Precipitation Formation Interactive VR Module

Intern: Ian Way
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Objectives

- Model and simulate precipitation in VR
- Explain the processes involved in precipitation formation

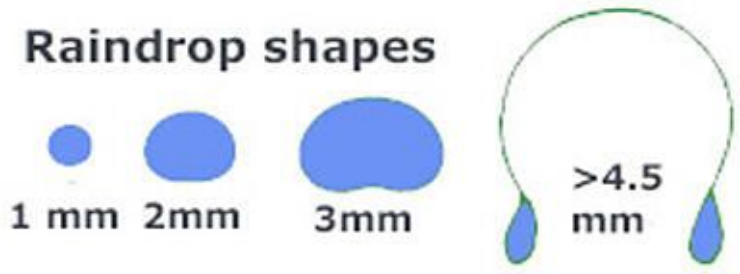

Figure 1: Raindrop shape determined by drop radius and air resistance [USGS]

Educational Aspects

- Covers frozen and liquid precipitation
- Covers environmental effects on precipitation
- Explains cloud effect on precipitation formation

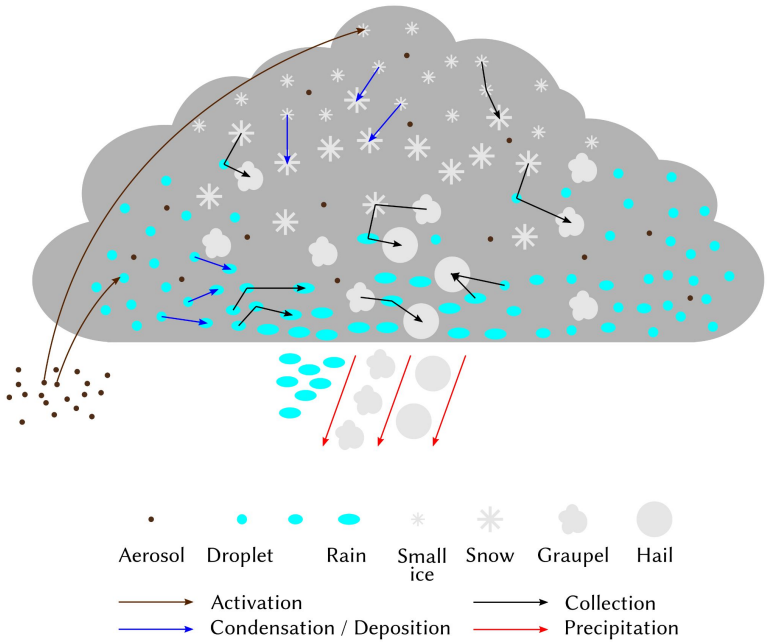

Figure 2: Precipitation formation process in a cloud [Benoit, 2025]

Figure 3: Snow crystal formations [Libbrecht, 1999]

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Challenges

- Per Particle Vertex Deformation to model air resistance in rainfall
- Accurate precipitation in educational demo

Solutions

- Used UV channels to pass particle data to shaders for air resistance deformation
- Model accurate ice crystals from scratch

