

Ongoing Metric Tracking for ND EPSCoR NSF RII Track-1: New Discoveries in the Advanced Interface of Computation, Engineering and Science (ND-ACES)

4/30/2022

CCBSE: Materials Design at Bionterfaces Pillar		Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
Color Key:	<p>Objective 1.1a: Design and optimize nanoclay scaffolds (Activity 1: Prepare nanoclay scaffolds with amino acids for cancer cell growth)</p> <p><i>[Change in metric approved by NSF on 9/8/2021]</i></p>	<p>Prepare 3 different biocompatible scaffolds</p> <p>Y1 Annual Report: On track to complete</p> <p>Y1 ACTUAL: Prepared 3 nanoclay scaffolds. These scaffolds will be delivered to the Cellular Team in Y2</p>	<p>Develop 2 nanoclay scaffolds incorporating the amino acids and evaluate additional one hard scaffold</p> <p>Y2 Annual Report: All three Y1 hard scaffolds were delivered to the Cellular Team in September 2021. On track to deliver Y2 scaffolds and evaluation</p> <p>Since Y2 Annual Report: No changes</p>	<p>Select one optimal scaffold (critical)</p>	<p>Prepare enough scaffolds for the other Pillars and for Materials Design Pillar Goal 3</p>	<p>Prepare enough scaffolds for the other Pillars and for Materials Design Pillar Goal 3</p>	<p>Lead: K. Katti, Co-lead: G. Du, W. Xia, (Computational Approaches Pillar liaison), New Hire at NDSU</p>
	<p>Objective 1.1a: (Activity 2: Assist non-RU campuses involved in Activity 1 with compliance protocols)</p> <p><i>[Change in metric approved by NSF on 7/28/21]</i></p>	<p>Assist with the initiation of conversations between non-RU faculty and RU campuses for the administration of necessary compliance protocols (IBC, MTAs)</p> <p>Y1 Annual Report: N/A</p> <p>Y1 ACTUAL: Change under review by NSF</p>	<p>Ensure that all necessary compliance protocols are in place at the non-RU campuses</p> <p>Y2 Annual Report: Per NSF policy, IBC protocols are not required of non-RU CCBSE researchers. See PROSPER P&C regarding workshops delivered to CCBSE researchers in Y2. CCBSE leads will develop a blanket NDA and MTA for CCBSE by the end of Y2</p> <p>Since Y2 Annual Report: No changes</p>	<p>Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all campuses</p>	<p>Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all campuses</p>	<p>Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all campuses</p>	<p>Leads: K. Katti, C. Combs, S. Mallik, J. Zhao</p>
	<p>Objective 1.1b: Characterize the scaffolds and demonstrate cancer cell growth (Activity 1: Characterize the scaffolds and culture of breast and prostate cancer cells)</p> <p><i>[Change in metric approved by NSF on 9/8/2021]</i></p>	<p>Complete characterizations on the scaffolds prepared in 1.1a. Demonstrate growth of MCF7 and PC3a cells</p> <p>Y1 Annual Report: On track to complete</p> <p>Y1 ACTUAL: Completed characterizations on the 3 nanoclay scaffolds from 1.1a; growth of MCF7 and PC3a cells was demonstrated</p>	<p>Demonstrate growth of MDA-MB-231 and PC3 cells and compare with MCF7 and PC3a cells</p> <p>Y2 Annual Report: Scaffold activity with 4 types of cells completed on one hard scaffold and initiated on second hard scaffold</p> <p>Since Y2 Annual Report: No changes</p>	<p>Demonstrate tumoroid formation (critical)</p>	<p>Time evaluation of tumor growth on optimized scaffolds</p>	<p>The tumors on the scaffold are genetically and morphologically similar</p>	<p>Lead: K. Katti, Co-lead: G. Du, W. Xia (Computational Approaches Pillar liaison), New Hire at NDSU</p>
	<p>Objective 1.2a: Design and optimize soft polymeric scaffolds (Activity 1: Prepare soft scaffolds from Chi, Alg, and PgA, characterize the scaffolds)</p>	<p>Prepare 3 different biocompatible scaffolds</p> <p>Y1 Annual Report: On track to complete</p> <p>Y1 ACTUAL: Prepared 3 scaffolds. These scaffolds were delivered to the Cellular Team in Y1</p>	<p>Prepare 3 different biocompatible scaffolds</p> <p>Y2 Annual Report: Y1 scaffolds were rejected by the Cellular Systems team due to low pH values. Four new soft scaffolds have been developed and delivered to the Cellular Systems team</p> <p>Since Y2 Annual Report: No changes</p>	<p>Select 1 optimal scaffold (critical)</p>	<p>Prepare enough scaffolds for the other Pillars and for Materials Design Pillar Goal 3 (nanomaterials testing)</p>	<p>Prepare enough scaffolds for the other Pillars and for Materials Design Pillar Goal 3</p>	<p>Lead: K. Katti, K. Hossain, Co-leads: M. Quadir, B. Voels, M. Parker, A. Allard, W. Xia (Computational Approaches Pillar liaison)</p>
	<p>Objective 1.2a: (Activity 2: Assist non-RU campuses involved in Activity 1 with compliance protocols)</p> <p><i>[Change in metric approved by NSF on 7/28/21]</i></p>	<p>Assist with the initiation of conversations between non-RU faculty and RU campuses for the administration of necessary compliance protocols (IBC, MTAs)</p> <p>Y1 Annual Report: N/A</p> <p>Y1 ACTUAL: Change under review by NSF</p>	<p>Ensure that all necessary compliance protocols are in place at the non-RU campuses</p> <p>Y2 Annual Report: Per NSF policy, IBC protocols are not required of non-RU CCBSE researchers. See PROSPER P&C regarding workshops delivered to CCBSE researchers in Y2. CCBSE leads will develop a blanket NDA and MTA for CCBSE by the end of Y2</p> <p>Since Y2 Annual Report: No changes</p>	<p>Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all campuses</p>	<p>Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all campuses</p>	<p>Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all campuses</p>	<p>Leads: K. Katti, C. Combs, S. Mallik, J. Zhao</p>
Behind Schedule							
On Track / In-Progress							
Ahead of Schedule / Complete							

N/A or Not yet started

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<p>Objective 1.2b: Characterize the scaffolds and demonstrate cancer cell growth (Activity 1: Determine mechanical properties, cell viability in the scaffolds, analyze gene expression profiles)</p>	<p>Complete characterizations on the scaffolds prepared in 1.2a. Demonstrate growth of MCF7 and PC3a cells. Y1 Annual Report: On track to complete Y1 ACTUAL: Completed characterizations on the 3 soft polymeric scaffolds from 1.2a; growth of MCF7 and PC3a cells was demonstrated</p>	<p>Demonstrate growth of MDA-MB-231 and PC3 cells and compare with MCF7 and PCa Y2 Annual Report: The "first generation" scaffolds did not support cell growth. Studies are in progress with the pH-controlled scaffolds Since Y2 Annual Report: No changes</p>	<p>Demonstrate tumoroid formation (critical)</p>	<p>Time evaluation of tumor growth on optimized scaffolds</p>	<p>The tumors on the scaffold are genetically and morphologically similar</p>	<p>Lead: K. Katti, Co-lead: G. Du, M. Quadir, K. Hossain, W. Xia (Computational Approaches Pillar liaison)</p>
<p>Objective 1.2b: (Activity 2: Assist non-RU campuses involved in Activity 1 with compliance protocols) <i>[Change in metric approved by NSF on 7/28/21]</i></p>	<p>Assist with the initiation of conversations between non-RU faculty and RU campuses for the administration of necessary compliance protocols (IBC, MTAs) Y1 Annual Report: N/A Y1 ACTUAL: Change under review by NSF</p>	<p>Ensure that all necessary compliance protocols are in place at the non-RU campuses Y2 Annual Report: Per NSF policy, IBC protocols are not required of non-RU CCBSE researchers. See PROSPER P&C regarding workshops delivered to CCBSE researchers in Y2. CCBSE leads will develop a blanket NDA and MTA for CCBSE by the end of Y2 Since Y2 Annual Report: No changes</p>	<p>Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all campuses</p>	<p>Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all campuses</p>	<p>Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all campuses</p>	<p>Leads: K. Katti, C. Combs, S. Mallik, J. Zhao</p>
<p>Objective 1.3a: (Activity 1: Design and develop stimuli-responsive polymeric materials as nanocarriers) <i>[Change in metric approved by NSF 7/28/21]</i></p>	<p>Prepare 5 different PSEs and characterize nanoparticles. Y1 Annual Report: On track to complete Y1 ACTUAL: Developed 5 different PSEs and characterized them. Optimized one of them as the most suitable PSE</p>	<p>Demonstrate drug release in the tumoroids cells in scaffolds Y2 Annual Report: Degradation studies of the nanoparticles are in progress in low pH values Since Y2 Annual Report: No changes</p>	<p>The nanoparticles release drugs within desirable time in scaffolds (critical)</p>	<p>Prepare 3 different polymers, demonstrate imaging in the tumor cells in 3D scaffolds</p>	<p>Released drugs kill majority of cancer cells in scaffold/models</p>	<p>Lead: G. Du, Co-leads: J. Zhao, C. Combs, B. Sui</p>
<p>Objective 1.3b: (Activity 1: Design and develop silicon quantum dots (QDs) and polymer-QDs hybrids for bioimaging) <i>[Change in metric approved by NSF 7/28/21]</i></p>	<p>QDs with stable signal in cells Y1 Annual Report: On track to complete Y1 ACTUAL: Completed</p>	<p>Demonstrate good biocompatibility with cancer cell lines Y2 Annual Report: Biocompatibility studies with cancer cells are in progress Since Y2 Annual Report: No changes</p>	<p>Identify two polymers (critical)</p>	<p>Make two polymer-SiQD hybrids</p>	<p>Demonstrate optimized imaging</p>	<p>Lead: J. Zhao, Co-leads: G. Du, C. Combs, B. Sui</p>
<p>Objective 1.3c: Design and test polymer nanoparticles for vascular surrogacy (Activity 1: Design, preparation, and testing of hypoxia-responsive polymer nanoparticles) <i>[Change in metric approved by NSF 9/8/21]</i></p>	<p>Prepare 3 polymers with different hypoxia-responsive units, characterize nanoparticles. Y1 Annual Report: On track to complete Y1 ACTUAL: Prepared three polymer nanoparticles</p>	<p>Prepare two additional polymers, demonstrate drug release in the tumoroids on hard and soft scaffolds. Y2 Annual Report: Studying the release of metarrestin from the nanoparticles under various oxygen levels Since Y2 Annual Report: No changes</p>	<p>The nanoparticles release drugs within 2 hours in the hard and soft scaffolds (critical).</p>	<p>Release drugs kill at least 80% of the breast and prostate cancer cells on the scaffolds (critical)</p>	<p>Released drugs kill at least 80% of the cancer cells in the patient-derived model.</p>	<p>Lead: S. Mallik, Co-leads: M. Bobylev, K. Katti, G. Du</p>
<p>Objective 1.3c (Activity 2: Design, preparation, and testing of pH-responsive polymer nanoparticles) <i>[Change in metric approved by NSF 9/8/21]</i></p>	<p>Prepare 3 polymers, characterize nanoparticles Y1 Annual Report: On track to complete Y1 ACTUAL: Prepared and characterized 3 pH-responsive polymer nanoparticles</p>	<p>Demonstrate drug release in the tumoroids on hard and soft scaffolds Y2 Annual Report: Validation ongoing in provided scaffolds Since Y2 Annual Report: No changes</p>	<p>The nanoparticles release drugs within 2 hours in the hard and soft scaffolds (critical)</p>	<p>Release drugs kill at least 80% of the breast and prostate cancer cells on the scaffolds (critical)</p>	<p>Released drugs kill at least 80% of the cancer cells in the patient-derived model</p>	<p>Lead: M. Quadir, Co-leads: S. Mallik, K. Katti, G. Du</p>

