

GARD-Online Exchange (OE)

Potential Team Projects

Program Objective: To foster interdisciplinary understanding and innovation in One Health and Global Innovation for Impact (integrating human, animal, food, water, and environmental health) through collaborative learning among students in biology, biosystems engineering, physics, geography, chemical engineering, and entrepreneurship.

Examples of Challenge Briefs

1. BioBoundaries: Preventing the Next Pandemic at the Human-Animal Interface

Challenge: Design a community-based early warning system for zoonotic disease spillover in regions where livestock, wildlife, and humans interact.

Suggested Team Composition

- Biology: Understand pathogen reservoirs and transmission vectors
- Geography: Map land use and spatial risk zones
- Biosystems Engineering: Integrate sensors and mobile diagnostics
- Entrepreneurship: Develop scalable service models for rural health

Tasks & Tools

- Identify key zoonotic pathogens in your target region
- Map high-risk interfaces using GIS tools (e.g., QGIS, Google Earth Engine)
- Design a prototype for biosensor or mobile alert system
- Draft a business model for community deployment (e.g., subscription, NGO partnership)

Deliverables

- Concept sketch, system diagram, or alert system with geospatial integration.
- Risk map with hotspot overlays
- 1-page pitch: “How our system prevents outbreaks before they start”

2. AquaShield: Mitigate Waterborne Diseases in Urban Slums

Challenge: Develop a portable, affordable solution to detect and mitigate waterborne pathogens in informal settlements.

Suggested Team Composition

- Biosystems Engineering: Design water treatment and contaminant detection
- Physics: Sensor design and fluid dynamics
- Biology: Microbial profiling and health risks
- Entrepreneurship: Community-led business model

Tasks & Tools

- Select key pathogens (e.g., E. coli, cholera) and detection methods
- Design a low-cost water testing kit or sensor
- Explore filtration or solar disinfection options
- Create a community engagement and training plan

Deliverables

- Prototype concept or materials list for a deployable water safety kit
- Infographic: “How our kit works”
- Outreach strategy for slum communities

3. AMRTrace: Tracing Antimicrobial Resistance in Food Systems

Challenge: Create a strategy to monitor and reduce antimicrobial resistance (AMR) in food production and supply chains.

Suggested Team Composition

- Biology: AMR mechanisms and surveillance
- Biosystems Engineering: Traceability and sensor integration
- Geography: Mapping AMR hotspots
- Entrepreneurship: Incentive models for safer practices

Tasks & Tools

- Identify AMR risks in livestock or aquaculture
- Design a traceability system (e.g., QR codes, blockchain)
- Map supply chain flows and intervention points
- Propose a reward or certification scheme for farmers

Deliverables

- AMR monitoring framework
- Supply chain map with risk nodes
- Farmer engagement toolkit
- A policy-tech hybrid solution for AMR monitoring and farmer engagement

4. AgriShield: Predict Disease Vector Expansion

Challenge: Predict the expansion of disease vectors (e.g., mosquitoes, ticks) due to global travel and trade.

Suggested Team Composition

- Geography: Climate modeling and spatial analysis

- Biology: Vector ecology and disease transmission
- Physics: Environmental modeling and sensor networks
- Entrepreneurship: Public awareness and adaptive tools

Tasks & Tools

- Select a vector (e.g., mosquitoes, ticks) and disease (e.g., dengue, Lyme)
- Use climate data to model future spread zones
- Design a community dashboard or mobile app
- Develop a public education campaign

Deliverables

- Vector risk map (current vs projected)
- App wireframe or dashboard mockup
- Awareness campaign brief
- A geospatial dashboard and community toolkit for vector-borne disease preparedness

5. Planetary Pulse: Interdisciplinary One Health Innovation Lab

Challenge: Design a virtual or mobile “One Health Lab” that enables interdisciplinary student teams to co-develop solutions across human, animal, and environmental health.

