1. Elevator Pitch:

Pitch your innovation, sharing its essence, impact, customers and business potential.

Every year, your body consumes nearly 52,000 microplastics, catalyzing detrimental health effects [1]. Clarity is the first step towards household and systemic public health safety.

Clarity is the first consumer device that is able to detect real-time microplastics in a compact, affordable form under $250, with similar capabilities to $10,000+ lab equipment. Utilizing optical scattering with an AI model trained on diverse plastics, the device constantly monitors the drinking water within households.

The device extends beyond just a household protector; it's a part of building civic infrastructure. By collecting anonymous, crowd-sourced data to be used by researchers, policy makers, and environmental groups, our device assists in implementing effective regulations and mapping contamination for better responses. For the average family, particularly health-conscious ones, this innovation offers transparency into what is actually in their water, so they can take the necessary steps to avoid impurities. See the unseen.

2. Team: How did your team form? What role will each team member play? What motivated you to make this innovation? What special capabilities, resources or experiences do your team members bring?

We were motivated to create Clarity because we've seen the lack of action being taken regarding microplastics, and concerns were raised by close family members regarding unknown health consequences. Anushka brought the team together to tackle the issue.

Anushka and Noga met at the NYU GSTEM program, where they conducted independent research with the mentorship of professional lab faculty. Furthermore, Anushka and Gaathri have collaborated numerous times on previous innovation challenges, such as Technovation and the Diamond Challenge, where they built projects still standing today. All our team members' past experiences in building and entrepreneurship prompted us to work together for the Conrad Challenge.

Anushka and Noga bring an extensive programming background through classes and self-study that they will capitalize on to build Clarity efficiently and effectively. Gaathri provides marketing and communication expertise to ensure that Clarity is profitable, reaches the necessary target audience, and addresses the water issue strategically.

3. Opportunity: What issue or pain point does your innovation address?

Microplastics are one of the most underrecognized threats to human health and environmental safety. The public is unaware that they're consuming tens of thousands [1] of microplastics every year because of an issue located within their own home: drinking water. Since there's a lack of visibility in identifying contaminated water, it hinders consumers from making informed decisions regarding their water quality. This lack of transparency impacts the public daily. Clarity bridges this gap in knowledge by providing an at-home solution consumers can use to track and avoid microplastics.

However, even if consumers were aware of the severity of microplastics, the current infrastructure and devices on the market are built periodically and rely on expensive laboratory equipment [2]. Since there's no centralized data collection identifying where the contamination originates, policymakers aren't able to manufacture targeted interventions for these hotspots. As a result, water quality data is sparse and disconnected from actual consumption sources, which prevents timely responses. This break in communication allows for contamination patterns to continue undetected. Clarity provides big data in order to hold water processing facilities accountable.

For households, the only readily available solutions are generalized filters or lifestyle changes, which are both inconvenient and ineffective in addressing the root issue of water supply. Without accurate data, consumers aren't able to directly respond to a key safety issue within their own home.

Research connects microplastic ingestion with greater risks of cancer, inflammation, and neurological conditions such as dementia [3]. Without proper detection, individuals, researchers, and governments will not be able to respond to the issue. This highlights that the core issue is not only contamination itself, but the lack of awareness regarding the extent of impurity in everyday water sources. Our innovation, Clarity, directly solves this by transforming microplastic detection from a laboratory process to a consumer-level device.

4. Innovation: Describe your innovation, its design and your technology. How does it work? What is new or proprietary about the innovation? How does it meet needs and resolve pain points? What impact does your innovation create for individual users and for humankind? Describe this qualitatively and quantitatively. How can new or proprietary aspects be protected and made valuable by one or more methods such as a patent,

trade secret, copyright or otherwise competitively defensible configuration?

Clarity consists of a low-cost, home microplastic detector, a mobile application, and data processing. We aim to utilize our novel access to large amounts of microplastic data to give users transparency and save money on the micro-scale, while providing fuel to hold problematic water processing facilities accountable on the macro-scale.

The detector consists of an LED light, 4K camera, Raspberry Pi, and a power source. These components are held together with a plastic body that clips onto a sink faucet end. The body is a hollow rectangular prism with two parallel circular holes, oriented so water flows uninterrupted through the holes. The LED and camera are mounted on opposite rectangular openings, with the camera aligned to capture light transmitted through the water. The camera will be attached to a Raspberry Pi and power source, contained within an enclosure to ensure no water damage.