Ongoing Metric Tracking for ND EPSCoR NSF RII Track-1: New Discoveries in the Advanced Interface of Computation, Engineering and Science (ND-ACES)

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CCBSE: Cellular Systems at Materials Interface Pillar		Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
	Objective 2.1a: Increase CCBSE capacity/expertise in basic and translational use of in vivo-like 3D cell cultures (Activity 1: Validate multiple soft and hard tissue scaffolds)	Validation SOP creation using existing materials and 2D culture Y1 Annual Report: Behind schedule Y1 ACTUAL: We have created SOPs based on commercially available materials and 2D culture; first gen soft scaffold materials failed to support growth, second gen materials not yet available for testing	<i>Metric was not completed in Y1 as planned</i> Y2 Annual Report Second gen materials are available for testing Since Y2 Annual Report: No changes				Leads: A. Dhasarathy, J. Wilkinson Co-leads: C. Combs, G. Du, (Materials Design Pillar liaison), K. Hartman [Approved by NSF 7/28/21] ; K. Katti, A. Haage, H. van Gijssel, M. Hoffmann [Approved by NSF 7/28/21] (Computational Approaches Pillar liaison)
Color Key: <div style="background-color: red; color: white; padding: 5px; text-align: center;">Behind Schedule</div> <div style="background-color: yellow; color: black; padding: 5px; text-align: center;">On Track / In-Progress</div> <div style="background-color: green; color: black; padding: 5px; text-align: center;">Ahead of Schedule / Complete</div> <div style="background-color: white; color: black; padding: 5px; text-align: center;">N/A or Not yet started</div>	Objective 2.1a (Activity 1 - cont.)	Protocol database creation based on validation Y1 Annual Report: On track to complete Y1 ACTUAL: Database created and protocols are being uploaded by the team	Completion of secondary validation on provided 1st generation materials Y2 Annual Report: Validation incomplete since first generation materials failed initial screening Since Y2 Annual Report: No changes	Completion of tertiary validation, provided 1st generation materials	Completion of quaternary validation, provided 1st generation materials	Completion of quaternary validation, provided 2nd generation materials	
	Objective 2.1a (Activity 1 - cont.)	Reagent database creation based on validation Y1 Annual Report: On track to complete Y1 ACTUAL: Reagent database created and will be updated continuously	Completion of preliminary validation on provided 2nd generation materials Y2 Annual Report: Validation ongoing as materials continue to arrive in labs Since Y2 Annual Report: No changes	Completion of secondary validation, provided 2nd generation materials	Completion of tertiary validation, provided 2nd generation materials		
	Objective 2.1a (Activity 1 - cont.)	Completion of preliminary evaluation of provided first generation materials (baseline viability and growth, initial hypoxic response and EMT/MET signatures) e.g., 85% similar to 2D and matrigel cultures Y1 Annual Report: On track to complete Y1 ACTUAL: First gen hard scaffold work completed. First gen soft scaffold materials did not work, second gen materials not provided during Y1	<i>Metric was not completed in Y1 as planned</i> Y2 Annual Report: Second gen materials are available for testing Since Y2 Annual Report: No changes	Completion of preliminary nanomaterial delivery assessments	Completion of secondary nanomaterial delivery assessments	Completion of tertiary nanomaterial delivery assessments	
	Objective 2.1a (Activity 1 - cont.)	Data exchange with Materials Design and Computational Approaches Pillars Y1 Annual Report: On track Y1 ACTUAL: Data exchange initiated and is continuing	Continued data exchange with Materials Design and Computational Approaches Pillars Y2 Annual Report: Data exchange is continuous and will not be complete until year ends Since Y2 Annual Report: No changes	Continued data exchange with Materials Design and Computational Approaches Pillars	Continued data exchange with Materials Design and Computational Approaches Pillars	Continued data exchange with Materials Design and Computational Approaches Pillars	
	Objective 2.1a (Activity 2: Generate heterogeneous multicellular 3D cultures with improved in vivo-like tissue)	A protocol for growth of multi-cellular cultures on provided hard and soft 1st generation materials Y1 Annual Report: On track to complete Y1 ACTUAL: Incomplete, as materials failed/ not provided respectively.	An optimized co-culture protocol for growth on provided hard and soft 1st generation materials Y2 Annual Report: Co-culture cannot be tested until single cell culture validation of first generation materials is completed, as noted above Since Y2 Annual Report: No changes				Leads: C. Combs, J. Wilkinson, A. Haage, N. Galt, G. Du, (Materials Design Pillar liaison), K. Katti, M. Hoffmann [Approved by NSF 7/28/21] , (Computational Approaches Pillar liaison)
	Objective 2.1a (Activity 2 - cont.)		A co-culture protocol for growth on provided hard and soft 2nd generation materials Y2 Annual Report: Second generation materials have been received and validation is ongoing Since Y2 Annual Report: No changes	An optimized co-culture protocol for growth on provided hard and soft 2nd generation materials			

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Objective 2.1a (Activity 2 - cont.)		Establish phenotype marker criteria (e.g., morphology and proteins) for co-cultures on provided hard and soft 1st generation materials to compare to <i>in vivo</i> tumors Y2 Annual Report: We have a source of PDX tumor tissue; experiments are starting on this metric Since Y2 Annual Report: No changes	Establish phenotype marker criteria (e.g., morphology and proteins) for co-cultures on provided hard and soft 2nd generation materials to compare to <i>in vivo</i> tumors	Genomic and transcriptomic characterization of co-cultures on hard and soft materials	Genomic and transcriptomic characterization of nanocarrier-mediated drug delivery to co-cultures on hard and soft materials	
Objective 2.1a (Activity 2 - cont.)			Protocol for nanocarrier design and drug delivery to 3D-cultures	Optimized protocol for nanocarrier design and drug delivery to 3D-cultures	Demonstration of nanocarrier-mediated drug delivery effects on co-culture viability and the established cellular phenotype markers	
Objective 2.1a (Activity 2 - cont.)	Continued data exchange with Materials Design and Computational Approaches Pillars Y1 Annual Report: On track Y1 ACTUAL: Data exchange initiated and is continuing	Continued data exchange with Materials Design and Computational Approaches Pillars Y2 Annual Report: Data exchange is continuous and will not be complete until year ends Since Y2 Annual Report: No changes	Continued data exchange with Materials Design and Computational Approaches Pillars	Continued data exchange with Materials Design and Computational Approaches Pillars	Continued data exchange with Materials Design and Computational Approaches Pillars	
Objective 2.1a (Activity 3: Develop a high throughput system that combines materials and modeling to create an improved culture paradigm for human <i>in vivo</i> relevance)	Successful establishment of PDX colonies as source of test materials Y1 Annual Report: On track to compete Y1 ACTUAL: a breast cancer PDX colony has been established at NDSU, this is supported by a different project and not currently associated with ND-ACES. Administrative efforts are in progress to correct this problem					
Objective 2.1a (Activity 3 - cont.)	Establishment and maintenance of PDX explant tissues (XOs) in scaffold cultures with greater than 1-month viability Y1 Annual Report: Behind schedule, as noted above Y1 ACTUAL: Administrative efforts in progress to associate established breast cancer PDX with the ND-ACES project before explant testing can begin	Complex Analysis of phenotypic criteria indicating XO tissues on scaffolds exhibit growth and gene expression characteristics similar to <i>in vivo</i> conditions Y2 Annual Report: We have arranged to get PDX tissues from the NDSU Animal Core Facility Since Y2 Annual Report: No changes	Response to hypoxia/ acidification by XO/scaffolds that mimics the <i>in vivo</i> tumor environment	Successful long-term culture of PDO with TAM/TAF on scaffolds	Changes in PDO/scaffold growth behavior, genetics, and morphology upon the intervention of TAM-PDO communication	Leads: J. Kim, J. J. Wilkinson, C. Combs, A. Haage, H. van Gijssel
Objective 2.1a (Activity 3 - cont.)	Development of standard protocols for sustained growth of XO tissues on next generation material scaffolds Y1 Annual Report: Behind schedule Y1 ACTUAL: Administrative efforts in progress to associate established breast cancer PDX with the ND-ACES project before explant testing can begin	Faster and more efficient growth of XO tissues under scaffold conditions when compared to <i>in vivo</i> maintenance Y2 Annual Report: We have arranged to get PDX tumor tissue <i>ex vivo</i> from the NDSU Animal Core Facility Since Y2 Annual Report: No changes	Development of a standard protocol for successful co-culture of XO with TAM/TAF on scaffolds	Presentation of miniature tumor microenvironment by PDO/TAM/TAF on scaffolds that is similar to TME of PDX tumor	Presentation of drug resistance characteristics by explanted tumoroids that maintain similar properties to those observed <i>in vivo</i>	
Objective 2.1a (Activity 3 - cont.)		Successful growth of PDO on the next generation scaffolds Y2 Annual Report: PDO's have been established in conventional culture, assessment in scaffolds is underway Since Y2 Annual Report: No changes	Complex Analysis of phenotypic criteria indicating PDO tissues on scaffolds exhibit growth and gene expression characteristics similar to <i>in vivo</i> conditions			

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Objective 2.1a (Activity 3 - cont.)	Continued data exchange with Materials Design and Computational Approaches Pillars Y1 Annual Report: On track Y1 ACTUAL: In progress, this is a continuous process.	Continued data exchange with Materials Design and Computational Approaches Pillars Y2 Annual Report: data exchange is continuous and will not be complete until year ends Since Y2 Annual Report: No changes	Continued data exchange with Materials Design and Computational Approaches Pillars	Continued data exchange with Materials Design and Computational Approaches Pillars	Continued data exchange with Materials Design and Computational Approaches Pillars	
Objective 2.1a (Activity 4: Assist non-RU campuses involved in Activity 1 with compliance protocols) <i>[New activity - Approved by NSF on 7/28/21]</i>	Assist with the initiation of conversations between non-RU faculty and RU campuses for the administration of necessary compliance protocols (IBC, MTAs) Y1 Annual Report: N/A Y1 ACTUAL: Change under review by NSF	Ensure that all necessary compliance protocols are in place at the non-RU campuses Y2 Annual Report: Per NSF policy, IBC protocols are not required of non-RU CCBSE researchers. See PROSPER P&C regarding workshops delivered to CCBSE researchers in Y2. CCBSE leads will develop a blanket NDA and MTA for CCBSE by the end of Y2 Since Y2 Annual Report: No changes	Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all non-RU campuses	Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all non-RU campuses	Ensure that all necessary compliance protocols (IBC, MTAs) are in place at all non-RU campuses	Leads: K. Katti, C. Combs, A. Dhasarathy, J. Wilkinson

