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"