When water flows, the camera detects this motion, the light turns on, and the camera starts recording up to a five-second video clip. Using this video, sent from the Raspberry Pi to the user's app via Wi-Fi, we'll utilize a unique methodology to extract microplastic concentration.

Our methodology consists of first taking a base image of the light shining directly onto the camera during the initial setup of the device. The video recorded is used to identify individual suspended particles by using background subtraction relative to the base image. A machine learning model uses light diffraction within the video to determine which instances are caused by certain materials [4]. The instances of diffraction labelled as being caused by polyethylene, polypropylene, and polystyrene, nylon, PVC, polyester, or acrylic will be marked as an instance of microplastic. These particles are tracked across consecutive frames so that each particle is only counted once. The number of unique particles will be denoted as *c*. The tracked particles are used to estimate the average flow velocity *v.* by measuring their displacement across frames and converting the pixel motion to real-world distance using the known channel diameter *D* as a reference. This channel diameter will be adjustable so that it can fit a wide faucet size range. Knowing *D*, allows for the calculation of the channel cross-sectional area (*A = pi* (D/2)^2*). The total volume of water passing through the device during the recording time *V* is computed as *V=vAT*. The microplastic concentration is then calculated as *C= c/V*, which gives the standard PPL measurement.

The detector will have a retractable filter that will activate when the threshold, 500 particles/liter, is marked as dangerous by the California Water Board [5]. Average faucet filters last for about 3 months or 100 gallons of water, but through our retractable filter, it will only be used when needed, and increase lifespan throughout its use.

Clarity utilizes a mobile app to present the data our physical device collects in a digestible way. The app consists of water quality monitoring and particle detection. The app starts off by default in guest mode and presents microplastic data from the previous week. If the user would like to see data on a long-term scale, they have the option to create an account and will be able to see their data mapped out on a longer

time frame, up to a year. This creates a strong customer base to utilize for future relevant partnerships and email lists.

Using the data we collect and publicly available water center allocation zones, we can identify problematic water processing sites. This can be done using common path-finder algorithms with the data. We will do monthly releases of our data compilation findings and contact the responsible entities. The mobile app makes the user experience feel more like a wellness product rather than a complex scientific tool.

Clarity's nature as a home consumer-level product is novel within microplastic detection. Traditionally, microplastics have been tested only in lab settings, which makes the process expensive and tedious. Clarity makes microplastic data collection ~$9750 cheaper and more accessible, resolving the lack of large quantities of geographically diverse microplastic data. Professional studies utilize only approximately 400 samples, while Clarity would be able to collect 250% more data with only 1000 units distributed. Currently, problematic water processing facilities go unregulated because of a lack of data to drive policy change. Clarity will enable a new wave of policy change, regulation, and industrial reform to ensure a focus on public safety.

We plan to patent the methodology for extracting PPL from the video feed and the physical product itself.

5. Validation and Progress: How have you validated your innovation, technology or processes? What progress have you made in developing your innovation?

Due to the multipart process that drives the functionality of Clarity, the innovation was validated by testing each process individually.

We first tested the machine learning model by putting a small amount of dirt into the water and taking a video of the light through this mixture. This was to test the model's ability to not misidentify other impurities in the water for microplastics. The model had a 91.6% accuracy when detecting these particles as a material other than types of plastics. Once this basic accuracy was verified we rented a Raman Microscope and used research-grade microplastics from the Rice University Shared Equipment Authority to do further testing [6]. We found that the detector would detect 86.4% of the microplastics we put into filtered water.

Removing the variability within the environment of the video captured is essential to our methodology. Our background subtraction was powered by a frame differencing algorithm that recognizes the static components in the video. Our background subtraction isolated 90.2% of microplastic particles suspended in the water.

We used Tinkercad and a 3D printer to ideate, develop, and create the body of our device. We used an e-CAM130_CURB - Raspberry Pi 4K Camera, a Raspberry Pi 4 Model B/8GB, an LED light, and a USB

C cable to create our physical prototype. The camera and Raspberry Pi are connected using a flexible printed circuit and the UCB C cable connects to our power source. Our mobile app is built using a React framework and our data is stored in Firebase. We built this prototype after conducting the testing previously mentioned.

We tested our device by putting it under our home sink and seeing if the measurements are reasonable, since we do not have constant access to lab equipment. These measurements were between 2 particles per liter and 8 particles per liter which fits into a reasonable range when compared to scientifically tested measurements [7].