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CCBSE: Computation, Machine Learning, and Predictive Modeling Pillar		Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
Color Key:	Objective 3.1: Create an evolutionary in-silico platform to predict tumor growth (Activity 1: Machine learning to understand cellular and materials connections)	C7-ML Bone site - Classification Accuracy >=0.4 Y1 Annual Report: On track to meet Y1 ACTUAL: Databases of cancer tissue images were used to identify best performing ML algorithms. Classification Accuracy >=0.4 has been achieved	C7 ML Bone site - Classification Accuracy >=0.5 Y2 Annual Report: Discussion with Cellular Systems pillar to identify experimental data necessary for ML is taking place Since Y2 Annual Report: No changes	C7 ML Bone site - Classification Accuracy >=0.6			Leads: C7 - L. Liu; C8 - J. Delhommelle
	Objective 3.1: (Activity 1 - cont.)	C8-ML Primary site - Datasets generation from composite data sources for ML model training & identification of best performing ML algorithms for image recognition of the 4 types of cancer cells on bone stem cells Y1 Annual Report: On track to meet Y1 ACTUAL: Databases of cancer tissue images were used to identify best performing ML algorithms and image recognition of at least 4 was achieved	C8 ML Primary site - 1) Datasets generation for the cellular growth-material formulation using data from experimentalists and other collaborators. Identification of high performing ML algorithms on image recognition for cell migration and clustering Y2 Annual Report: Discussion with Cellular pillar to identify experimental data necessary for ML is taking place Since Y2 Annual Report: No changes	C8 ML Primary site - Determination of patterns & optimal properties via ML			Leads: C7 - L. Liu; C8 - J. Delhommelle
	Objective 3.1: (Activity 1 - cont.) [Metric change approved by NSF 8/27/21]		Build Machine learning capacity at a PUI and determine Y3-5 PUI researcher activity Y2 Annual Report: PUI investigator with ML expertise added, will collaborate with existing ML researcher to develop PUI content Since Y2 Annual Report: No changes	TBD, see Y2			Lead: M. Fries, D. Katti, M. Hoffmann, L. Liu, J. Delhommelle
	Objective 3.1: Activity 2: Multiscale modeling with Materials Design Pillar)	M1-Ab-initio/DFT-Obtain binding interface information at the atomistic level Y1 Annual Report: On track to complete Y1 ACTUAL: Binding affinity of 13 aminoacids with clays completed	M1-Ab-initio/DFT - Obtain binding interface information at the atomistic level Y2 Annual Report: Electrostatic description of amino acids and clays on binding obtained Since Y2 Annual Report: No changes	M1-Ab-initio/DFT - Obtain binding interface information at the atomistic level			Leads: M1 & M2 - M. Hoffmann [Approved by NSF 7/28/21] M3 & M5 - D. Katti M4 - W. Xia M6 - T. Le
	Objective 3.1: (Activity 2 - cont.)	M2-Ab-initio/DFT -Building atomistic models to understand interfaces Y1 Annual Report: On track Y1 ACTUAL: Ab-initio/DFT modeling of clay is completed	M2-Ab-initio/DFT - Building atomistic models to understand interfaces Y2 Annual Report: Integrin model is identified. Specific domains to be used for the calculations are to be finalized Since Y2 Annual Report: No changes	M2-Ab-initio/DFT - Building atomistic models to understand interfaces			Leads: M1 & M2 - M. Hoffmann [Approved by NSF 7/28/21] M3 & M5 - D. Katti M4 - W. Xia M6 - T. Le
Behind Schedule	Objective 3.1: (Activity 2 - cont.)	M3-Molecular Dynamics - Successful model development Y1 Annual Report: On track to complete Y1 ACTUAL: MD model for the PCN being currently used by other pillars is complete	M3-Molecular Dynamics - Successful model development; compare mechanical properties with nanoindentation with results within an order of magnitude Y2 Annual Report: MD model for a new nanocomposite for hard scaffolds under development. The MD nanoclay model with a new amino acid is built Since Y2 Annual Report: No changes	M3-Molecular Dynamics - Successful model development; compare mechanical properties with nanoindentation with results within an order of magnitude			Leads: M1 & M2 - M. Hoffmann [Approved by NSF 7/28/21] M3 & M5 - D. Katti M4 - W. Xia M6 - T. Le
On Track / In-Progress	Ahead of Schedule / Complete						

N/A or Not yet started

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Objective 3.1: (Activity 2 - cont.)	M4-Coarse Graining - CG model of clay developed; CG model of polymer developed; CG force field validated Y1 Annual Report: On track Y1 ACTUAL: CG model of clay is developed and validated; CG modeling strategy of polymer is established and the CG polymer model is under development	M4-Coarse Graining - CG model of clay developed; CG model of PCN developed; CG force field validated Y2 Annual Report: Polymer PCL CG model is under development Since Y2 Annual Report: No changes	M4-Coarse Graining - CG model of clay developed; CG model of PCN developed; CG force field validated			Leads: M1 & M2 - M. Hoffmann [Approved by NSF 7/28/21] M3 & M5 - D. Katti M4 - W. Xia M6 - T. Le
Objective 3.1: (Activity 2 - cont.)	M5-Finite Element Modeling - Successful model development Y1 Annual Report: On track to complete Y1 ACTUAL: FEM model for the scaffold currently used by other pillars is complete	M5-Finite Element Modeling - Successful model development. Elastic modulus within an order of magnitude of nanoindentation/ macroscale experiments Y2 Annual Report: Simulations will be done in Y2 Since Y2 Annual Report: No changes	M5-Finite Element Modeling - Successful model development. Elastic modulus within an order of magnitude of nanoindentation/ macroscale experiments			
Objective 3.1: (Activity 2 - cont.)	M6-Deterministic models for degrading scaffold under shear flows developed; Rate of degrading validated Y1 Annual Report: On track Y1 ACTUAL: Computational model for shear flows developed; the model for degrading is being developed	M6-Computational Fluid Dynamics - Range of model parameters for degradable scaffold established; Models for cell interaction and migration developed Y2 Annual Report: CFD simulations of flow through scaffolds in progress Since Y2 Annual Report: No changes	M6-Computational Fluid Dynamics - Multi-resolution CFD model for scaffold developed; Local distribution of shear stresses in complex geometries validated			
Objective 3.1: (Activity 3: Multiscale modeling with Cellular Systems Pillar)	C1-Ab-initio/DFT Bone site - Creation of reduced models for integrin domains, nanoclays, and polymers Y1 Annual Report: On track Y1 ACTUAL: Integrin molecular model is identified. Clay model to be used for the study has been developed	C1-Ab-initio/DFT Bone site - Validation and improvement of reduced models for nanoclays and polymers interacting with Integrin domains Y2 Annual Report: Modeling is in progress Since Y2 Annual Report: No changes	C1-Ab-initio/DFT Bone site	C1-Ab-initio/DFT Bone site	C1-Ab-initio/DFT Bone site	C1 - S. Kilina C2 - D. Cakir C3, C5 & C11 - D. Katti C4, C9 - W. Xia
Objective 3.1: (Activity 3 - cont.)	C2-Ab-initio/DFT - Building atomistic models to model bio-interfaces Y1 Annual Report: On track to complete Y1 ACTUAL: Integrin molecular model is identified	C2-Ab-initio/DFT - Building atomistic models to represent/model bio-interfaces Y2 Annual Report: Modeling is in progress Since Y2 Annual Report: No changes	C2-Ab-initio/DFT Primary site - Building atomistic models to model bio interfaces	C2-Ab-initio/DFT Primary site	C2-Ab-initio/DFT Primary site - Building atomistic models to represent/model bio-interfaces	
Objective 3.1: (Activity 3 - cont.)	C3-Molecular Dynamics - Successful model development of actin and integrin. Obtaining mechanical properties of actin from SMD Y1 Annual Report: On track to complete Y1 ACTUAL: Both tasks are completed- actin results are published in a Journal paper	C3-Molecular Dynamics - Successful model development of actin and depolymerization genes; integrin on surfaces; Obtaining mechanical properties of actin and integrin from SMD Y2 Annual Report: The model development of actin and depolymerization genes is completed and the results will be submitted soon to a Journal. The integrin modeling is complete and simulations are ongoing Since Y2 Annual Report: No changes	C3, C9, C10-Molecular Dynamics - Determine the mechanical properties of E-Cadherin junctions; Determine the mechanical properties of the integrin molecules on PCN and polymers	C3, C9, C10-Molecular Dynamics - Determine the mechanical properties of the additional six integrin molecules on PCN and polymers	C11-Multibody dynamics simulations integrated with Finite Element Modeling - Successful development of multibody dynamics simulations model for cell migration	
Objective 3.1: (Activity 3 - cont.)	C4-Coarse Graining - CG model of integrins developed; Integrins-PCN interfacial interactions captured by CG modeling Y1 Annual Report: On track Y1 ACTUAL: CG modeling framework of interface is established, and CG model of integrins has been developed	C4-Coarse Graining - Continued Y2 Annual Report: Awaiting MD results for parameter development Since Y2 Annual Report: No changes	C4-Coarse Graining - Mechanical properties of interphases obtained with CG modeling for six integrins and varying interfacial design parameters	C4-Coarse Graining - Mechanical properties of interphases obtained with CG modeling for additional six integrins with extended interfacial design parameters		

