabetic Erectile Dysfunctions</i>
Emma Koukos Saint Michael's College Biology, Junior	Steve J. Walker, PhD Associate Professor	<i>Biomarkers in Complex Disease</i>
Daniel Lee Winston-Salem State University Exercise Science, Senior	Sang Jin Lee, PhD Associate Professor	<i>Development of Tissue-Specific ECM Bioink for Cell-Based Bioprinting</i>
David McGuirt Elon University Biology, Junior	Khalil Bitar, PhD Professor	<i>Paracrine-Mediated Neural Progenitor Cell Differentiation: Role of Exosomes</i>
Samuel Moss University of Wisconsin – Madison Biomedical Engineering, Junior	Aleks Skardal, PhD Assistant Professor	<i>Bioprinting of Myeloma Microenvironments to study Myeloma Malignancies/Cancer Tumor Organoids</i>
Alexandra Saldana LaTourneau University Biomedical Engineering, Junior	Anthony Atala, MD Professor and Director of WFIRM	<i>Bioprinted Urethra Construct with Bilayer GelMA Architecture for Urothelial and Smooth Muscle Tissue Formation</i>
Macaiah Sheffield Georgia Military College Sports Medicine, Sophomore	Tracy Criswell, PhD Assistant Professor	<i>Skeletal Muscle Regeneration after Injury</i>
Emma Carin Statt University of Dayton Pre-Med, Junior	Emmanuel Opara, PhD Professor and Yuanyuan Zhang, MD, PhD Associate Professor	<i>Controlled Delivery of IGF1/NGF for USC-Induced Neuromuscular Tissue Regeneration</i>
Mallory Thomas North Carolina State University Biological Sciences, Freshman	Graca Almeida-Porada, MD, PhD Professor and Christopher Porada, PhD Associate Professor	<i>Effects of Space Travel on Human Hematopoietic System</i>
Jacob Thompson University of Iowa Biomedical Engineering, Junior	Shay Soker, PhD Professor	<i>Bioengineered Tissue Organoids for Disease Modeling</i>
Nikhil Vettikattu University of Southern California Human Biology, Junior	Vijay Gorantla, MD, PhD Associate Professor	<i>Macrophage Tracking in Surgical Inflammation</i>
Olivia Zyniewicz University of Notre Dame Neuroscience and Behavior, Junior	Young Min Ju, PhD Assistant Professor	<i>Target Angiogenesis (3D Bioprinting/Drug Delivery)</i>

WFIRM Summer Scholars 2019

Schedule at a Glance with Key Dates

June 3rd, 2019

8:30am – 9:00 am
Room 335

Welcome to Wake Forest Institute for Regenerative Medicine

Location: Richard H. Dean Building, 391 Technology Way,
Winston-Salem, NC 27101

Notes: Parking available in open lot across street from WFIRM.
Upon entering gate, buzz security card and indicate you are new
WFIRM summer scholar. Meet in lobby.

9:30am – 12:00pm

Pick-Up Employee Badges

(Shuttle provided from WFIRM to Medical Center)

2:00pm – 3:00pm

2nd Floor Collaboration Area

Scholars' Meet Mentors

Note: *Your daily schedule to be coordinated w/faculty mentor*

June 5th, 2019

9:00am – 10:00am
Room 250A&B

Wednesday Summer Scholar Series Begin (All Scholars will
participate) Held June 5th, 19th, 26th, July 10th, 17th, 24th, 31st
(**Note:** See Wednesday Seminar Schedule, page 8, for speakers,
Topics, room #s, and times)

June 6th, 2019

9:30am – 10:00am
Room 439

Director's Welcome: Dr. Anthony Atala, MD, Director of WFIRM

June 10th – 14th, 2019

[6th Annual Regenerative Medicine Essentials Course](#)

Venue: Wake Forest Bowman Gray Center for Medical Education,
475 Vine Street, Winston-Salem, NC 72101

Visit the website for details and agenda: [RME Course Information](#)

June 17th, 2019

9:00am – 10:00am
Room 250A&B

Monday Research Meetings Begin (Scholars within the
Monday Research Meeting cohort to be confirmed)

Held June 17 and 24, July 1, 8, 15, 22 and 29 and August 5

Faculty Leaders: Tracy Criswell, PhD, Aleks Skardal, PhD
and Steve J. Walker, PhD

June 20th, 2019

9:00am – 10:00am
Room 335 on 6/20 only
Room 250A&B all other dates

Thursday Research Meetings Begin (Scholars within the
Thursday Research Meeting cohort to be confirmed)

Held June 20 and 27, July 11, 18, and 25 and August 1

Faculty Leader: John Jackson, PhD and Sang Jin Lee, PhD

June 23rd, 2019

4:00pm – 7:00pm

WFIRM Annual Summer Picnic at [Tanglewood Park](#)

(**Notes:** See map at website link. Parking is covered by WFIRM.
When you enter gate, tell them you are attending the WFIRM
picnic. Guard will also provide directions to Shelter #2)

June 27th, 2019
12:00pm – 2:00pm
Biotech Place Room 153 A&B

Pizza Lunch with Wake Forest School of Medicine
Students' Regenerative Medicine Interest Group - Med Student
Leader: Adam Jorgensen, MD, PhD Candidate

July 24th, 2019
Specific Room TBD

WFGS Overview/Tour with Lunch
Jennifer Chapman, MS, Grad School Enrollment Mgr.
Location: Wake Forest University Graduate School of
Arts and Sciences, 525 Vine Street.

