

Física Perceptiva: realidade virtual e experiências imersivas

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sampa



Física perceptiva

- Física – X
- Realidade Virtual
- Sonificação
- Física dos Cheiros
- Outros sentidos e experimentações
- Contribuições em Ensino e Extensão
- Oportunidades

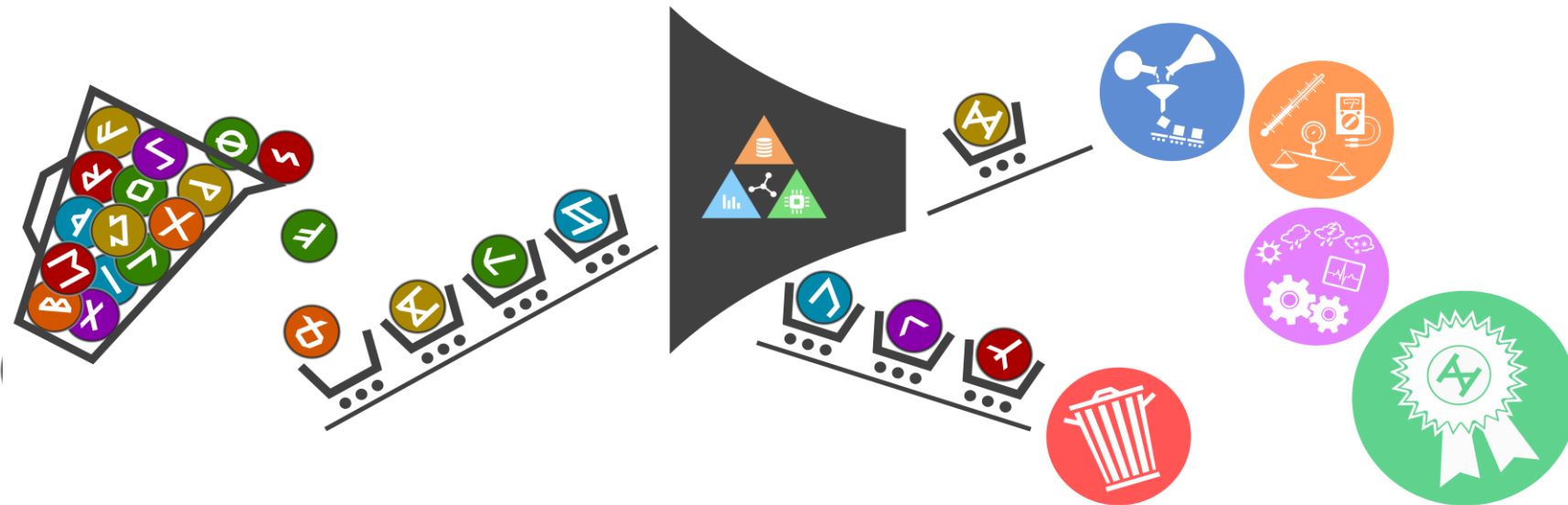


FÍSICA - X

Indústria 4.0 e tecnologias habilitadoras

Tentativa e erro - Otimização multidimensional - Parâmetros / propriedades desconhecidos