CCBSE: Computation, Machine Learning, and Predictive Modeling Pillar	Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
Objective 3.1: (Activity 3 - cont.)	C5-Finite Element Modeling - Successful development of FEM cell model Y1 Annual Report: On track Y1 ACTUAL: FEM model of single cells is completed and nonlinear material properties are being evaluated	C5-Finite Element Modeling -Successful development of FEM cell model on substrate; incorporation of adhesion parameters from C1 through C4; calibration with experiments Y2 Annual Report: Adhesion models under development Since Y2 Annual Report: No changes	C5-Finite Element Modeling - Successful development of FEM cell model on substrate and Cell-Cell adhesion model; incorporation of adhesion parameters from C1 through C4; calibration with experiments			
Objective 3.1: (Activity 3 - cont.)	C6-Computational Fluid Dynamics - Continuum representation of actin networks in cell membrane developed; Cell adhesion model developed and validated Y1 Annual Report: On track Y1 ACTUAL: The DPD model for actin network of cellular membrane has been developed. The result has been published in a Journal article. The adhesion model is being developed	C6-Computational Fluid Dynamics - Models for cell migration on a clay substrate developed and validated Y2 Annual Report: A realistic model for eukaryotic cells has been developed. The migration model is being developed Since Y2 Annual Report: No changes	C6-Computational Fluid Dynamics - CFD simulations of flows around groups of cancer cells populated on a substrate	C6-Computational Fluid Dynamics - Using measures such as cell density and alignment to validate CFD models for cellular migration on the surface of scaffold	C6-Computational Fluid Dynamics - Full-scale simulation of cell migration in a bio-reactor. Resolution provides from millimeter to micrometer (three order of magnitudes). Flow distribution and shear stresses will be provided in all pores of the scaffold	C6 - T. Le C10 - M. Hoffmann [Approved by NSF 7/28/21]
Objective 3.1: (Activity 4: Machine learning to develop the in-silico platform)			C12, C14, C15, C16, C18-ML Bone Site - Obtain the knowledge to construct preliminary rules of designing new scaffold materials for bone site. Classification Accuracy ≥ 0.6	C12, C14, C15, C16, C18-ML Bone Site - Obtain the knowledge to construct fundamental rules of designing new scaffold materials for bone site; Classification Accuracy ≥ 0.7 ; Generate simulated datasets under perturbed conditions and use those datasets to build ML models for cell migration; ML predictive models derived; ML model predictions validated against modeling and experiments	C12, C14, C15, C16, C18-ML Bone Site - Accuracy ≥ 0.8 ; ML predictive models derived; ML model predictions validated against modeling and experiments; obtain the knowledge to construct fundamental rules of designing new scaffold materials for bone site	C12 - L. Liu (lead) C13 - J. Delhommelle (lead) C14 - W. Xia C15 - M. Hoffmann [Approved by NSF 7/28/21] C16 - D. Katti C18 - T. Le
Objective 3.1: (Activity 4 - cont.)				C12, C14, C15, C16, C18-ML Bone Site - ML predictive models derived; ML model predictions validated against modeling and experiments; obtain the knowledge to construct fundamental rules of designing new scaffold materials for bone site		
Objective 3.1: (Activity 4 - cont.)			C13, C14, C15, C16, C18-ML Primary Site - Obtain the knowledge to construct preliminary rules of designing new scaffold materials for primary site. Statistical and reduced order models will be developed to predict where cancer cells migrate and grow	C13, C14, C15, C16, C18-ML Primary Site - ML predictive models derived; ML model predictions validated against modeling and experiments; obtain the knowledge to construct fundamental rules of designing new scaffold materials for primary site	C13, C14, C15, C16, C18-ML Primary Site - Accuracy ≥ 0.8 ; ML predictive models derived; ML model predictions validated against modeling and experiments; obtain the knowledge to construct fundamental rules of designing new scaffold materials for primary site	
Objective 3.1: (Activity 4 - cont.) [Metric change approved by NSF 8/27/21]			PUI researcher activity TBD, based on Y2, activity #1	PUI researcher activity TBD, based on Y2, activity #1	PUI researcher activity TBD, based on Y2, activity #1	Lead: M. Fries , D. Katti, M. Hoffmann, L. Liu, J. Delhommelle
Objective 3.1: (Activity 5: Design Rules)				C17, C12, C13, C14, C15, C16, C18-Parameter-structure-property relationships drawn for design of materials; optimized design parameters identified; develop design rules (geometry, material properties) for fluid flows in degradable scaffolds	C17, C12, C13, C14, C15, C16, C18-Formulation of updated design rules for materials and scaffolds - Parameter-structure-property relationships refined for design of materials; materials design parameters finalized; validate design rules and establish optimized ranges of parameters	C12 - L. Liu C13 - J. Delhommelle C14 - W. Xia C15 - M. Hoffmann [Approved by NSF 7/28/21] C16 - D. Katti C17 - All Pillar and science leads C18 - T. Le

Ongoing Metric Tracking for ND EPSCoR NSF RII Track-1: New Discoveries in the Advanced Interface of Computation, Engineering and Science (ND-ACES)

4/30/2022

Center for Cellular Biointerfaces in Science and Engineering (CCBSE) Overall		Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025
Number of new hires			Y2 Annual Report: UND - 1 hired: Binglin Sui NDSU - Initial virtual interviews have been completed. Spring 2022 campus interviews. On track for Fall 2022 start Since Y2 Annual Report: No change	2 hired: NDSU new materials science faculty member will be hired	Retained	5-yr goal: 2
Total number of peer-review publications		Y1 Annual Report: 13 Y1 ACTUAL: 14	Y2 Annual Report: 6 Since Y2 Annual Report: 3	Continue toward goal	Continue toward goal	5-yr goal: 140
Number of collaborative peer-review publications (one senior author from two or more ND-ACES institutions)		Y1 Annual Report: 0 Y1 ACTUAL: 0	Y2 Annual Report: 0 Since Y2 Annual Report: request submitted to NSF to change metric language	Continue toward goal	Continue toward goal	5-yr goal: 70
Total number of conference presentations by CCBSE senior personnel		Y1 Annual Report: 15 Y1 ACTUAL: 28	Y2 Annual Report: 9 Since Y2 Annual Report: 15	Continue toward goal	Continue toward goal	5-yr goal: 90
Total number of submitted research proposals (PI/Co-PI from two or more ND-ACES institutions)		Y1 Annual Report: 0 Y1 ACTUAL: 1	Y2 Annual Report: 2 Since Y2 Annual Report: no change	Continue toward goal	Continue toward goal	5-yr goal: 50
Number of submitted collaborative proposals (two or more ND-ACES senior personnel)		Y1 Annual Report: 2 Y1 ACTUAL: 6	Y2 Annual Report: 3 Since Y2 Annual Report: no change	Continue toward goal	Continue toward goal	5-yr goal: 25
Number of CAREER proposals submitted		Y1 Annual Report: 0 Y1 ACTUAL: 0	Y2 Annual Report: 0 Since Y2 Annual Report: no change	Continue toward goal	Continue toward goal	5-yr goal: '2-4
Total external research funding (million \$) – 5-year total is cumulative		Y1 Annual Report: \$0; 12 proposals, two collaborative, totaling \$14,368,361 were submitted (there were actually 11 submitted totaling \$12,083,756 - one was added in twice in error) Y1 ACTUAL: \$745,521 (three awarded proposals). 13 proposals, 6 collaborative, totaling \$13,783,756 were submitted	Y2 Annual Report: \$0 awarded at this time; 4 have been submitted in award Year 2, 3 are collaborative, for a combined total of \$4,523,157 Since Y2 Annual Report: no change	Continue toward goal	Continue toward goal	5-yr goal: \$25M
Number of projects funded with private sector partners		Y1 Annual Report: 0 Y1 ACTUAL: 0	Y2 Annual Report: 0 Since Y2 Annual Report: no change	Continue toward goal	Continue toward goal	5-yr goal: 12
Number of graduate students trained (some may be counted in multiple years)		Y1 Annual Report: 30 Y1 ACTUAL: 56 (3 are STTAR interns)	Y2 Annual Report: 76 (48 are students not counted in Y1 report [3 of 48 are STTAR interns]) Since Y2 Annual Report: 4 new graduate students	Continue toward goal	Continue toward goal	5-yr goal: 140
Number of conference presentations by graduate students (oral and poster)		Y1 Annual Report: 7 Y1 ACTUAL: 49	Y2 Annual Report: 9 Since Y2 Annual Report: 40	Continue toward goal	Continue toward goal	5-yr goal: 120

Color Key:
Behind Schedule
On Track / In-Progress
Ahead of Schedule / Complete
N/A or Not yet started

Center for Cellular Biointerfaces in
Science and Engineering (CCBSE)
Overall

	Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025
Number of undergraduate students trained (some may be counted in multiple years)	Y1 Annual Report: 20 Y1 ACTUAL: 64 (5 are dREU, 20 are STTAR interns)	Y2 Annual Report: 77 (57 are students not counted in Y1 report [20 of the 57 are STTAR interns]) Since Y2 Annual Report: 2 new undergraduate students	Continue toward goal	Continue toward goal	5-yr goal: 70
Number of conference presentations by undergraduate students (oral and poster)	Y1 Annual Report: 0 Y1 ACTUAL: 10	Y2 Annual Report: 0 Since Y2 Annual Report: 5	Continue toward goal	Continue toward goal	5-yr goal: 80
Seed Funding: seed funding support of \$60,000 in Translational Research Initiative Project and an additional \$101,655 in other research opportunity support – 5-year total is cumulative <i>[approved by NSF]</i>	Y1 Annual Report: Emerging Areas/Seed Award Request for Proposals has been issued and 4 proposals awarded totaling \$103,568 Y1 ACTUAL: No change	Y2 Annual Report: Emerging Areas/Seed Award Request for Proposals have been issued and 5 new proposals awarded totaling \$175,162.80 and additional funds totaling \$85,508 provided to Y1 awardees, for a total of \$260,670.80 Since Y2 Annual Report: no change	Continue toward goal	Continue toward goal	5-yr goal: 161655
Number of CCBSE research participant meetings (to be scheduled monthly)	Y1 Annual Report: 5 Y1 ACTUAL: 10	Y2 Annual Report: 7 Since Y2 Annual Report: 2 more meetings	Continue toward goal	Continue toward goal	5-yr goal: 50-60

Ongoing Metric Tracking for ND EPSCoR NSF RII Track-1: New Discoveries in the Advanced Interface of Computation, Engineering and Science (ND-ACES)