Suggested Team Composition

- All disciplines: integration of tools, data, and perspectives
- Entrepreneurship: platform design and sustainability

Tasks & Tools

- Define lab functions (e.g., diagnostics, data sharing, training)
- Choose a format: mobile van, virtual platform, hybrid
- Design modular learning and prototyping spaces
- Plan for funding, partnerships, and open access

Deliverables

- Lab blueprint or concept deck for a global student-led innovation hub
- Sample module or activity
- Sustainability and outreach plan

6. BioShield — Rapid Response to Emerging Pathogens

Challenge Summary: Design a deployable biosensor system for early detection of emerging pathogens in high-risk environments (e.g., hospitals, communities, farms, water sources).

Suggested Team Composition

- Biology: Identify target pathogens and biomarkers
- Biosystems Engineering: Design portable biosensor systems
- Physics: Optimize detection sensitivity and signal processing
- Entrepreneurship: Develop a scalable deployment and business model

Key Tasks

- Select a use case (e.g., avian flu in poultry)
- Define detection targets and environmental conditions
- Design a prototype concept (hardware + data interface)
- Map stakeholders (e.g., farmers, health workers, regulators)
- Build a sustainability and scale-up strategy

Deliverables

- System concept diagram or storyboard
- Risk-benefit matrix for deployment
- 1-page pitch: “How BioShield protects communities from the next outbreak”

7. Global Resilience Mapper

Challenge Summary: Build a geospatial tool that helps communities visualize and prepare for transboundary-related health risks.

Suggested Team Composition

- Geography: Climate and health data mapping
- Biology: Identify health impacts (e.g., vector-borne diseases, malnutrition)
- Physics: Environmental modeling and sensor integration
- Entrepreneurship: Platform design and stakeholder engagement

Key Tasks

- Choose a region and climate-health challenge (e.g., dengue in coastal cities)
- Source open climate and health datasets (e.g., NASA, WHO, local ministries)
- Design a user-friendly dashboard or mobile interface
- Identify end users (e.g., local governments, NGOs, farmers)
- Plan for data updates, training, and long-term access

Deliverables

- Wireframe or mockup of the tool
- Stakeholder map and use case scenario

- 1-page pitch: “How our tool builds health resilience”

8. CleanTech Catalyst — Waste-to-Value Innovation

Challenge Summary: Develop a circular solution that transforms agricultural or food industry waste into valuable products.

Suggested Team Composition

- Bioenergy Engineering: Process design and conversion pathways
- Biosystems Engineering: Waste stream analysis and system integration
- Biology: Microbial or enzymatic transformation
- Entrepreneurship: Market analysis and go-to-market strategy

Key Tasks

- Select a waste stream (e.g., rice husks, dairy effluent, brewery waste)
- Identify conversion pathways (e.g., compost, biochar, bioplastics)
- Design a pilot-scale process or modular unit
- Analyze environmental and economic impact
- Explore partnerships with local producers or cooperatives

Deliverables

- Process flow diagram or prototype sketch
- Circular economy impact map
- 1-page pitch: “Turning waste into wealth for people and planet”

9. AquaGuard — Smart Water Safety for Remote Communities

Challenge Summary: Create a low-cost, smart water monitoring system that detects contaminants and alerts users in real time.

Suggested Team Composition

- Environmental Engineering: Contaminant detection and filtration
- Physics: Sensor design and power optimization
- Biosystems Engineering: System integration and field deployment
- Entrepreneurship: Community engagement and distribution model

Key Tasks

- Identify key contaminants (e.g., arsenic, E. coli, nitrates)
- Design a sensor or test strip with visual or digital readout
- Explore solar or kinetic power options for remote use

- Develop a training and maintenance plan for local users
- Build a business model (e.g., pay-per-use, NGO partnership)

Deliverables

- Concept sketch or prototype storyboard
- Community training plan
- 1-page pitch: “Safe water, smart tech, stronger communities”

10. Impact Incubator — Innovation for Marginalized Communities

Challenge Summary: Design a modular innovation hub (physical or virtual) that supports local entrepreneurship and STEM learning in underserved regions.