In silico Approach



Data Mining Classification Learning Predictive Model Algorithm

MACHINE LEARNING

Big Data Deep Learning Neural Networks AI Autonomous

DATA ANALYTICS



EXTENDED REALITY

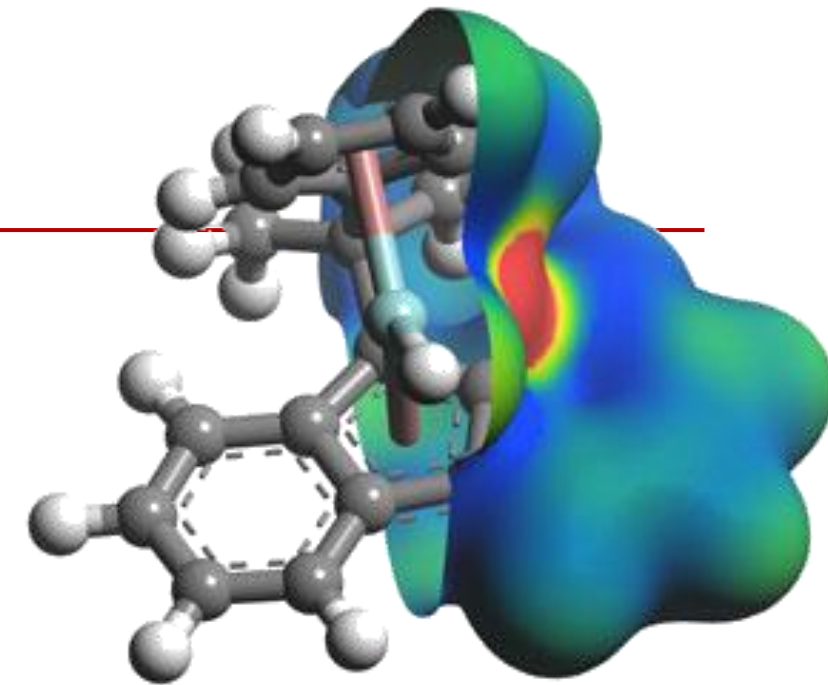
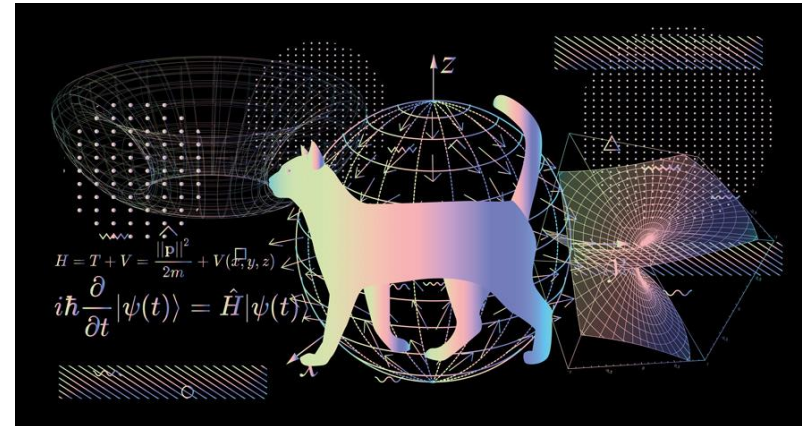
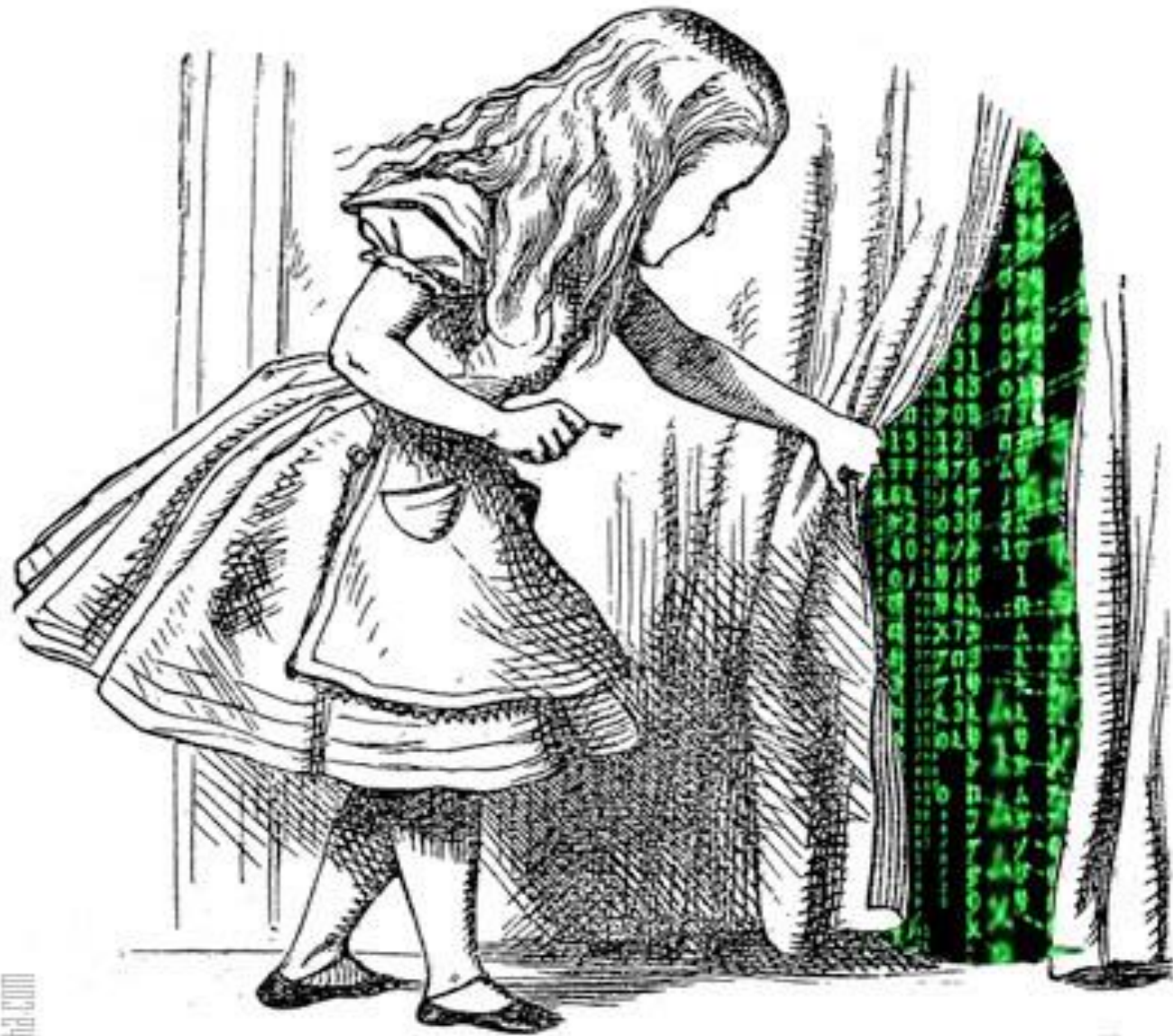
Apenas os melhores candidatos devem ser sintetizados, caracterizados e testados, resultando em grande economia de tempo e custo