4/30/2022

PROSPER Element: Education and Workforce Development	Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
<p>Objective 4.1a: Retain/ advance CCBSE's early career faculty and graduate students (Activity 1: Early Career Faculty Mentoring Program) [Change approved by NSF 3/9/21]</p>	<p>ECFs retained. ECF PD plans developed and implemented; Set baselines. Monthly Pillar meetings held between CCBSE research leads and faculty as a means of providing mentoring and guidance to ECF faculty. Information gathered from ECF about their mentorship and professional development needs and implemented; set baselines Y1 Annual Report: Developing a mitigation plan that will take baselines set by ECF faculty to identify mentor training materials and/or programs Y1 ACTUAL: Monthly pillar meetings held. Information gathered about ECF professional development needs and mentoring experiences. Baselines set for sense of belonging, work-self-efficacy, professional/ technical transferable skills, turnover intentions, and scholarly productivity</p>	<p>ECFs retained. 1 new faculty member hired at NDSU and 1 new faculty member hired at UND. Meet/ exceed baselines. Monthly Pillar meetings held between CCBSE research leads and faculty. Minimum of two EWD Personnel trained and prepared to facilitate training for all ND-ACES CCBSE faculty in mentorship best practices (Summer- Fall 2021). Train all ND-ACES CCBSE Faculty in mentorship best practices (Fall 2021). 1:1 Mentor-Mentee meetings held a minimum of 4 times between 1/1/2022 and 6/30/2022. ECF PD plans created and implemented Y2 Annual Report: New Faculty hired at UND. Two EWD Personnel trained and prepared to facilitate mentor training for CCBSE personnel. Four Mentor Training modules delivered in Fall 2021. Remaining modules will be delivered in Spring 2022. Due to scheduling issues as a result of increased workload issues related to COVID and other external factors, Mentor Training was not fully completed in Fall 2021 ultimately pushing back deadlines for mentor-mentee activities and survey follow-up Since Y2 Annual Report: No change</p>	<p>Mentor-mentee meetings 6 out of 9 academic year months. ECFs and new hires retained. ECF PD plans refined and implemented. Meet/exceed baselines. Monthly Pillar meetings held between CCBSE research leads and faculty</p>	<p>Mentor-mentee meetings 6 out of 9 academic year months held TO MentorMentee pairings will check in electronically on at least a monthly basis and will meet 1:1 at least 4 times over the calendar year. ECFs and new hires retained. ECF PD plans refined and implemented. Meet/exceed baselines. Monthly Pillar meetings held between CCBSE research leads and faculty</p>	<p>Mentor-mentee meetings 6 out of 9 academic year months held TO MentorMentee pairings will check in electronically on at least a monthly basis and will meet 1:1 at least 4 times over the calendar year. ECFs and new hires retained. ECF PD plans refined and implemented. Meet/exceed baselines. Monthly Pillar meetings held between CCBSE research leads and faculty.</p>	<p>Lead: R. Navarro, S. Sletten</p>
<p>Objective 4.1a: (Activity 2: Early Career Faculty Professional Development Activities)</p>	<p>Develop list of ECF professional development activities available and disseminated to ECFs (alternatively develop and implement 2 PD activities); track engagement with PD activities with goal that at least 70% of ECF participate Y1 Annual Report: On track Y1 ACTUAL: List of ECF PD activities developed and information about these activities disseminated to ECF via email. Need to develop a more effective process of tracking participation in said activities.</p>	<p>Develop list of ECF professional development activities available and disseminated to ECFs (alternatively develop and implement 3 PD activities); track engagement with PD activities with goal that at least 70% of ECF participate Y2 Annual Report: Continue to develop list of professional development activities and disseminate information about said activities. Developing PD outreach presentations, infographics, etc. based on baseline survey where information about ECFs PD needs was gathered. Develop tracking mechanism for this activity Since Y2 Annual Report: No change</p>	<p>Develop list of ECF professional development activities available and disseminated to ECFs (alternatively develop and implement 3 PD activities); track engagement with PD activities with goal that at least 70% of ECF participate</p>	<p>Develop list of ECF professional development activities available and disseminated to ECFs (alternatively develop and implement 3 PD activities); track engagement with PD activities with goal that at least 70% of ECF participate</p>	<p>Develop list of ECF professional development activities available and disseminated to ECFs (alternatively develop and implement 2 PD activities); track engagement with PD activities with goal that at least 70% of ECF participate</p>	<p>Lead: R. Navarro, S. Sletten</p>
<p>Objective 4.1a: (Activity 3: Student Research Training Groups (RTG))</p>	<p>10 mentor/mentee pairs will be established; mentor/ mentee pairs will meet monthly; and mentee individual development plan created Y1 Annual Report: On track Y1 ACTUAL: 0 mentor/mentee pairs were established, student list was generated</p>	<p>10 mentor/ mentee pairs will be maintained or established; mentor/mentee pairs will meet monthly; mentee individual development plan created Y2 Annual Report: 14 mentor/ mentee groups were established for 2021-22. Mentor Memo-a monthly mentoring newsletter is sent out each month to encourage monthly conversations between mentors and mentees Since Y2 Annual Report: No change</p>	<p>10 mentor/ mentee pairs will be maintained or established; mentor/ mentee pairs will meet monthly; transition from mentee to mentor for graduate students progressing; mentee individual development plan created.</p>	<p>10 mentor/ mentee pairs will be maintained or established; mentor/ mentee pairs will meet monthly; transition from mentee to mentor for graduate students progressing; mentee individual development plan created</p>	<p>10 mentor/ mentee pairs will be maintained or established; mentor/ mentee pairs will meet monthly; transition from mentee to mentor for graduate students progressing; mentee individual development plan created</p>	<p>Lead: S. Sletten, R. Navarro</p>

PROSPER Element: Education and Workforce Development		Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
Color Key:	Objective 4.1a: (Activity 3 - cont.)	50% of RTG students present work at one regional/national meeting Y1 Annual Report: On track Y1 ACTUAL: 39% of the 66 RTG students presented their work and 5 of those published (3 of them are a RTG student).	80% of students present work at one regional/national meeting; 75% of students publish (first author) paper prior to graduation Y2 Annual Report: so far, 8% of 100 RTG students presented their work and the ND EPSCoR conference is being held 4/6/22 where students are expected to present; 5 ACES students are listed first on a publication (3 of them are a RTG student). Since Y2 Annual Report: No Change	80% of students present work at one regional/national meeting; 75% of students publish (first author) paper prior to graduation	80% of students present work at one regional/national meeting; 75% of students publish (first author) paper prior to graduation	80% of students present work at one regional/national meeting; 75% of students publish (first author) paper prior to graduation	
	Objective 4.1a: (Activity 3: - cont)	Set baselines Y1 Annual Report: On track Y1 ACTUAL: Baselines were set for professional/ technical skills, self efficacy, persistence/ intention, and sense of belonging	Meet/exceed baselines Y2 Annual Report: Survey is being prepared and will be sent out in January 2022 Since Y2 Annual Report: No change	Meet/exceed baselines	Meet/exceed baselines	Meet/exceed baselines	
Behind Schedule	Objective 4.1a: (Activity 4a: Graduate Student Cyber infrastructure)	30% of the total participants are trained Y1 Annual Report: On track Y1 ACTUAL: 46/163 (28.2%) [Change approved by NSF 8/27/21]	80% response from CCBSE researchers and graduate students to the CI Needs Survey Y2 Annual Report: Survey has been developed and was approved by the PROSPER members. The survey was released on 2/17/22. Survey has been sent to all CCBSE researchers and graduate students. Since Y2 Annual Report: No change	2 (1 from CCAST and 1 from CRC) new or customized CI workshops developed; Both workshops offered once during Y3; 10% of CCBSE researchers and graduate students participate in the Y3 workshop or other CI training programs	2 (1 from CCAST and 1 from CRC) new or customized CI workshops developed; Both workshops offered once during Y4; 10% of CCBSE researchers and graduate students participate in the Y4 workshop or other CI training programs	2 (1 from CCAST and 1 from CRC) new or customized CI workshops developed; Both workshops offered once during Y5; 10% of CCBSE researchers and graduate students participate in the Y5 workshop or other CI training programs	Lead: A. Bergstrom , K. Hoang [Approved by NSF 2/18/21], J. Ostrom-Blonigen [Approved by NSF 8/27/21]
On Track / In-Progress	Objective 4.1a: (Activity 4a: Graduate Student Cyber infrastructure)	2 CI assistantships awarded Y1 Annual Report: 2 awarded Y1 ACTUAL: 2 awarded (one awarded at NDSU [has since graduated] and one at UND [remains working on the project under the UND CRC])	2 CI GRAs hired Y2 Annual Report: 2 additional awarded (one awarded at NDSU and one at UND; trainings ongoing for Y2) Since Y2 Annual Report: No change	2 CI GRAs hired.	2 CI GRAs hired.	2 CI GRAs hired	
Ahead of Schedule / Complete	Objective 4.1a (Activity 4b: STEM Teaching Assistantship)	<i>THIS PROGRAM HAS BEEN MOVED TO Y2 DUE TO COVID-19</i>	Explore virtual options for doctoral student assistants and reallocate unused funding to additional TCU/PUI/MCU faculty time Y2 Annual Report: TCU/PUI/MCU faculty to request additional summer salary Since Y2 Annual Report: No change	1-2 GTAs hired Incorporate virtual options into the program Continued	1-2 GTAs hired Continued Continued	1-2 GTAs hired Continued Continued	Lead: J. Ostrom-Blonigen [Approved by NSF 8/27/21], A. Allard, M. Bobylev, C. Combs, M. Fries [Approved by NSF 8/27/21], N. Galt, K. Hartman, K. Hossain, K. Katti, M. Parker, S. Sletten, H. van Gijssel, B. Voels
N/A or Not yet started	Objective 4.1a: (Activity 5: % of participants in Activities 1-4b presenting at a workshop or conference)		95% of participants presenting Y2 Annual Report: 29.3% of participants presented since 7/1/2020 (44 of 150) Since Y2 Annual Report: No change	95% of participants presenting	95% of participants presenting	95% of participants presenting	
	Objective 4.1b: Engage/ develop K-16 student interest in biosciences (Activity 1: Distributed Research Experience for Undergraduates (dREU))	6 dREU students complete research, and present at the state conference and undergraduate research showcase. Y1 Annual Report: 6 students Y1 ACTUAL: 7 students, of which 5 presented at the ND EPSCoR state conference 2021	12 dREU students complete research and present at the state conference and undergraduate research showcase Y2 Annual Report: 1 new student, 3 still active from Y1. 1 of 4 scheduled to present at the ND EPSCoR state conference 2022; 2 other dREU students are co-researchers on other student presentations Since Y2 Annual Report: 1 new dREU presentation and 2 co-presenters at 2022 ND EPSCoR conference	12 dREU students complete research, and present at the state conference and undergraduate research showcase	12 dREU students complete research, and present at the state conference and undergraduate research showcase	6 dREU students complete research, and present at the state conference and undergraduate research showcase; 50% of REU students matriculate to graduate/ professional school; 8 REU students in graduate/ professional school	Leads: S. J. Ostrom-Blonigen [Approved by NSF 8/27/21], S. Sletten

PROSPER Element: Education and Workforce Development	Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
Objective 4.1b: (Activity 2: Engage grade 6-12 students in NATURE/Sunday Academy)	Baseline was set at 350 students per year Y1 Annual Report: 117 TCU camp students Y1 ACTUAL: 117 TCU students; 3 Bridge Camp students; 298 Sunday Academy participants for 2020/2021	Meet/exceed baselines Y2 Annual Report: 91 Sunday Academy students 2021/2022 as of 1/31/22 * TCU and Bridge camps will be held June/July 2022 Since Y2 Annual Report: Additional 87 Sunday Academy students since 1/31/22	Meet/exceed prior year's numbers	Meet/exceed prior year's numbers	Meet/exceed prior year's numbers	Leads: R. Navarro , J. Ostrom-Blonigen [Approved by NSF 8/27/21]
Objective 4.1b: (Activity 3: Training of Rural and tribal K-12 teachers in the use of PROSPER bioscience modules)	Module 1 developed Y1 Annual Report: On track Y1 ACTUAL: Developed 1 Module	Baselines number of teachers reached set via Module 1. Module 2 developed Y2 Annual Report: Two cellular modules were finalized in Fall 2021, training events for both modules are being planned for Spring 2022 Since Y2 Annual Report: No Change	Meet/exceed prior year's training numbers via Lesson plan 1 and 2	Meet/exceed prior year's training numbers	100 total teachers trained over 5-year period	Leads: R. Summers , J. Ostrom-Blonigen [Approved by NSF 8/27/21]
Objective 4.1b: (Activity 4: Pre-service STEM teachers will engage in rural/tribal student teaching experiences)		2 pre-service teachers trained each semester (Fall/Spring); 2 pre-services teachers placed each semester Y2 Annual Report: 2 student teachers placed for Fall 2021, 1 student teacher placed in Spring 2022, and 1 student teacher recruited for Fall 2022 Since Y2 Annual Report: No change	2 pre-service teachers trained each semester; 2 pre-services teachers placed each semester	2 pre-service teachers trained each semester; 2 pre-services teachers placed each semester	2 pre-service teachers trained each semester; 2 pre-services teachers placed each semester	Leads: R. Summers , J. Ostrom-Blonigen [Approved by NSF 8/27/21]