July 30th, 2019
7:00pm – 9:30pm

WFIRM at the DASH Ballgame

August 1st, 2019

Abstract Submission Deadline by 5:00pm

August 2nd, 2019

Poster Submission Deadline by 5:00pm

August 7th, 2019
12:00pm – 1:00pm

Summer Scholars Poster Set-Up at WFIRM (Room 250 A&B)

2:00pm – 4:00pm

Summer Scholars Dress Rehearsals (PTCRC)

4:00pm – 4:30pm

Summer Scholars Poster Set-Up at WFIRM (Room 250 A&B)

August 8th, 2019
7:30am – 1:00pm

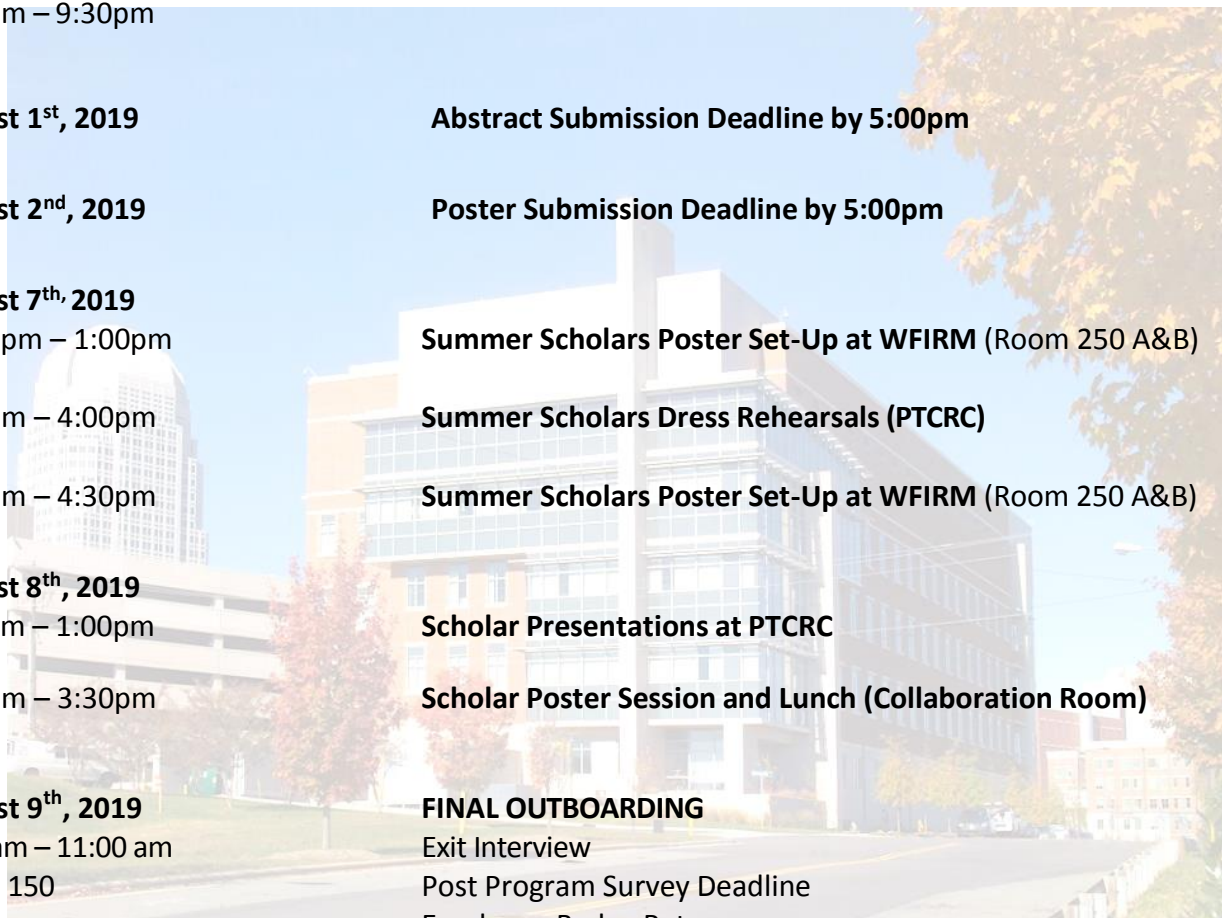
Scholar Presentations at PTCRC

1:00pm – 3:30pm

Scholar Poster Session and Lunch (Collaboration Room)

August 9th, 2019
9:30 am – 11:00 am
Room 150

FINAL OUTBOARDING
Exit Interview
Post Program Survey Deadline
Employee Badge Return



2019 WFIRM Summer Scholar Program Orientation Schedule

Monday, June 3rd, 2019

Wake Forest Institute for Regenerative Medicine (WFIRM)

Location: Richard H. Dean Building, 391 Technology Way, Winston-Salem, NC, 27101. [Map and Directions](#)

8:30am – 9:00am Welcome and Program Overview with Joan Schanck, Summer Scholars Program Director
Room 335

Note: We will meet you in the lobby area and escort you to Room 335

9:30am – 12:00pm Leave for Wake Forest Baptist Medical Center – ALL

Note: Shuttle service provided

Wake Forest Baptist Medicine Center (WFBMC)

Location: 1 Medical Center Blvd, Winston-Salem, NC 27103. [Map and Directions](#)

9:30am – about 11:00pm Obtain badges at WFBMC

12:00pm – 1:00pm Lunch* and Shuttle return to WFIRM

Note: Various lunch options. You may bring your own brown bag, lunch in cafeteria or in downtown Winston-Salem area.