Images from the web



DIGITAL TWIN

Simulação Computacional dos Materiais



Simulação tornou-se uma forma de experimentação em um universo de teorias
Gary Flake (The computational Beauty of Nature – MIT press)

Física-X

Ciência de dados



Física Perceptiva



LABORATÓRIO DE DESIGN DE INTERAÇÃO

FLUÍDO - MATERIAL

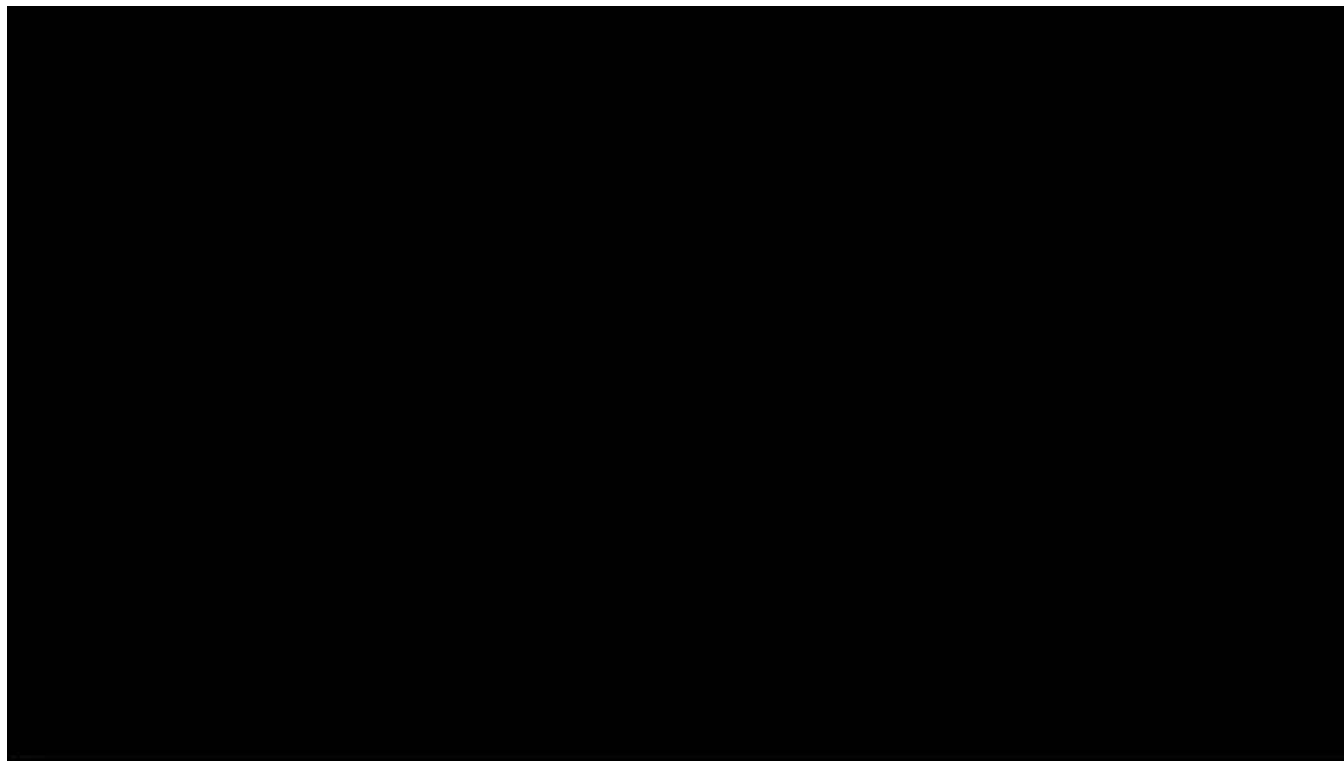
Design de materiais através de modelos de aprendizado de máquina e realidade virtual