Ongoing Metric Tracking for ND EPSCoR NSF RII Track-1: New Discoveries in the Advanced Interface of Computation, Engineering and Science (ND-ACES)

4/30/2022

PROSPER Element: Broadening Participation		Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
	Objective 5.1: Increase the participation of all groups engaged in bioscience education and careers (Activity 1: TCU bioscience students will conduct outreach in their local K-12 schools via bioscience lesson plans)	Create five ND-ACES related bioscience lesson plans Y1 Annual Report: 5 high school lesson plans developed from NATURE Sunday Academy STEM activities Y1 ACTUAL: 5 high school lesson plans with 7 cultural supplements (3 Lakota and 4 Ojibwa) created from NATURE Sunday Academy informal STEM activities	5 additional ND-ACES related STEM lesson plans Y2 Annual Report: 5 middle school lesson plans with no cultural supplements created from NATURE Sunday Academy informal STEM activities. The next set of NATURE Sunday Academy informal STEM activities will be selected in June 2022 Since Y2 Annual Report: Additional lesson plans will be developed Summer 2022	5 additional ND-ACES related STEM lesson plans	5 additional ND-ACES related STEM lesson plans	25 ND-ACES related STEM lesson plans developed over 5 years	Leads: R. Burns, V. Doze
Color Key:	Objective 5.1: (Activity 1 - cont.) [Approved by NSF 2/9/22]	2 TCU students deliver the bioscience lessons to 40 students Y1 Annual Report: TCU students could not go into K-12 facilities due to the COVID pandemic Y1 ACTUAL: No change	6-12 grade STEM teachers identified for Y3 and TCU student involvement planned Y2 Annual Report: Efforts are underway to identify 6-12 grade STEM teachers for Y3 activities Since Y2 Annual Report: Working with NATURE Coordinators to identify STEM teachers for Fall	Fall 2022 and Spring 2023 TCU students identified and introduced to 6-12 grade STEM teachers	Fall 2023 and Spring 2024 TCU students identified and introduced to 6-12 grade STEM teachers	Fall 2024 and Spring 2025 TCU students identified and introduced to 6-12 STEM teachers	
	Objective 5.1: (Activity 1 - cont.)	3 NATURE students matriculating into STEM degrees (either AS or above). Y1 Annual Report: 16 matriculated Y1 ACTUAL: No change	4 NATURE students completing STEM degrees Y2 Annual Report: 8 matriculated and 3 with graduate degrees Since Y2 Annual Report: No changes - new tracking in Fall 2022	4 NATURE students completing STEM degrees	4 NATURE students completing STEM degrees	>10 NATURE students with STEM B.S and >5 NATURE students with STEM graduate/ professional degrees over 5 years	
Behind Schedule	Objective 5.1: (Activity 2: Support engagement in biosciences at the B.S. level (particularly for AI)) [Approved by NSF 2/9/22]	Plan research assistantships for juniors and seniors. Year 1 Annual Report: 2 students received assistantships Y1 ACTUAL: No change	2-3 students will have received research assistantships as juniors and seniors or post-associate assistantships Y2 Annual Report: Current RFA has been extended to post-associate assistantships Since Y2 Annual Report: 1 student identified to post-back at MISU	2-3 additional students will have received research assistantships as juniors and seniors and 1 student will have completed their B.S. degree or post-associate assistantships	2-3 additional students will have received research assistantships as juniors and seniors and 1 student will have completed their B.S. degree or post-associate assistantships	7-10 students will have received research assistantships as juniors and seniors or post-associate assistantships and 3 of those will have completed their B.S. degree over 5 years	Leads: V. Doze, NATURE Coordinators
On Track / In-Progress	Objective 5.1: (Activity 3: TCU bioscience faculty will be offered research techniques and equipment training) [Approved by NSF 2/9/22]	One TCU faculty will visit CCBSE collaborators and learn a research technique/learn a HPC technique/expand knowledge in a Pillar area Year 1 Annual Report: 1 visit by a CCCC faulty member to NDSU Y1 ACTUAL: No change, as the COVID pandemic continues to interfere with travel	Survey for TCU STEM faculty re: training preferences developed and distributed. Preferences prioritized. Collaborating institutions' faculty requested to provide training in those areas identified through the survey. One training video on identified areas will be produced and released to TCU faculty. Y2 Annual Report: Survey instrument is being developed for distribution. TCU faculty made aware that requests may be forthcoming Since Y2 Annual Report: Survey will be complete 6/15/22	Survey of TCU STEM faculty updated Preferences prioritized - continue Provide training - continue Training video - continue	Survey updated - continue Preferences prioritized - continue Provide training - continue Training video - continue, with two training videos produced and released	Five collaborative projects using the new skills over 5 years Survey updated - continue Preferences prioritized - continue Provide training - continue Training video - continue, with two training videos produced and released	Leads: R. Burns, V. Doze
Ahead of Schedule / Complete	Objective 5.1: (Activity 4: TCU camps for middle and high school kids at the four partnering TCUs)	120 participants Year 1 Annual Report: 0 participants; prior RII Track-1 INSPIRE-ND overlapped with this Track-1 and 117 participants were counted in June/July 2020 Y1 ACTUAL: 126 participants June/July 2021	140 participants Y2 Annual Report: TCU camps will be held June/July 2022; planning is underway for the TCU camps Since Y2 Annual Report: Planning will occur June 6-17	140 participants	140 participants	680 participants over 5 years	Leads: V. Doze, NATURE coordinators
N/A or Not yet started							

PROSPER Element: Broadening Participation	Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
Objective 5.1: (Activity 5: Sunday Academies for middle and high school kids at the four partnering TCUs)	350 participants Y1 Annual Report: 0 participants (due to COVID pandemic, prior RII Track-1 was overlapped and 429 students were counted under INSPIRE-ND) Y1 ACTUAL: 298 Virtual Sunday Academy participants for 2020/2021	350 participants Y2 Annual Report: 91 Sunday Academy students 2021/2022 as of 1/31/22 (Note: 9 Sunday Academy events postponed due to weather or COVID parameters) Since Y2 Annual Report: Additional 87 Sunday Academy students since 1/31/22	350 participants	350 participants	1,750 participants over 5 years	Leads: R. Burns, V. Doze, NATURE coordinators
Objective 5.1: (Activity 6: Bridge camps for graduating high school seniors at the four partnering TCUs)	10 participants Y1 Annual Report: Camp runs July 2020 Y1 ACTUAL: 0 participants in 2020. 3 participants in July 2021 due to the COVID pandemic; only 2 of 4 TCUs participated	15 participants Y2 Annual Report: Camp will be held June/June 2022 – planning is underway Since Y2 Annual Report: Planning will occur June 6-17	15 participants	15 participants	55 participants over 5 years	Leads: R. Burns, V. Doze, NATURE coordinators
Objective 5.1: (Activity 7: University Summer Camp for participants)	20 participants Y1 Annual Report: Camp runs June 2021 Y1 ACTUAL: 14 participants in June 2021 virtual camp	20 participants Y2 Annual Report: Camp runs June 2022 Since Y2 Annual Report: Face-to-face camp runs June 6-17	20 participants	20 participants	A total of 100 participants over 5 years	Leads: R. Burns, V. Doze, NATURE coordinators

Ongoing Metric Tracking for ND EPSCoR NSF RII Track-1: New Discoveries in the Advanced Interface of Computation, Engineering and Science (ND-ACES)

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PROSPER Element: Partnerships and Collaborations		Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
	Objective 6.1a: Expand the intellectual reach of the CCBSE by building stronger collaborations with other academic institutions and federal labs (Activity 1: Determine and build upon the baseline)	Baseline established by senior personnel Y1 Annual Report: 29 collaborations with 24 academic institutions identified. 23 domestic and 1 international Y1 ACTUAL: No change	20% increase in meaningful collaborations over prior year Y2 Annual Report: 45 collaborations with 50 academic institutions identified. 49 domestic and 1 international Since Y2 Annual Report: No change	20% increase in meaningful collaborations over prior year	20% increase in meaningful collaborations over prior year	20% increase in meaningful collaborations over prior year	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen
Color Key:	Objective 6.1a: (Activity 2: Support participant interactions with external collaborators with travel funding) <i>[Approved by NSF 2/9/22]</i>			1-3 trips to external collaborators and 1-3 external collaborators coming to campuses	Continued with 2- 6 total visits	Continued with 2- 6 total visits	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen
	Behind Schedule	Objective 6.1a: (Activity 3: Support interactions with external collaborators)		Fund at least one seed award between CCBSE and an external collaborator	Continue to fund one seed award per year	Continued	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen
On Track / In-Progress	Objective 6.1b: Create pathways for translating research results into commercially viable end products (Activity 1: Determine and build upon the baseline for partnerships)	Baseline established using CDAs, MTAs, other efforts (grant applications, etc.) Y1 Annual Report: 5 instate partnerships with 2 organizations Y1 ACTUAL: No change	Increase in partnership engagement or partner activities over baseline Y2 Annual Report: 6 instate partnerships with 3 organizations Since Y2 Annual Report: No change	Increase in partnership engagement or partner activities over the prior year - measured by the increased provision of valuable resources	Increase in partnership engagement or partner activities over the prior year - measured by the increased provision of valuable resources	Increase in partnership engagement or partner activities over the prior year - measured by the increased provision of valuable resources	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen, identified subject matter experts at NDSU and UND
Ahead of Schedule / Complete	Objective 6.1b: (Activity 2: Support Partnerships)	Y1 Annual Report: Identification of Y2 support efforts based on baseline data and determination of measures [# participants (if event), # of inquiries following communication effort, etc.] Y1 ACTUAL: Provision for 3 informational workshops in Y2	Increased engagement by meeting of prior year's identified support efforts Y2 Annual Report: 3 workshops and 1 conference panel addressing prior year's support needs (initiating interactions with industry) were held and made the decision of use I-Corps for next year's workshops Since Y2 Annual Report: Working to schedule another meeting with subject matter experts at UND and NDSU	Increased engagement by meeting of prior year's identified support efforts	Increased engagement by meeting of prior year's identified support efforts	Increased engagement by meeting of prior year's identified support efforts	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen, identified subject matter experts at NDSU and UND
N/A or Not yet started	Objective 6.1b: (Activity 3: Identify ND companies using tools like NAICS) <i>[Approved by NSF 2/9/22]</i>		Following the April 2022 EAB meeting, together with CCBSE and Pillar leads, begin to develop a CCBSE prospectus for cultivating partnerships and exploring potential funding possibilities Y2 Annual Report: The team will work with UND Center for Innovation to provide I-Corp Hub training (tools/resources/activities) to participants Since Y2 Annual Report: No change	Finalize a CCBSE prospectus	Update CCBSE prospectus	Continued	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen, identified subject matter experts at NDSU and UND
	Objective 6.1b: (Activity 4: Identify partnership opportunities)		Begin to identify 3-5 opportunities, and determine 1-3 of which are actionable by CCBSE leads Y2 Annual Report: The team has limited experience with industry engagement; thus will be well served in Y3 with the NSF I-Corps training platforms Since Y2 Annual Report: No change	Identify 3-5 opportunities, 1-3 of which are actionable	Identify 3-5 opportunities, 1-3 of which are actionable	Identify 3-5 opportunities, 1-3 of which are actionable	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen, identified subject matter experts at NDSU and UND