2:00pm – 3:00pm Scholars meet WFIRM team and Mentors (2nd floor collaboration area)

Note: Remainder of day determined in consultation with mentor(s).

Tuesday, June 4th, 2019

Wake Forest Institute for Regenerative Medicine (WFIRM)

9:30am – 10:00am WFIRM Lab Orientation/Overview with Thomas Eaton, Lab Operations Manager (Room 150)

10:00 am – 12:00 pm Small group specialized training (Approximately 10:00am to noon)

Note: Following lab orientation overview, Mr. Eaton will break students into groups based on identified training needs. Scholars can refer to the key below for their required core training. Each core training to take approximately 40-45 minutes.

- Cell Culture Training
- Imaging Training
- Histology Training
- Flow Cytometry

- 12:00pm – 1:00pm Lunch (Bring your own and remain in Collaboration area of WFIRM, outdoor patio or easy walk into downtown area)
- 1:00pm – 1:30pm Animal Orientation with Miranda Moore and Amanda Dillard
Room 150
- 1:30 pm – 2:00pm Vivarium Orientation with Dr. Erin Mitchell
Room 150
- 2:00 pm – 2:30 pm Vivarium Tour with Dr. Erin Mitchell

Note: Outside of programmatic activities, weekly schedule per assigned mentor



2019 WFIRM Summer Scholar Program Wednesday Seminar Series

June 2019

9am to 10am
Room 250A&B

June 5th

Michael Seeds, MD

Hypothesis Generation and Hypothesis Testing

June 19th

Emmanuel Opara, PhD

RM Technologies for Diseases of Rena-Urogenital Axis

June 26th

Graca Almeida-Porada, MD, PhD

Cell Therapies and Prenatal Therapies

July 2019

Various as below

9am-10am **July 10th**

Room 150 **David Williams, PhD**

Global matters in Medical Technology and Regenerative Medicine

4pm – 5pm **July 10th**

Room 150 **Marshall Schwartz, MD**

Role of Growth Factors in Management of Intestinal Failure

9am-10:30am **July 17th**

PTCRC **Aleks Skardal, PhD**

Auditorium *Manuscript Writing*

9am to 10am **July 24th**

Room 250A&B **Tracy Criswell, PhD**

Gender Differences in Regenerative Medicine

9am to 10am **July 31st**

Room 250A&B **Vijay Gorantla, MD, PhD** (9:00am – 10:00am @ Room 250A&B)

Reconstructive Transplantation

WFIRM Summer Scholars Program 2019

Social Schedule and Events

June 14 th & July 12 th	Innovation & Cinema: Outdoor Cinema @ Bailey Park
June 14 th – 500 Days of Summer (2009)	Presented by Wake Forest Innovation Quarter and A/perture Cinema
July 12 th – High Noon (1952) Event Kickoff: 7:30pm Movie Start Time: 8:30pm	All screenings are free and open to the community! Food: TBD Beverage: Hoots Beer Co. (Beer & Wine for purchase) Other: Hot popcorn for purchase courtesy of a/perture Cinema
Sunday, June 23 rd 4:00pm – 7:00pm	WFIRM Annual Picnic at Tanglewood Park
Tuesday, July 30 th 7:00pm – 9:30pm	Summer Scholars @ Winston-Salem Dash Game Dash vs. Hillcats DASH Schedule
Thursday, August 8 th 7:30am – 4:00pm	Summer Scholars Research Day and Poster Session
<u>Additional Events/Ideas:</u>	
Winston-Salem Dash	Minor League Baseball Team Located Downtown
Spirits of Summer June 2019	Beer, Wine, Food & Music Location: Fourth Street, Downtown Winston-Salem
Summer on Liberty 7:00pm – 10:00pm	Downtown Summer Music Series (Every Saturday Starting June 15 th) Location: 6 th & Liberty
Hiking at Pilot Mountain State Park	
Old Salem Museums & Gardens	Historic Town, location of Salem College; walking distance from WFIRM
Reynolda House and Art Museum	Free for students and employees of WFBMC
Southeastern Center for Contemporary Art	Free admission; rotating exhibitions
Planetarium @ Kaleideum North	Different weekend shows available (Museum & Science Center)
North Carolina Zoo	Location: Asheboro (60 minutes away)
Carowinds Amusement Park	Discounts available for WFBMC employees Location: Charlotte, NC (90 minutes away)
U.S. National Whitewater Center	Location: Charlotte, NC (90 minutes away)
Visit Winston-Salem Website	Winston-Salem website with a calendar of events in town

June 10th to 14th, 2019

Wake Forest Medical Education Center

Winston Salem, NC

Regenerative Medicine Essentials Course

Often referred to as the next evolution of modern health care, regenerative medicine touches many disciplines - from clinical care and engineering to basic science and bioethics. This one-week course, taught by prominent experts, provides attendees a foundation in this exciting field. From the science behind groundbreaking discoveries to regulatory and manufacturing challenges, the course provides a comprehensive look at progress to date as well as future applications.