The mobile app is completed in development. There are pages for users to view their daily water quality data, filter data when we eventually implement the retractable filter, insights and FAQs, and an account view screen. Once users are invested in their water quality data, they have the option to create an account. Account creation is reframed as an upgrade to unlock cloud backup, cross-device access, and the ability to contribute anonymously to public health research. This approach maximizes both user adoption and research data quality while respecting privacy through permanent guest mode access. Users with accounts are granted access to a page that displays advanced historical data and advanced insights and community impact news.

Currently, our team is trying to acquire lab space through Rice University to accurately test our prototype detector.

6. Market: Describe your customers and your target segments. What is important to them? What is the size of the opportunity? Is the buyer or payer different from the customer in this market? Describe the industry ecosystem.

Clarity's first set of customers are everyday households seeking to purify their water, particularly health-conscious consumers who want clear, direct information regarding the state of their water supply rather than receiving vague data from a secondary source. These consumers prioritize health protection, transparency, and affordability, since clean water is essential for long-term health.

Globally, there is currently a massive shift to the wellness market, valued at $2 trillion [8]. In the United States alone, there are over 130 million households that lack a household-level device to tackle microplastics [9]. Clarity seeks to tap into this market to increase consumers' confidence in healthy water and advance their ideals of fitness and balance.

Beyond households, Clarity also appeals to environmental groups attempting to advance their advocacy efforts. These groups can utilize Clarity's detection technology to support research and community-based action for cleaner water and environmental accountability. Furthermore, governments and researchers can utilize the large-scale and geographically-based data collected by Clarity to identify contamination

sites that can be addressed by policy implementation. All the data collected is anonymous through geographical groupings and opt-in, ensuring that no household identifiers remain. This increases knowledge regarding microplastics and fuels the effective development of infrastructure improvements.

Clarity utilizes this two-pronged marketing approach to address the issue of microplastics both on the surface-level for consumers and the root issue at contamination sites. Households purchase Clarity for their personal use, while governments, researchers, and environmental groups will utilize the licensed data to fund projects that benefit larger communities. The distinction between buyers and consumers is critical, since the payer is distinct from the end user. The current ecosystem is very fragmented, which makes it difficult to initiate timely responses to contamination. By connecting these stakeholders together through data, Clarity drives both consumer action and systemic change.

7. Competition: What competes with your innovation, and how does your innovation compare? What are the advantages and disadvantages of your innovation? What is your positioning?

There are three primary solutions that compete with Clarity. The first are changes in lifestyle by focusing more on avoidance-based approaches to microplastics, such as changes in consumption habits. These strategies focus on minimizing exposure to microplastics already present, but they are unrealistic and inconvenient for consumers to implement.

The second competing category of solutions is household water filtration products from companies such as Brita, ZeroWater, and Berkey. These companies designed their products to improve the quality of water and remove contaminants. However, these products are often expensive, ranging from $1000 to $3,000 [10], require frequent replacement cartridges (every 2 to 6 months), and involve heavy maintenance costs [11]. Clarity seeks to address this by limiting the cost to approximately $150 to $250, which comes primarily from the hardware expenses, while also being easily purchased and requiring minimal filter changes annually, since Clarity has smart activation filtering.

The final competing solution is laboratory-based microplastic testing, which is typically conducted by educational institutions or environmental labs that use spectroscopy, such as FT-IR and Raman, and microscopy. Although accurate, the test conducted with this equipment is expensive, costing from $10,000 to $500,000+, takes place over a long period, and is not accessible to the average consumer [12].

Clarity actively addresses the key limitations from all categories through a sink-attachable consumer-level microplastic detection device that is not currently available in the market. In addition to active filtering, it collects real-time data on a large-scale for policy makers and researchers to utilize for effective action, which no other product on the market does. However, Clarity will face early adoption challenges due to the lack of microplastic awareness. Even so, the need for an available solution creates the perfect positioning for Clarity at the intersection of public health and environmental accountability.

8. Go-to-Market: How will you attract and sell to customers? Who are the best initial or pilot customers? Is the market best served through direct sales, distribution, licensing, strategic partnerships or other strategies?

Clarity will begin with a direct-to-consumer (B2C) rollout, prioritizing health-conscious consumers who track health-related metrics, such as smart rings, watches, and Brita. Since these consumers value transparency and are willing to pay for preventive health measures, they are the best pilot customers. Marketing efforts to drive early sales will initially include targeted social media campaigns, partnerships with wellness influencers, and live demonstrations at health expos. Early adopters will be incentivized with beta pricing and clear health-based metrics, increasing Clarity's public trust and product validation.