>> Machine Learning



>> High throughput processes



Material Design using VR

Visualization and data analysis laboratory

On-the-fly simulations

Virtual reality

Larger systems

Longer simulation time

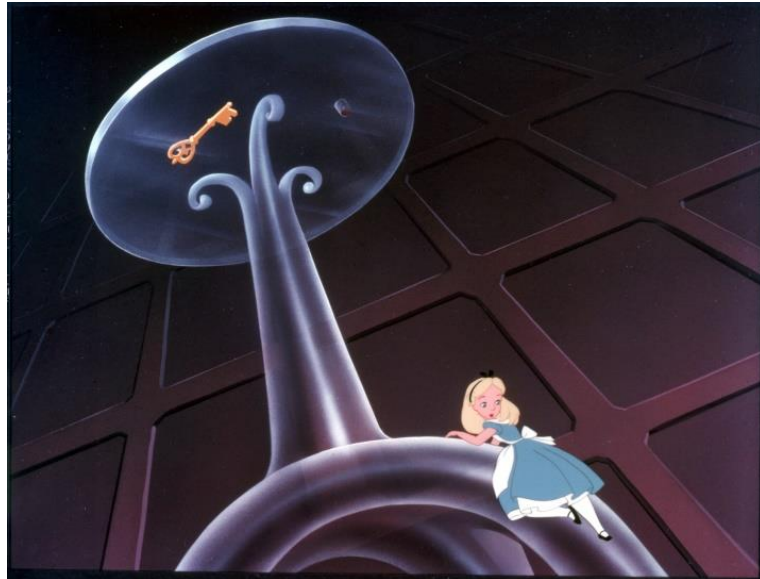


Física Perceptiva



- Novas formas de ver e interagir com simulações físicos.
 - A ideia é vivenciar escalas muito distintas da que vivemos no dia-dia
 - Percepção do mundo em distintas escalas
 - Criar uma intuição física sobre os fenômenos, a forma, tamanhos, espaço e processos dinâmicos nessa escala.
-

Experiências imersivas em escalas: Imagine se ... encolhêssemos... milhões de vezes

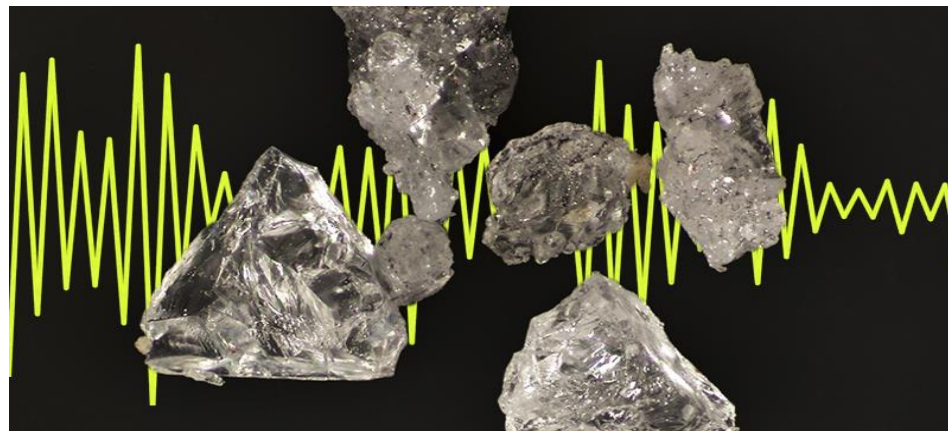


- **Exploração perceptiva:** experimentar sistemas físicos (de átomos a galáxias) na mesma escala que a nossa percepção física.