PROSPER Element: Partnerships and Collaborations	Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
Objective 6.1b: (Activity 5: Identify IP protocols at all 10 institutions)	Work with campuses to identify IP protocols with >50% protocols identified Y1 Annual Report: Protocols identified at 2 RUs, 1 MCU, and 3 PUIs – all ND University System campuses: 6 of 10 = 60% Y1 ACTUAL: No change	100% protocols identified; Collaborative decision made regarding the handling joint IP and updated protocol document Y2 Annual Report: 4 of 4 TCUs surveyed. There are currently no IP protocols in place at the TCUs for invention IP. 2 TCUs (SBC and TMCC) are now working to develop these protocols Since Y2 Annual Report: No change	Up to date protocol document and joint IP agreement	Up to date protocol document and joint IP agreement	Up to date protocol document and joint IP agreement	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen, identified subject matter experts at NDSU and UND
Objective 6.1b: (Activity 6: Understand how tribal laws impact IP disclosures)	Work with TCU campuses located in ND to identify impacts with 50% identified Y1 Annual Report: 0 identified. The COVID pandemic prevented travel and TCU personnel were busy with the change to online delivery Y1 ACTUAL: No change	Work with campuses to identify commercialization protocols with 100% protocol identified Y2 Annual Report: 4 of 4 TCUs identified (100%). There are currently no IP protocols in place at the TCUs for invention IP. 2 TCUs (SBC and TMCC) are now working to develop these protocols, which include tribal law Since Y2 Annual Report: No change	Survey developed and released	Survey results compiled	Results published	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen, identified subject matter experts at NDSU and UND
Objective 6.1b: (Activity 7: Identify commercialization protocols at all 10 participating institutions) <i>[Change approved by NSF 2/9/22]</i>	Work with campuses to identify commercialization protocols with >50% protocols identified Y1 Annual Report: Commercialization protocols identified at 2 RUs, 1 MCU, and 3 PUIs, which equates to 6 of 10 participating institutions (60%) Y1 ACTUAL: No Change Enroll participants in SHARPhub with 25% of CCBSE participants enrolled Y1 Annual Report: Five of 27 CCBSE researchers enrolled in SHARPhub = 19% Y1 ACTUAL: No change	Work with campuses to identify commercialization protocols with 100% protocol identified Y2 Annual Report: There are currently no commercialization protocols in place at the TCUs. 2 TCUs (SBC and TMCC) are now working to develop these protocols Since Y2 Annual Report: No change Continue to encourage CCBSE participants to enroll or take part in SHARPhub activities, work with campuses to identify commercialization protocols and enroll participants in SHARPhub and in Spring 2022, meet with the ND SHARPhub coordinator to determine next steps Y2 Annual Report: Five of 28 CCBSE researchers enrolled in SHARPhub = 18%. Met with SHARPhub coordinator and learned that an I-Corps Hub will replace SHARPhub. As a result, the team has begun to examine the I-Corps training modules and will work with the CCBSE and Pillar Leads following the April EAB meeting to initiate next steps Since Y2 Annual Report: Submitted a mitigation plan to NSF to change SHARPhub to I-Corps	Updated protocol document and assistance with IP disclosures with 1 invention disclosure Continue to encourage CCBSE participants to enroll in SHARPhub activities	Updated protocol document, 3+ invention disclosures, and 2+ provisional patents Continued	Updated protocol document, 3+ invention disclosures, 2+ provisional patents, and 2+ patents Continued	Lead: K. Rusch , Co-leads: J. Mihelich, J. Ostrom-Blonigen, identified subject matter experts at NDSU and UND

PROSPER Element: Partnerships and Collaborations	Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties
<p>Objective 6.1b: (Activity 8: Identify workshops / conferences to attend and mentoring opportunities (SHARPhub, USPTO Denver, SBIR, etc.)</p>	<p>Identify initial workshops related to typical processes for participants to discuss IP. Hold 1+ workshop or conference attended by >40% CCBSE participants Y1 Annual Report: Delayed due to COVID pandemic Y1 ACTUAL: 3 planned workshops</p>	<p>Continue to identify workshops related to typical processes for participants to discuss IP. Hold 1+ workshop or conference attended by >60% CCBSE participants Y2 Annual Report: Held 3 workshops and one conference panel session. Another panel session will be held at the April 2022 conference Since Y2 Annual Report: No change</p>	<p>1+ workshop or conference attended by >75% CCBSE participants</p>	<p>1+ workshop or conference attended by 75%+ CCBSE participants and 1 CCBSE workshop or conference attended by 80% CCBSE participants</p>	<p>1+ workshop or conference attended by 85%+ CCBSE participants and 1 CCBSE workshop or conference attended by 80% CCBSE participants</p>	<p>Possible partners (ND entities): Bismarck-Mandan Development Assoc., Campus Career Centers, Innovate ND, Jamestown/Stutsman Development Corp., Minot Economic Development Corp., NDSU EDA Makerspace (Brian Kalk), NDSU Ozbun Entrepreneurship Center (Kodee Furst), NHSC Applied Engineering Center (Ann Vallie), UND Center for Innovation</p>
<p>Objective 6.1b: (Activity 9: Based on other activities, determine potential funding possibilities with other SHARPhub EPSCoR states [KS, NE, OK, SD]) [Approved by NSF 2/9/22]</p>		<p>After Spring 2022 meeting with the SHARPhub coordinator and April 2022 EAB meeting, together with CCBSE and Pillar leads and the ND SHARPhub coordinator explore potential conversations with other EPSCoR states participating in SHARPhub Y2 Annual Report: Met with SHARPhub/now I-Corps Hub facilitator to explore changes ahead of meeting with CCBSE and Pillar leads Since Y2 Annual Report: Submitted a mitigation plan to NSF to change SHARPhub to I-Corps and to remove specific EPSCoR states</p>	<p>List of action items for 5 states</p>	<p>States continue to be engaged</p>	<p>1-3 sustainable goals for at least 3 of the 5 states</p>	<p>Possible partners: EPSCoR offices in KS, NE, OK, and SD)</p>

Ongoing Metric Tracking for ND EPSCoR NSF RII Track-1: New Discoveries in the Advanced Interface of Computation, Engineering and Science (ND-ACES)

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PROSPER Element: Communication and Dissemination		Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025	Responsible parties	
<div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Color Key:</div> <div style="background-color: #f08080; padding: 5px; margin-bottom: 5px;">Behind Schedule</div> <div style="background-color: #ffff00; padding: 5px; margin-bottom: 5px;">On Track / In-Progress</div> <div style="background-color: #90ee90; padding: 5px; margin-bottom: 5px;">Ahead of Schedule / Complete</div> <div style="background-color: #e0e0e0; padding: 5px;">N/A or Not yet started</div>	Objective 7.1a: Provide clear communication between all participants (Activity 1: Facilitate communication through regular meetings)	Meeting attendance Y1 Annual Report: Monthly Pillar, CCBSE and Management/Leadership meetings. Bimonthly PROSPER meetings Y1 ACTUAL: No change	Meeting attendance Y2 Annual Report: Monthly Pillar, CCBSE and Management meetings; bi-monthly PROSPER meetings Since Y2 Annual Report: No change	Meeting attendance	Meeting attendance	Meeting attendance	Leads: Z. Majdik, C. Shovkoplyas	
	Objective 7.1a: (Activity 2: Facilitate communication across the by providing updates)	At least monthly outreach to participants, stakeholders, and citizens Y1 Annual Report: 7 newsletters (July 2020-January 2021) Y1 ACTUAL: 12 newsletters	At least monthly outreach to participants, stakeholders, and citizens Y2 Annual Report: 7 newsletters (July 2021-January 2022) Since Y2 Annual Report: 3 more newsletters published	At least monthly outreach to participants, stakeholders, and citizens	At least monthly outreach to participants, stakeholders, and citizens	At least monthly outreach to participants, stakeholders, and citizens	At least monthly outreach to participants, stakeholders, and citizens	Leads: Z. Majdik, C. Shovkoplyas
	Objective 7.1a: (Activity 3: Facilitate communication by providing internal communication training)	Training offered at least quarterly Y1 Annual Report: On track Y1 ACTUAL: 6 training sessions	Training offered at least quarterly Y2 Annual Report: 4 training sessions Since Y2 Annual Report: No change	Training offered at least quarterly	Training offered at least quarterly	Training offered at least quarterly	Training offered at least quarterly	Leads: Z. Majdik, C. Shovkoplyas
	Objective 7.1b: Inform and educate stakeholders (Activity 1: Populate website and social media with relevant public-facing content)	Same metric framework for all: Baseline established of interaction (engagement rate) Y1 Annual Report: On track Y1 ACTUAL: baseline established	≥5% Increase in number of interactions per day divided by followers Y2 Annual Report: N/A until end of Y2 Since Y2 Annual Report: No change	≥5% Increase in number of interactions per day divided by followers.	Maintain engagement over the prior year. Maintain number of interactions per day divided by followers	Maintain engagement over the prior year. Maintain number of interactions per day divided by followers.	Maintain engagement over the prior year. Maintain number of interactions per day divided by followers.	Leads: Z. Majdik, C. Shovkoplyas
	Objective 7.1b: (Activity 2: Assist team members from CCBSE and PROSPER with creating public-facing communication products)	<i>Needs research products; sessions begin in Y2</i>	5 sessions per year completed Y2 Annual Report: weekly drop-in training opportunities offered during Fall '21/Spring '22 Since Y2 Annual Report: No change	5 sessions per year completed	5 sessions per year completed	5 sessions per year completed	5 sessions per year completed	Leads: Z. Majdik, C. Shovkoplyas
	Objective 7.1b: (Activity 3: Disseminate project milestones and talking points to stakeholders and decision makers in the state)	2+ press releases Y1 Annual Report: On track Y1 ACTUAL: 3 press releases	4+ press releases; Updating stakeholders on project milestones (quarterly) Y2 Annual Report: 2 press releases Since Y2 Annual Report: No change	4+ press releases; Updating stakeholders on project milestones (quarterly)	4+ press releases; Updating stakeholders on project milestones (quarterly)	20 press releases over the 5-year period. Updating stakeholders on project milestones (quarterly)	20 press releases over the 5-year period. Updating stakeholders on project milestones (quarterly)	Leads: Z. Majdik, C. Shovkoplyas
	Objective 7.1c: Contribute to a scientifically informed citizenry (Activity 1: Offer workshop opportunities for faculty and graduate students)	<i>2 workshops planned annually. Workshops begin Y2</i>	40+% attendance by ND-ACES participants Y2 Annual Report: poster design workshop planned mid-Spring '22; Alda Center workshop already completed; data for attendance % n/a until workshops are completed Since Y2 Annual Report: No change. Will begin working with new Communication Lead 5/16/22	55+% attendance by ND-ACES participants	75+% attendance by ND-ACES participants	90% of ND-ACES participants will have attended at least 1 workshop over the 5-year period	90% of ND-ACES participants will have attended at least 1 workshop over the 5-year period	Leads: Z. Majdik, C. Shovkoplyas
	Objective 7.1c: (Activity 2: Include public engagement opportunities as part of the annual conference)	Annual conference with attendees from each of the participating campuses. Y1 Annual Report: Conference is April 2021 Y1 ACTUAL: 1 annual conference, 10 of 10 participating institutions	2022 Annual conference with attendees from each of the participating campuses Y2 Annual Report: Conference is April 2022 Since Y2 Annual Report: 1 annual conference	2023 Annual conference with attendees from each of the participating campuses.	2024 Annual conference with attendees from each of the participating campuses	2025 Annual conference with attendees from each of the participating campuses.	2025 Annual conference with attendees from each of the participating campuses.	Leads: Z. Majdik, C. Shovkoplyas
	Objective 7.1c: (Activity 3: Ensure that we have a diverse representation of science and scientists on website, to help engage all publics)		Scoring by external evaluation firm's diversity rubric Y2 Annual Report: discussed with The Mark in Y1/planned for Y2 Since Y2 Annual Report: Analyzing The Mark's report		Scoring by external evaluation firm's diversity rubric			Leads: Z. Majdik, C. Shovkoplyas