After a strong consumer base is established, Clarity will expand to B2G and B2B partnerships with water quality regulators and environmental health agencies. These organizations directly benefit from Clarity due to our large-scale, location-based data that increases incentives for their work. In this phase, sales will be focused on licensing data dashboards, strategic partnerships, and pilot programs, positioning Clarity to overall public health.

9. Business Model: What are your key revenues and costs? What are the pricing and costs to deliver one product or service unit?

Clarity utilizes a hardware-data revenue model that combines a one-time purchase of a physical device with data collection and service. The primary source of revenue is the sale of the Clarity device to households, and the second source is from data partnerships with organizations that aim to mitigate the microplastic issue. Clarity also has a mobile app that users can use to track daily contamination levels and purchase premium features, driving another revenue source.

Clarity's device is priced between $150 to $200 for consumers. The cost to deliver one product is $80 to $120, with the main costs being hardware and software, such as UV LEDs, optical sensors, AI detection models, and a modular clip-on filtration cartridge. This pricing ensures affordability while maintaining a stable profit.

In addition to device sales, Clarity also generates revenue from B2B and B2G partnerships, where Clarity licenses anonymous, geographically-aggregated water quality data to public health agencies, researchers, and policy makers. Access to data is provided through a tiered subscription plan depending on geographic region and data granularity.

The main ongoing costs include cloud infrastructure for data storage, AI model training, and salaries for workers. As the number of users grows, data storage and AI model refinement increase, but are offset by the proportional growth of sales and data licensing. Cloud storage costs an average of $.50 to $1.00 per device per year, assuming anonymized uploads [13]. The AI analysis feature costs an average of $2 to $5 per device per year [14]. Furthermore, retraining the model for more accuracy costs $50,000 to $75,000, and salaries are up to $250,000 for Clarity engineers, who are stipend-based during early development.

This dual-revenue pricing model ensures that as consumer sales increase, Clarity's data value strengthens, which will increase data partnerships with institutions.

10. Fundraising: What funds do you need to get started, and how will you use these funds? How much will it cost to develop the product and roll it out? What different sources will you pursue for funding, and why are these a fit?

To initially bring Clarity to the market, funding will be used to develop the prototype, manufacture early pilot units, build supporting infrastructure, and salaries. The estimated startup costs are around $400,000, with $180,000 for hardware prototyping and optimization, and about $200,000 for large-scale data aggregation to target contamination hotspots and R&D.

As an impact-driven for-profit company, Clarity will pursue a B2G strategy through government innovation grants, such as NSF SBIR/STTR funding and EPA environmental monitoring initiatives [15]. These sources are a fit for Clarity because they align with infrastructure reform and public health.

Clarity's strategy also includes focusing on B2B partnerships with public health agencies, research institutions, and universities that require data regarding microplastics. Through these partnerships, Clarity will be able to have pilot deployments to validate our technology in a real-world scenario to provide critical feedback for development while funding the initial design [16].

References: Add a list of the references you cited throughout the Innovation Brief here.

1. https://e360.yale.edu/digest/americans-consume-tens-of-thousands-of-microplastic-particles-annually#:~:text=It%20found%20that%20Americans%20eat,production%20and%20use%20of%20plastics.%E2%80%9D
2. https://pubmed.ncbi.nlm.nih.gov/40384175/
3. https://pmc.ncbi.nlm.nih.gov/articles/PMC12162254/
4. https://www.researchgate.net/publication/358209038_Identification_of_Model_Particle_Mixtures_Using_Machine-Learning-Assisted_Laser_Diffraction
5. https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/docs/stffrprt_jun3.pdf

6. https://research.rice.edu/sea/instruments
7. https://www.psu.edu/news/research/story/sounding-alarm-microplastic-pollution
8. https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/future-of-wellness-trends
9. https://www.statista.com/statistics/183635/number-of-households-in-the-us/
10. https://www.benjaminfranklinplumbing.com/league-city/blog/2025/january/how-much-does-water-filtration-system-cost-a-comprehensive-pricing-guide/
11. https://nexgenairandplumbing.com/blog/what-does-a-home-water-filtration-system-cost/
12. https://www.excedr.com/blog/raman-spectroscopy-instrument-pricing-guide
13. https://aws.amazon.com/s3/pricing/
14. https://aws.amazon.com/lambda/pricing/
15. https://seedfund.nsf.gov/topics/environmental-technologies/
16. https://www.zinfi.com/glossary/what-are-b2b-partnerships/