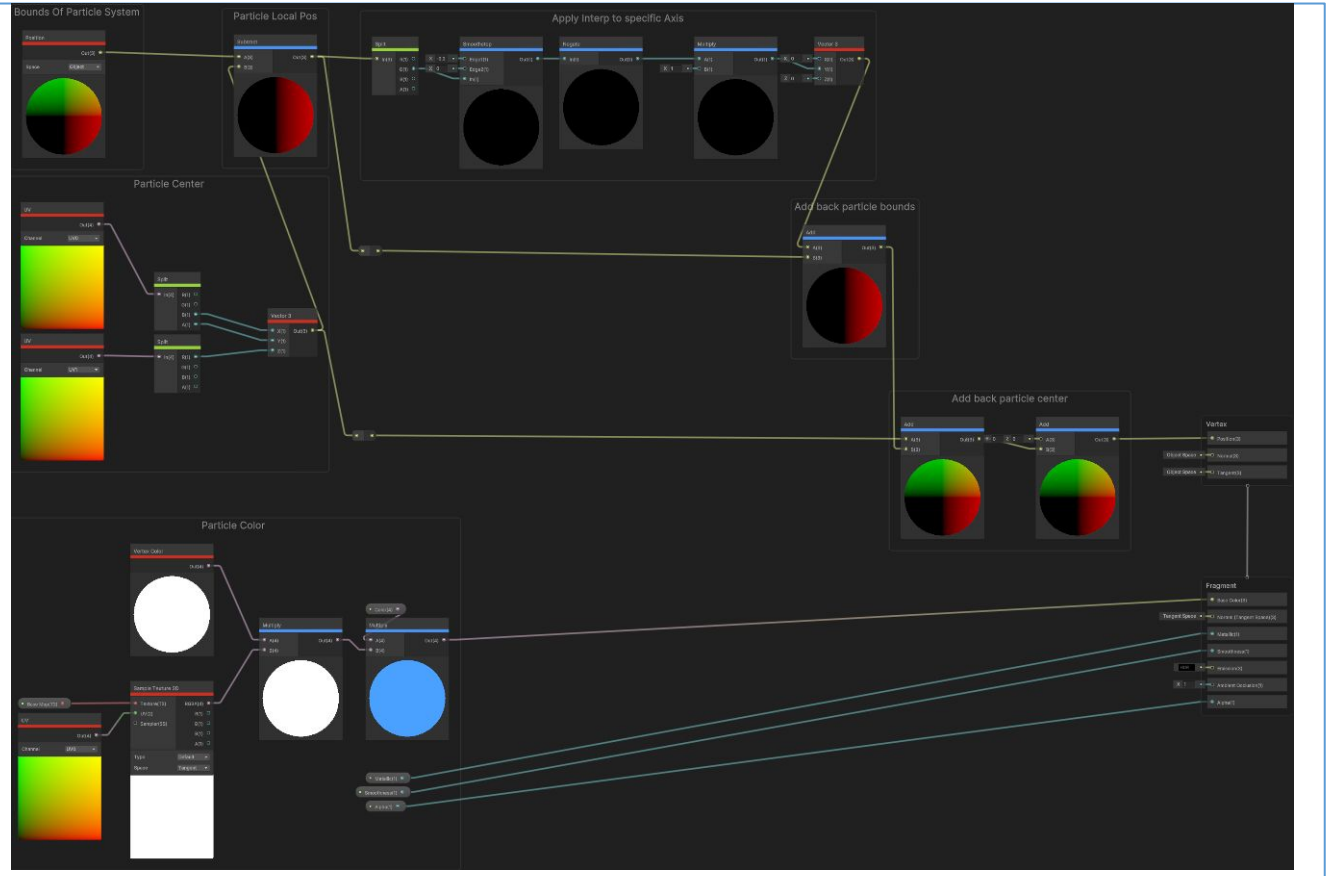

Figure 4: Per particle vertex shader modelling air resistance in water droplets

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Results

- Successfully built a particle system that simulates rain and snowfall with some microphysics
- Follow along educational reading panel that explains microphysics involved in precipitation formation

Future Works

- Demonstrate growth of cloud droplets by collision-coalescence as a bigger droplet collects smaller droplets on its way down.
- Demonstrate growth of ice crystals at the expense of supercooled water droplets.

References

Benoit, V. (2025). Representation of the microphysical processes of precipitation formation. In *Encyclopedia of the Environment*. https://www.encyclopedie-environnement.org/app/uploads/2020/09/microphysical-processes-evolution-cloud.png

Libbrecht, K. (1999). Snow types [Online]. In *caltech*. https://www.its.caltech.edu/~atomic/snowcrystals/class/snowtypes4.jpg

Hakim, Gregory J., and Jérôme Patoux, 2021, *Weather: A Concise Introduction*, Cambridge Aspire Website, Cambridge University Press, October 27. https://doi.org/10.1017/9781108963688.

United States Geological Survey. (n.d.). Precipitation affeced by air resistance [Online]. In *United States Geological Survey*. Retrieved August 15, 2025, from https://www.usgs.gov/media/images/raindrop-shape-determined-drop-size-and-air-resistance

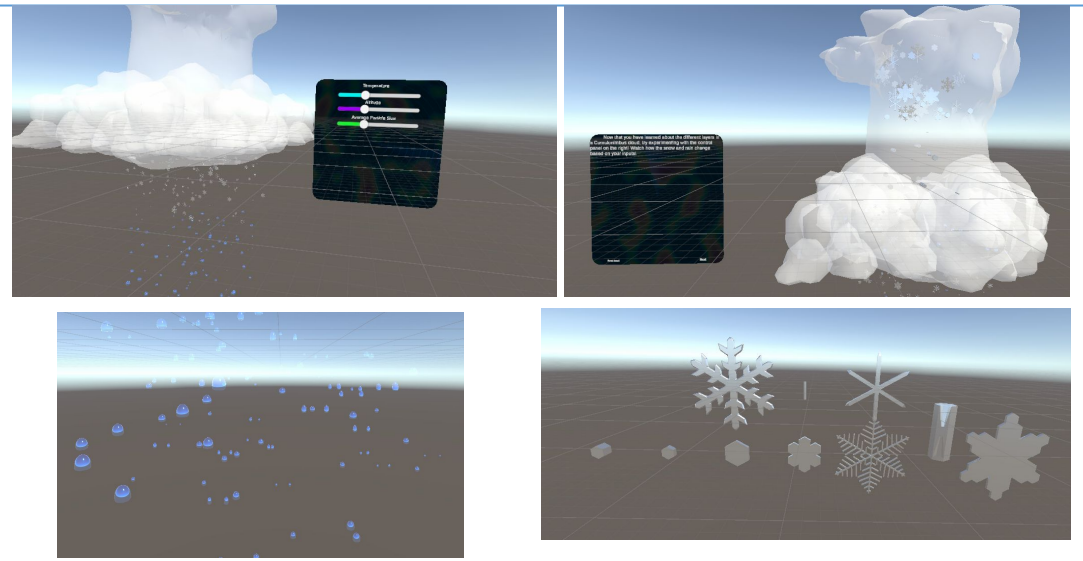

Figure 5: Snapshots of interactive module

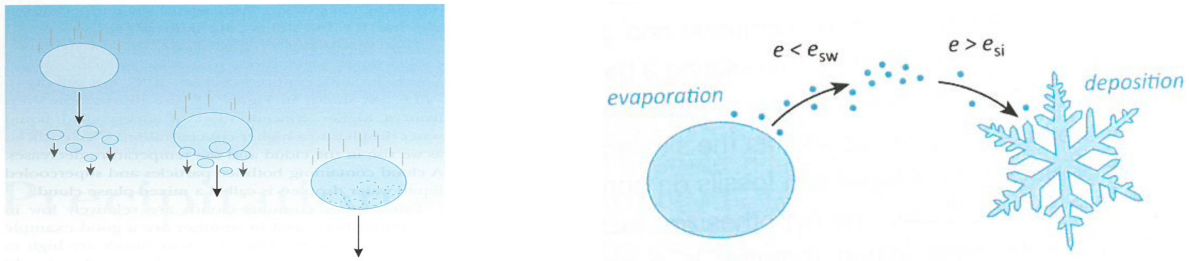

Figure 6: Growth of cloud droplets and ice crystals [Hakim and Patoux, 2021]

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