- Interagir e sentir o mundo em uma determinada escala (**nano ou astronômica**)
- Desenvolver uma intuição nessa escala (**fenômenos, forma, tamanhos, espaço e processos dinâmicos**)



Simulação Aplicada em Materiais: Propriedades Atômicas



TV USP

- 01/10/2018

Cientistas utilizam
realidade virtual para
criar novos materiais



Cientistas utilizam
realidade virtual
para criar novos materiais

REALIDADES EXTENDIDAS

Realidades extendidas



Realidade Virtual



Realidade Aumentada

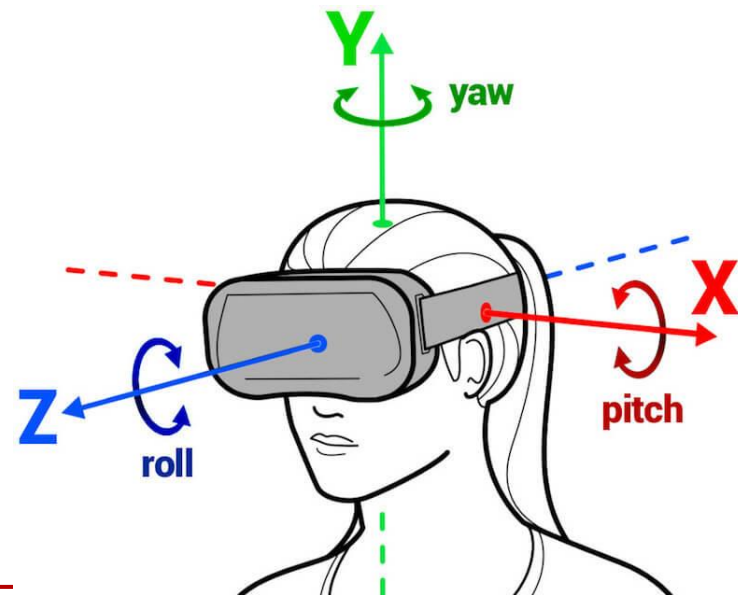
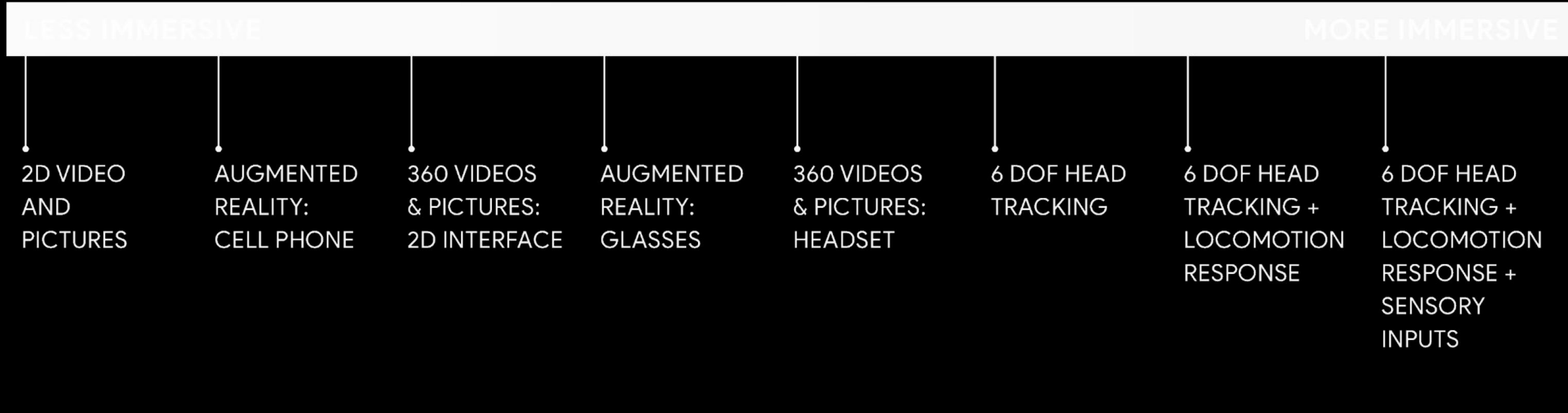