<p>PROSPER Element: Communication and Dissemination</p>	<p>Year 1 July 1, 2020-June 30, 2021</p>	<p>Year 2 July 1, 2021-June 30, 2022</p>	<p>Year 3 July 1, 2022-June 30, 2023</p>	<p>Year 4 July 1, 2023-June 30, 2024</p>	<p>Year 5 July 1, 2024-June 30, 2025</p>	<p>Responsible parties</p>
<p>Objective 7.1c: (Activity 4: Engage with local publics about the value and the benefits of the science)</p>	<p>Science cafés planned annually. Science cafés begin Y2 Y1 Annual Report: On track Y1 ACTUAL: Although planned for Y2, 1 science café was held</p>	<p>1-2 Science cafes supported Y2 Annual Report: planned, 1-2 in Fall '21 pending faculty availability 1 café held 10/26/2021 Since Y2 Annual Report: No change</p>	<p>2 Science cafés supported</p>	<p>2-3 Science cafés supported</p>	<p>2-3 Science cafés supported</p>	<p>Leads: Z. Majdik, C. Shovkoplyas</p>

Ongoing Metric Tracking for ND EPSCoR NSF RII Track-1: New Discoveries in the Advanced Interface of Computation, Engineering and Science (ND-ACES)

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PROSPER Overall Milestone Metrics		Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025
<p>Color Key:</p> <p>Behind Schedule</p> <p>On Track / In-Progress</p> <p>Ahead of Schedule / Complete</p> <p>N/A or Not yet started</p>	Meet annually with TCU presidents to report on the impacts of the collaboration efforts between CCBSE, PROSPER, and the TCUs. Report also on the numbers of American Indian students who are involved in ND-ACES programming	4 meetings/ year, one with each TCU president Y1 Annual Report: Not reported Y1 ACTUAL: Due to the COVID pandemic, these meetings were changed to a virtual format. Met with 4 TCU presidents during Summer/Fall 2020	4 meetings, one with each TCU president Y2 Annual Report: Due to the COVID pandemic, one of these meetings was changed to a virtual format. Met with 4 of 4 TCU presidents during Summer/Fall 2021 Since Y2 Annual Report: No change	Projected: 4 meetings, one with each TCU president	Projected: 4 meetings, one with each TCU president	Projected: 4 meetings, one with each TCU president 5-YEAR TOTAL: 20 total meetings across the 5-year project Total to date: 7 meetings
	Meet annually with MCU and PUI presidents to report on the impacts of the collaboration efforts between CCBSE, PROSPER and those campuses. Report also on the numbers of their students who are taking advantage of the programming	4 meeting/year, one with each MCU and PUI president Y1 Annual Report: Not reported Y1 ACTUAL: Due to the COVID pandemic, these meetings were changed to a virtual format. Met with PUI president during Summer/Fall 2020	4 meetings - one with each MCU and PUI president Y2 Annual Report: Met in-person with 2 PUI presidents in July 2021 Since Y2 Annual Report: No change	Projected: 4 meetings - one with each MCU and PUI president	Projected: 4 meetings - one with each MCU and PUI president	Projected: 4 meetings - one with each MCU and PUI president 5-YEAR TOTAL: 20 total meetings across the 5-year project. Total to date: 3 meetings
	Number of TCU visits (some of these visits will be virtual due to COVID-19)	4 visits - one visit at each TCU Y1 Annual Report: Not reported Y1 ACTUAL: Due to the COVID pandemic, these meetings were changed to a virtual format. Met with 4 of 4 TCUs during Summer/Fall 2020	4 visits - one visit at each TCU Y2 Annual Report: Due to the COVID pandemic, one of these meetings was changed to a virtual format. Met with 4 of 4 TCUs during Summer/Fall 2021 Since Y2 Annual Report: All four TCUs were visited in Spring 2022 associated with NATURE Sunday Academy activities	Projected: 4 - one visit at each TCU	Projected: 4 - one visit at each TCU	Projected: 4 - one visit at each TCU 5-YEAR TOTAL: 20 total meetings across the 5-year project Total to date: 7 meetings
	Number of MCU and PUI visits (some of these visits will be virtual due to COVID-19)	4 visits, one visit at each MCU and PUI Y1 Annual Report: Not reported Y1 ACTUAL: Due to COVID pandemic, met virtually with 1 MCU and 3 PUIs	4 visits, one visit at each PUI and MCU Y2 Annual Report: Visits to 1 MCU and 3 PUIs. Since Y2 Annual Report: Visits scheduled to MaSU and VCSU during the first week of May	Projected: 4 one visit at each PUI and MCU	Projected: 4 one visit at each PUI and MCU	Projected: 4 one visit at each PUI and MCU 5-YEAR TOTAL: 20 total meetings across the 5-year project Total to date: 8 meetings
	Number of legislator visits	2 visits Y1 Annual Report: not reported Y1 ACTUAL: 9 visits (6 with ND legislators and 3 with congressional delegation)	2 visits Y2 Annual Report: 17 visits (14 with ND legislators and 3 with congressional delegation) Since Y2 Annual Report: No changes	Projected: 2 visits	Projected: 2 visits	Projected: 2 visits 5-YEAR TOTAL: 10 total visits across 5-year project Total to date: 9 visits
	Number of annual conferences (some of these conferences will be virtual due to COVID-19)	1 annual conference Y1 Annual Report: Not reported Y1 ACTUAL: 1 conference - April 14, 2021	1 annual conference Y2 Annual Report: Conference to be held in April 2022 Since Y2 Annual Report: Annual conference held 4/6/22 (hybrid)	Projected: 1 annual conference	Projected: 1 annual conference	Projected: 1 annual conference 5-YEAR TOTAL: 5 total conferences across 5-year project Total to date: 1 conference
	Number of External Advisory Board meetings (some of these meetings will be virtual due to COVID-19)	2 EAB meetings Y1 Annual Report: Not reported Y1 ACTUAL: 2 EAB meetings: November 6, 2020 (virtual) and April 13, 2021 (virtual)	2 EAB meetings Y2 Annual Report: 1 EAB meeting: October 22, 2021 (virtual); April 5, 2022 (hybrid) to be held Since Y2 Annual Report: EAB meeting held 4/5/22	Projected: 2 EAB meetings	Projected: 2 EAB meetings	Projected: 2 EAB meetings 5-YEAR TOTAL: 10 EAB meetings across the 5-year project Total to date: 3 EAB meetings

PROSPER Overall Milestone Metrics	Year 1 July 1, 2020-June 30, 2021	Year 2 July 1, 2021-June 30, 2022	Year 3 July 1, 2022-June 30, 2023	Year 4 July 1, 2023-June 30, 2024	Year 5 July 1, 2024-June 30, 2025
Number of ND-ACES Management meetings (to be scheduled monthly)	12 meetings per year Y1 Annual Report: Not reported Y1 ACTUAL: 11 meetings	12 meetings per year Y2 Annual Report: 7 meetings Since Y2 Annual Report: 3 more meetings held	Projected: 12 meetings	Projected: 12 meetings	Projected: 12 meetings 5-YEAR TOTAL: 60 meetings across the 5-year project Total to date: 17 meetings
Number of ND-ACES Leadership meetings (to be scheduled quarterly) <i>[Approved by NSF August 2021]</i>	4 meetings per year Y1 Annual Report: Not reported Y1 ACTUAL: 4 meetings	4 meetings per year Y2 Annual Report: 1 meeting and no longer applicable – merged with monthly Management Meeting Since Y2 Annual Report: No longer a metric			15 meetings across the 5-year project; however, this meeting was eliminated by a mitigation plan in August 2021, which combined the Leadership meeting with the Management meeting
Number of ND-ACES All-Participant meetings (to be scheduled twice annually)	2 meetings per year Y1 Annual Report: Not reported Y1 ACTUAL: 2 meetings (July 2020 and April 2021)	2 meetings per year Y2 Annual Report: 1 virtual meeting on October 8, 2021 Since Y2 Annual Report: All participants were invited to the April 5, 2022 EAB meeting	Projected: 2 meetings	Projected: 2 meetings	Projected: 2 meetings 5-YEAR TOTAL: 10 meetings across the 5-year project Total to date: 3 meetings
Number of CCBSE and PROSPER meetings (to be scheduled every other month)	12 CCBSE and 6 PROSPER meetings Y1 Annual Report: Not reported Y1 ACTUAL: 10 CCBSE and 6 PROSPER meetings	12 CCBSE and 6 PROSPER meetings Y2 Annual Report: 7 CCBSE and 7 PROSPER meetings (PROSPER joining in on CCBSE meeting each month beginning Sept. 2021) Since Y2 Annual Report: 2 more CCBSE w/ PROSPER meetings held	12 CCBSE and 6 PROSPER meetings	12 CCBSE and 6 PROSPER meetings	12 CCBSE and 6 PROSPER meetings 5-YEAR TOTAL: 25-30 meetings across the 5-year project Total to date: 17 CCBSE and 13 PROSPER meetings