Summer Scholars will attend the 6th Annual RME Course

This course also enables opportunity to network with global leaders in the field and other attendees who come from a multitude of disciplines from across the globe.

Objectives:

To provide a state-of-the-art review of regenerative medicine including background material, key scientific components of the field, ethical, economic and other issues important to regenerative medicine. The course integrates information, technologies and skills from biological sciences, engineering, legal, commercial, regulatory and ethical disciplines. Sessions address the science behind regenerative medicine, its application to human disease and the importance to modern society. At the end of the course, participants will have received an enhanced foundation in the rules, regulations and ethics in the regenerative medicine environment, routines for first-in-man clinical trials, the practical and theoretical basis for GMP, and the ethical aspects of translational research.

Course Topics:

- Stem Cells
- Biomaterials
- Enabling Technologies
- Cell Therapies
- Tissue Engineering
- Regulatory, Process Development and Manufacturing
- Clinical Trials and Bioethics
- Commercialization
- Regulatory, Biomanufacturing and Process Development
- Regenerative Rehabilitation

Learning Goals:

- To provide participants relevant biological, engineering, legal, regulatory and ethical foundation and principles to understand the emerging field of regenerative medicine
- To become acquainted with topics from the broad spectrum that makes up regenerative medicine
- To learn about the technology and technique available for regenerative medicine research
- To springboard off this foundation into current, cutting-edge research
- To learn about the rules, regulatory process and ethics in regenerative medicine environments and routines for clinical trials, practical and theoretical basis for GMP
- To become familiar with the current state of affairs and successes in manufacturing regenerative medicine products and commercialization
- To learn about multidisciplinary educational opportunities and career pathways

More information can be found at www.wakehealth.edu/RMEssentials

WFIRM Summer Scholar Profile - Class of 2019

Audience: Non-scientific

Due Date: June 26th, 2019

Greetings WFIRM Summer Scholars!

We would like to highlight you on the WFIRM Education website. And, who better to help us write this blog post than you?!! Your WFIRM Summer Scholar profile should include the following:

1. *A short description of our scientific background and/or interests prior to the WFIRM Summer Scholars Program:* Please write 1 to 2 paragraphs describing your past educational/scientific history prior to joining the WFIRM Summer Scholars Program. This section should include mention of your major, home university, and any personal motivation for your interest in engaging in regenerative medicine at WFIRM. Although your biography should mostly focus on your scientific background/educational interests, you're welcome to include personal interests/accomplishments as well.

Please provide a picture of yourself (it can be either one in our out of the lab) that we can include in the blog post. When you arrive here, I'll be happy to take it for you in the WFIRM labs or outside!!

2. *Lay-friendly description of your WFIRM summer research project:* The second section will consist of a very short description of your project here at WFIRM Consider your audience to be an interested, but perhaps non-scientific family member. Identify your WFIRM mentor(s), define the goal of the project and maybe the rationale for the project. Verify with your mentor and/or a designated supervisor to make sure the information you are submitting is fine. This section will probably be 1 paragraph. Two at the very most. Don't fret, this is just a broad description. We realize you are in the early phase of your research assignment. You will have plenty of time later to provide a detailed description.
3. *Explanation of your future research plans and career goals:* The last section is a very short description of future plans, e.g., post-graduate interests and future career aspirations. Two to three sentences is fine.
4. Email all to Joan Schanck, jschanck@wakehealth.edu by June 26th!

See you soon!

Joan Schanck

Wake Forest Institute for Regenerative Medicine
Summer Scholars Final Poster Session
Thursday, August 8th, 2019

INSTRUCTIONS FOR PREPARING AN ABSTRACT FOR INCLUSION IN THE PUBLISHED POSTER SESSION
PROCEEDINGS MANUAL

Deadline for Submission of Abstract is Thursday, August 1st, 2019

Abstracts will be included in a Poster Session Proceedings Manual.

Each WFIRM Summer Scholar must prepare an abstract for the final poster session presentation. An abstract is a condensed summary of the main topics covered in your presentation. Abstracts are to be submitted electronically as a Word document to Joanne Gray at jgray@wakehealth.edu

1. Size and presentation:

- The text of the abstract (not including authors, institutions/affiliations and titles) should be limited to 550 words, single-spaced. Interns should list *Wake Forest Institute for Regenerative Medicine* as their institutional affiliation and *Summer Scholar* as their title.
- Must be typed single-spaced with 11 point, Times New Roman typeface
- Must be free of typographical and grammatical errors.

2. Title: Type title in CAPITAL LETTERS. The type should be succinct and clearly state the nature of the research study.

3. Authors' names: Authors should be listed by surname and initials, with the poster presenter's name marked with an asterisk (*).

4. Body of abstract: The following are elements should be included in the abstract:

- Brief background
- Statement of objectives and specific aims
- Brief description of research design/methods used
- Data and analysis
- Results and conclusions

5. References: The abstract should be accompanied by a short list of references which represents the primary sources of information used for the presentation. Place references on the same page as the abstract, and give references in standard scientific style.

6. Abbreviations: Standard abbreviations may be used for common terms. For uncommon terms, the abbreviations should be given in brackets after the first full use of the word.