Suggested Team Composition

- All disciplines: Co-design of tools, training, and infrastructure
- Entrepreneurship: Hub sustainability, funding, and impact tracking

Key Tasks

- Define the hub’s purpose (e.g., food innovation, water safety, biosensor training)
- Choose a format: mobile lab, virtual platform, community center
- Design modular learning and prototyping spaces
- Identify local partners (schools, NGOs, youth groups)
- Develop a sustainability and funding plan

Deliverables

- Hub blueprint or platform concept
- Sample training module or innovation challenge
- 1-page pitch: “Empowering innovation where it’s needed most”

11. NutriTrace — Smart Nutrition Surveillance

Challenge Brief: Design a system to monitor and improve nutritional health in vulnerable populations using biosensors, geospatial data, and behavioral insights.

Suggested Team Composition

- Biology: Identify nutrient biomarkers and deficiency indicators
- Biosystems Engineering: Develop wearable or point-of-care biosensors
- Geography: Map food access and malnutrition hotspots
- Entrepreneurship: Create incentive models and community engagement strategies

Tasks:

- Select a target population and nutritional challenge
- Design a detection and data visualization tool
- Propose a feedback loop for health workers or caregivers

Deliverables:

- Prototype concept or dashboard mockup
- Community implementation plan
- 1-page pitch: “Tracking nutrition to transform lives”

12. EcoHarvest — Energy from Agricultural Waste

Challenge Brief: Create a decentralized bioenergy solution that converts crop residues or animal waste into clean energy for rural communities.

Suggested Team Composition

- Bioenergy Engineering: Design conversion processes (e.g., anaerobic digestion, pyrolysis)
- Biosystems Engineering: Integrate systems for rural deployment
- Physics: Model energy efficiency and thermal dynamics
- Entrepreneurship: Develop cooperative ownership and microgrid models

Tasks:

- Choose a waste stream and energy output goal
- Design a modular unit for local use
- Build a business model for community adoption

Deliverables:

- Process flow diagram or system sketch
- Energy impact and cost analysis
- 1-page pitch: “Turning waste into clean power”

13. GeoSentinel — Environmental Risk Detection via Remote Sensing

Challenge Brief: Build a remote sensing platform to detect environmental health risks and inform public health responses.

Suggested Team Composition

- Geography: Analyze satellite imagery and spatial patterns
- Physics: Apply remote sensing technologies and spectral analysis
- Biology: Link ecological indicators to health outcomes

- Entrepreneurship: Package insights into services for governments and NGOs

Tasks:

- Select an environmental risk (e.g., algal blooms, air pollution)
- Design a detection and alert system
- Identify end users and data delivery methods

Deliverables:

- Risk map or dashboard concept
- Stakeholder engagement plan
- 1-page pitch: “Seeing risk before it strikes”

14. SafeHands — Hygiene Innovation for Resource-Limited Settings

Challenge Brief: Design a low-cost, culturally adaptable hand hygiene solution for schools, clinics, and markets in water-scarce regions.

Suggested Team Composition

- Biological Engineering: Explore soap alternatives and waterless sanitizers
- Biosystems Engineering: Design durable, low-maintenance dispensers
- Biology: Assess pathogen transmission and hygiene efficacy
- Entrepreneurship: Build local production and behavior change campaigns

Tasks:

- Identify hygiene barriers and cultural considerations
- Prototype a hygiene solution (product + delivery system)
- Develop a community rollout strategy

Deliverables:

- Product concept or dispenser sketch
- Outreach and education plan
- 1-page pitch: “Clean hands, healthy futures”

15. MindMap — Mental Health & Environmental Stress

Challenge Brief: Develop a tool that links environmental stressors to mental health risks and supports community resilience.

Suggested Team Composition

- Biology: Explore neurobiological effects of environmental stress
- Geography: Map exposure zones and vulnerable populations

- Physics: Integrate environmental sensors and data streams
- Entrepreneurship: Design digital tools and outreach strategies

Tasks:

- Choose a stressor (e.g., heat, pollution, displacement)
- Design a monitoring and support tool (app, dashboard, hotline)
- Plan for community engagement and mental health literacy

Deliverables:

- Tool concept or wireframe
- Mental health resource map
- 1-page pitch: “Mapping stress to build resilience”