Realidade Mista

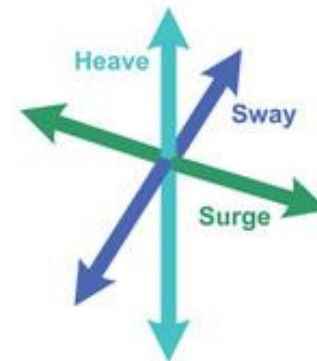


Realidade Extendida

The Virtual Reality Spectrum

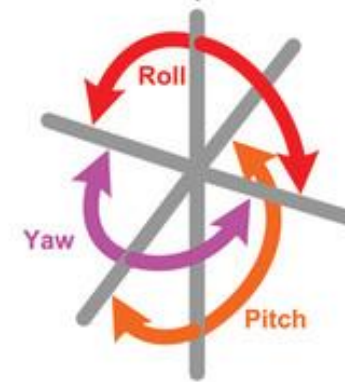


Translational Movement in Three Perpendicular Axes



Surge: Moving forward/backward
Heave: Moving up/down
Sway: Moving left/right

Rotational Movement about Three Perpendicular Axes



Roll: Tilting side to side
Pitch: Tilting forward and backward
Yaw: Turning left and right

Six Degrees of Freedom



Surge Roll
Heave Pitch
Sway Yaw

Níveis de imersão

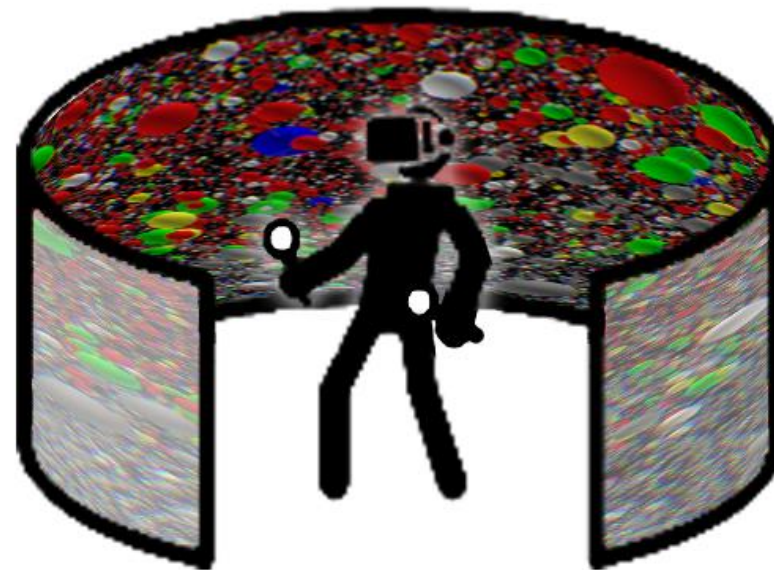
Visualização

SEE



Experiência com RV

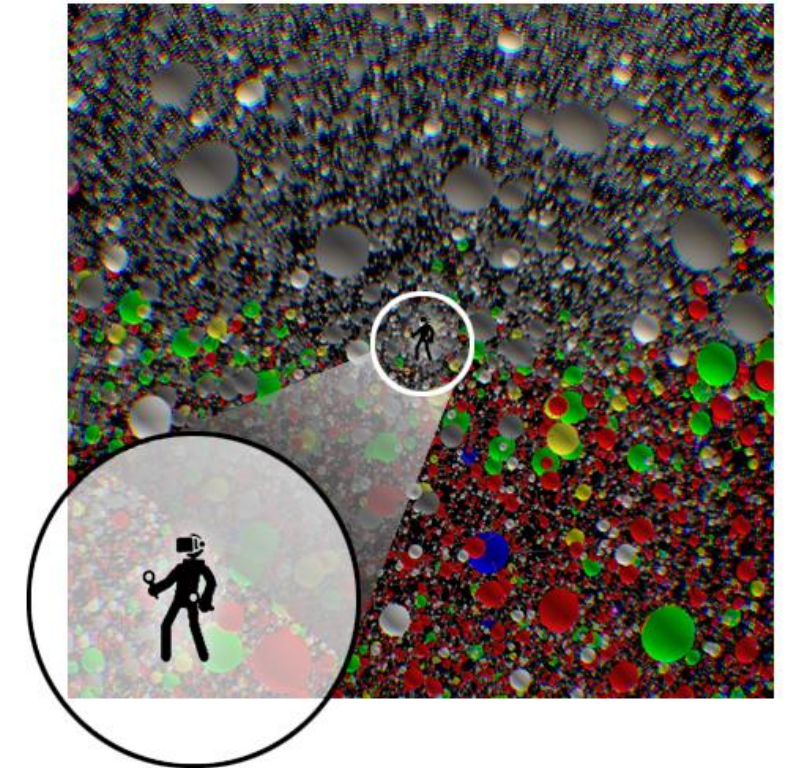
BE IN



Sistema de interesse

Experiência interativa com RV

BE THE

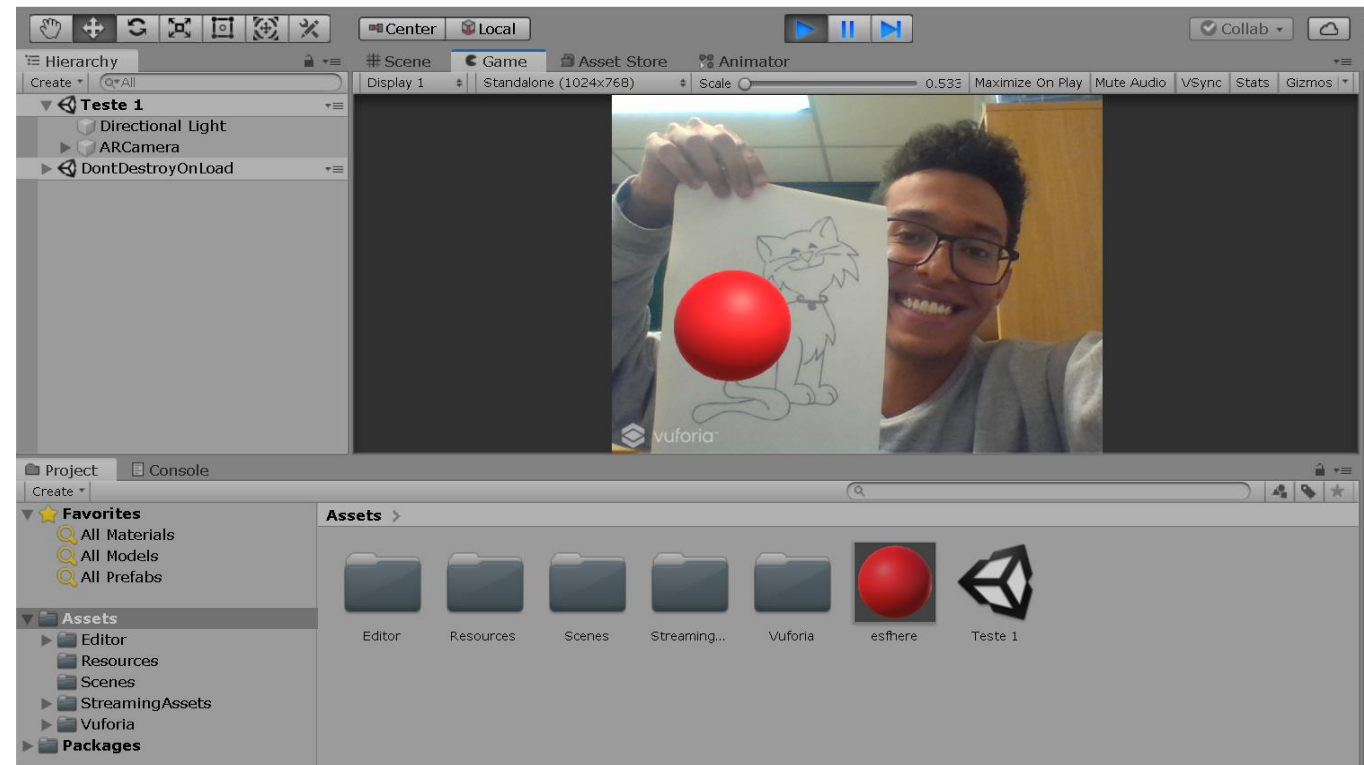


Realidade aumentada ...