EXAMPLES

DIFFERENTIATION OF AUTOLOGOUS SUBCUTANEOUS ADIPOSE-DERIVED STEM CELLS TO EPITHELIAL CELLS

*S. T. Lopresti, S. Natesan, D. O. Zamora, N. L. Wrice, R. J. Christy

*Summer Scholar, Wake Forest Institute for Regenerative Medicine

US Army Institute of Surgical Research, 3698 Chambers Pass, Bldg 3611-BHT1, Fort Sam Houston, TX 78234

Combat burn injuries are often full-thickness burns, involving large total body surface areas (TBSA) of skin (1). Epidermal substitutes have been developed using culture expanded keratinocytes to improve wound healing of burns (2). Although tissue engineered epidermal substitutes using autologous keratinocytes are applicable clinically, their use is limited due to time required for culture expansion and amount of standard skin biopsy sample. Adipose-derived stem cells have gained particular attention due to ease of isolation, relative abundance, and multi-lineage differentiation potential (3, 4). We've recently shown that hypodermal tissue present in discarded skin tissue, that are surgically debrided to remove necrotic tissue during surgical procedure, possess stem cells that retain their ability to differentiate into multilineages and can be isolated in quantities that could be used clinically for burn repair and regeneration (4). We hypothesize stem cells from discarded burn tissue can be differentiated into epithelial cells. These differentiated cells can be used to treat burn wounds that lack an autologous epithelial cell source.

In this study, subcutaneous adipose-derived stem cells were isolated from discarded human skin samples (dsASCs) following previously established protocol (4). Immunocytochemical analysis of human dsASCs showed positive expression for stem cell markers; CD54, CD105, and STRO-1. The dsASCs possessed multilineage differentiation ability, as confirmed through their commitment to differentiate into adipogenic and osteogenic, lineages. For epithelial-like differentiation, dsASCs were treated with a combination of inducers and/or growth factors such as keratinocyte growth factor (KGF), epidermal growth factor (EGF), hepatocyte growth factor (HGF), and insulin-like growth factor (IGF), all-trans retinoic acid (ATRA). Passage 2 dsASCs were seeded on top of a type-I collagen hydrogel matrix (70,000 cells/ml of gel), prepared according to the manufacturer's instructions by adjusting the pH to 6.8-7.0. After 48 hours incubation of dsASCs-gel in MesenPro media they were switched to DMEM media containing 5% fetal bovine serum supplemented with above mentioned growth factors and/or inducers. On day 5 the collagen gels were air-lifted to induce cell stratification. Light microscopy photos were taken at different days (4, 8 and 10) and mRNA was isolated at day 2, 4, 8, and 12. Real-time PCR analysis was used to determine the expression levels of such epithelial markers as keratins KRT5, KRT7, KRT8, KRT10, KRT13, KRT14, KRT18, KRT19, involucrin (IVL) and loricrin (LOR).

After treating the collagen gels with induction media, the dsASCs started to align into squamous cell-like morphology by day 4, and when air-lifted exhibited characteristic epithelial-like cuboidal cell morphology by day 10. Differentiating dsASCs expressed low levels (<10 fold) of both simple (KRT7, KRT8, KRT18 and KRT19) and stratified keratin markers (KRT5, KRT10, KRT13, KRT14) at early time points (day 4 and 8). By day 12, the cells exhibited a robust (>50 fold) increase in expression of stratified epithelial cell markers, along with cytoskeletal proteins IVL and LOR, which are responsible for formation of intermediate filaments in skin epithelia. In summary, we showed that stem cells from discarded human burn tissue can be potentially used as an autologous cell source for epithelial cells and differentiated dsASCs can potentially be used for developing regenerative skin products for burn wounds.

References:

1. Wolf SE, Kauvar DS, *et al.* Comparison between civilian burns and combat burns from Operation Iraqi Freedom and Operation Enduring Freedom *Ann Surg.* 2006;243(6):786-92.
2. Bremner LF, Mazurek M. Reconstructive challenges of complex battle field injury. *J Surg Orthop Adv* 2010, 19, 77.
3. Zuk PA, Zhu M, Mizuno H, *et al.* Multilineage cells from human adipose tissue: implications for cell-based therapies. *Tissue Eng* 2001, 7,211.
4. Brzoska M, Geiger H, *et al.* Epithelial differentiation of human adipose tissue-derived adult stem cells. *Biochem Biophys Res Commun* 2005, 330,142.
5. Natesan S, Wrice NL, Baer DG, Christy RJ. Debrided Skin as a Source of Autologous Stem Cells for Wound Repair. *Stem Cells*, 2011, Jun 14 [Epub ahead of print].

BIOFABRICATION OF FUNCTIONAL SKIN GRAFTS USING A 3D BIOPRINTER

*J. A. Marco, C. G. Jeong, J. J. Yoo, A. Atala

*Summer Scholar, Wake Forest Institute for Regenerative Medicine

Full-thickness skin wounds and extensive burn injuries are one of the major causes of morbidity and mortality. Globally, 11 million burn injuries are reported per year. Between 1998 and 2007, the overall mortality rate due to burn injuries was 4.9%. Currently, the clinical standard for wound treatment is the use of autologous split-thickness skin grafts. Unfortunately, this requires surgery to remove a portion of the patient's skin and is not applicable to extensive wound coverage. An alternative therapy is the use of allografts, but immunosuppression is used in conjunction with this therapy, leading to increased patient susceptibility to illness and pain.

The application of skin cells onto wound sites to improve wound healing is a promising area of research. This can provide wound coverage with minimal skin grafting as cells can be expanded to cover larger wound areas. Cell printing by a 3D bioprinter has been suggested as a primary form of cell application for wounded skin or skin grafting to cover such larger wound sites. The objective of this study was to create functional skin grafts by printing not only human fibroblasts and keratinocytes but also human papilla cells for hair follicle formation and human melanocytes for skin pigmentation, all with carefully controlled layering techniques. Fibroblasts and papilla cells were suspended in a printable hydrogel containing fibrin. These cells were printed first in order to create the dermal layer. Keratinocytes and melanocytes were suspended in the same hydrogel and were printed second to create the epidermal layer. The constructs were 1cm x 1cm and only two layers thick in order to mimic the thickness of normal mouse skin. Once the constructs were printed, they were cross-linked with thrombin to make the gels stable and firm. The bilayered skin grafts were cultured for 5 days and then implanted onto nude mice.

After a week of *in vivo* implantation, the constructs showed revascularization and started to mimic the structure of mouse skin. This indicated that the mice were not rejecting the implanted skin grafts. The constructs were also able to maintain their structural integrity during this time and were easily retrieved for analysis. A gel-only group (used as control) was also implanted on each mouse along with cell-seeded hydrogels. The gel-only group did not maintain its structure and was not retrievable after one week. This indicated that the cells within the construct were producing a sturdy matrix. Massons Trichrome staining confirmed the presence of ECM in the cell-containing constructs. Finally, it was noted that the wound size containing construct were slightly bigger than the gel only group, indicating that cells from the surrounding area are not migrating in to close the wound and suggesting that the construct is being allowed to integrate into the skin. Further analysis and relevant results from this study are ongoing. Based on the current data, we conclude that the constructs are capable of forming and maintaining their skin-like structure even after 1 week of *in vivo* implantation (12 days after printing). Constructs will be retrieved again at 3 weeks *in vivo* (26 days after printing) in order to examine the structural integrity, to determine if follicles are being formed, and to ascertain if any further pigmentation can be seen.

Acknowledgements: The summer scholars research reported was supported by the Douglas Jerome Bodner Fund for Research in Regenerative Medicine. A special thanks to Stephen L. Rego for technical assistance.

References:

1. Peck MD. Epidemiology of burns throughout the world. Part I: Distribution and risk factors. *Burns* 2011; 37:1087–1100.
2. Miller SF, Bessey P, Lentz CW et al. National burn repository 2007 report: A synopsis of the 2007 call for data. *J Burn Care Res* 2008; 29:862– 870; discussion 871.

Guidelines for Poster Preparation

Poster Submission Deadline: Friday, August 2nd, 2019, 5pm

Email to: jschanck@wakehealth.edu

General Aim and Format

- A poster is a graphically based approach to presenting research. In presenting your research with a poster, you should aim to use the poster as a means for generating active discussion of the research.
- Limit the text to about one-fourth of the poster space, and use "visuals" (graphs, photographs, schematics, maps, etc.) to tell your "story."
- Utilize the provided WFIRM Summer Scholar poster template (36" x 48")

Design and Layout Specifications

- Your entire poster (use WFIRM Poster Template, size 36" x 48"), will be mounted using push pins on a 40" x 60" foam-core board. Both the foam-core board and easel for display will be provided on site. The board must be oriented in the "landscape" position (long dimension is horizontal).
- A banner displaying your poster title, name, and department (or class, if appropriate) should be positioned at top-center of the board (see Figure 1).
- Make it obvious to the viewer how to progressively view the poster. The poster generally should read from left to right, and top to bottom. Numbering the individual panels, or connecting them with arrows is a standard "guidance system" (see Figure 1).
- Leave some open space in the design. An open layout is less tiring to the eye and mind.

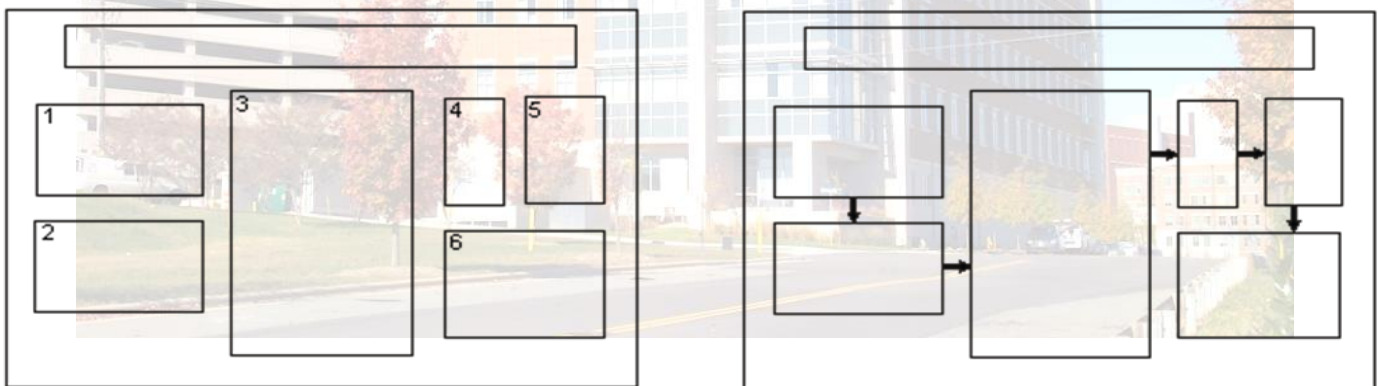


Figure 1: Conventional layouts for a poster. Long panel at top-center is title/author banner. Individual panels can be connected by numbers and arrows. Also, note the use of space between panels to achieve visual appeal. (From: C. W. Connor, 1992, The Poster Session: A Guide for Preparation: U. S. Geological Survey Open-File Report 88-667.)

Lettering

- Word-process all text (including captions). Print on plain white paper with a laser printer or inkjet printer.
- Text should be readable from five feet away. Use a *minimum* font size of 18 points.
- Lettering for the title should be large (at least 70-point font). Use all capital letters for the title.

Visuals

- Present numerical data in the form of graphs, rather than tables (graphs make trends in the data much more evident). If data must be presented in table-form, KEEP IT SIMPLE.
- Visuals should be simple and bold. Leave out or remove any unnecessary details.
- Make sure that any visual can "stand alone" (i.e., graph axes are properly labeled, maps have north arrows and distance scales, symbols are explained, etc.).
- Use color to enhance comprehension, not to decorate the poster. Neatly coloring black-line illustrations with color pencils is entirely acceptable.
- Make sure that the text and the visuals are integrated. Figures should be numbered consecutively according to the order in which they are first mentioned in the text. Each visual should have a *brief* title (for example: Figure 1- Location of study area).

Text

- Keep the text brief. For the most part, blocks of text should not exceed three paragraphs (viewers won't bother to read more than that). Use text to (a) introduce the study (what hypothesis was tested or what problem was investigated? why was the study worth doing?), (b) explain visuals and direct viewers' attention to significant data trends and relationships portrayed in the visuals, and (c) state and explain the interpretations that follow from the data. In many cases, conclusions can be summarized in a bullet-point list.
- Depending upon the stage or nature of your project, the text could also include sections on future research plans or questions for discussion with viewers.
- Cite and reference any sources of information other than your own, just as you would do with a research paper. Ask your professor about the particular citation system that you should use (every discipline uses slightly different styles). The "References Cited" is placed at the end of the poster.

Miscellaneous Suggestions

- SIMPLICITY IS THE KEY. Keep to the point, and don't try to cover too many things. Present only enough data to support your conclusions. On the other hand, make sure that you present sufficient data to support your conclusions.
- When you begin to make your poster, first create a list of the visuals that you would use if you were describing your project with *only the visuals*. Write the text *after* you have created the list of visuals.
- Mat the components of the poster on separate pieces of colored poster board. This sets-off the text and illustrations from the white mounting board. Also, you can easily attach each component to the mounting board with push-pins or thumb-tacks.
- Before the poster session, rehearse a brief summary of your project. Many viewers will be in a hurry and will want a quick "guided tour" of your poster. Don't be afraid to point out uncertainties in your work; this is where you may get useful feedback.

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I am at least 18 years of age and am competent to contract in my own name. I have read this release before signing below and I fully understand the contents, meaning, and impact of this release.

Print Name: _____

Signature: _____ Date: _____

If the person signing is under age 18, there must be consent by a parent or guardian, as follows:

I hereby certify that I am the parent or guardian of _____, named above, and do hereby give my consent without reservation to the foregoing on behalf of this person.

Parent/Guardian Print Name: _____

Parent/Guardian Signature: _____ Date: _____

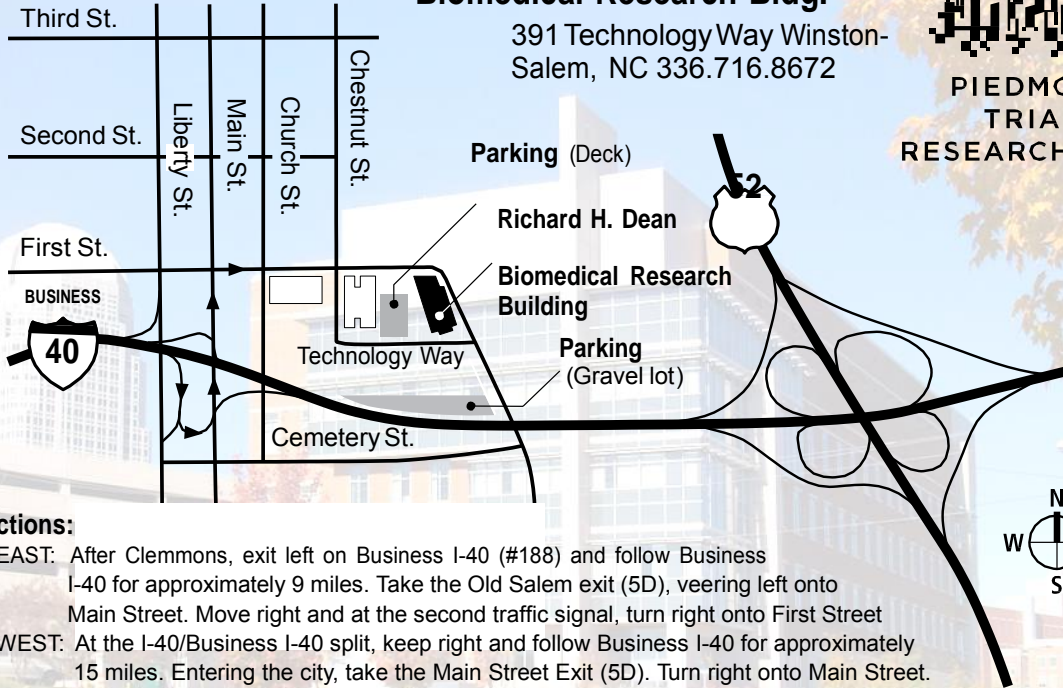
***NOTE: If photo depicts treatment, payment, or health care, use form MR 08/04, Authorization for Multi-Media Use and Disclosure of Protected Health Information.**

Richard H. Dean Biomedical Research Bldg.

391 Technology Way Winston-Salem, NC 336.716.8672



PIEDMONT
TRIAD
RESEARCH PARK



Directions:

- I-40 EAST:** After Clemmons, exit left on Business I-40 (#188) and follow Business I-40 for approximately 9 miles. Take the Old Salem exit (5D), veering left onto Main Street. Move right and at the second traffic signal, turn right onto First Street
- I-40 WEST:** At the I-40/Business I-40 split, keep right and follow Business I-40 for approximately 15 miles. Entering the city, take the Main Street Exit (5D). Turn right onto Main Street. At the first traffic signal, turn right onto First Street.
- Business 40 to Exit 5D (Main St./Downtown) Right on First St. – Right on Chestnut St. – Left on Technology Way**

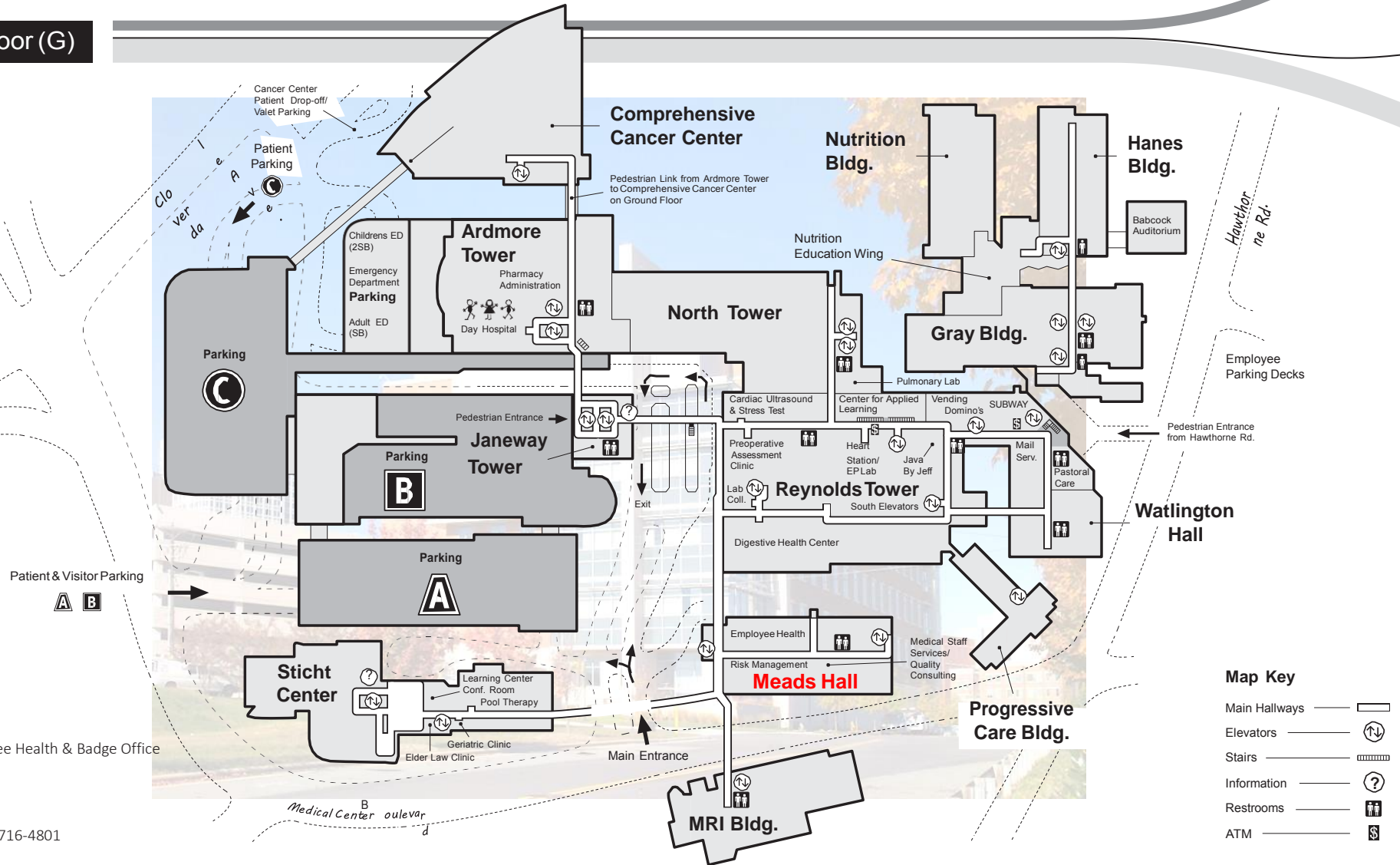


Wake Forest Baptist Medical Center

Campus Map

WakeHealth.edu

Ground Floor (G)



Visiting Location

Meads Hall - Employee Health & Badge Office

Room: Suite C

Floor: Ground Floor

Phone Number: 336-716-4801