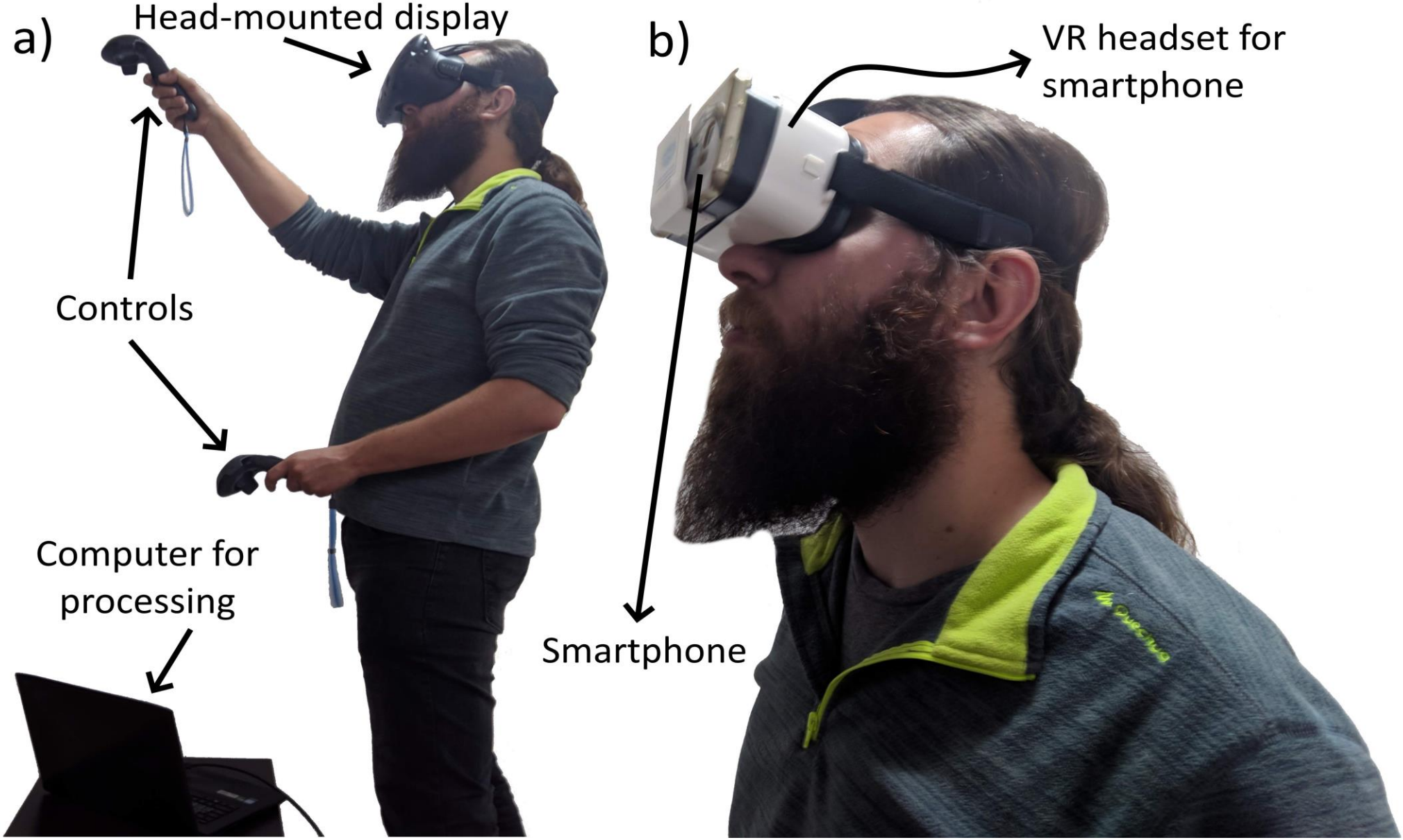


Teatro de Sombras

Exemplo de realidade aumentada



Dispositivos de Realidade Virtual



Dispositivos de Realidade Virtual



Recyclable Cardboard 0\$



VR Headset – US\$ 10

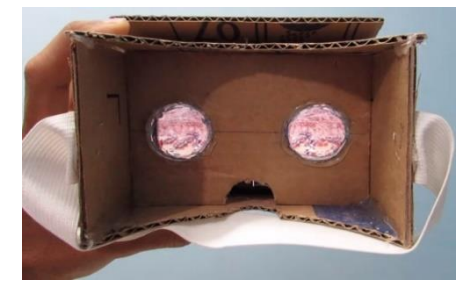


Oculus Rift – US\$ 300

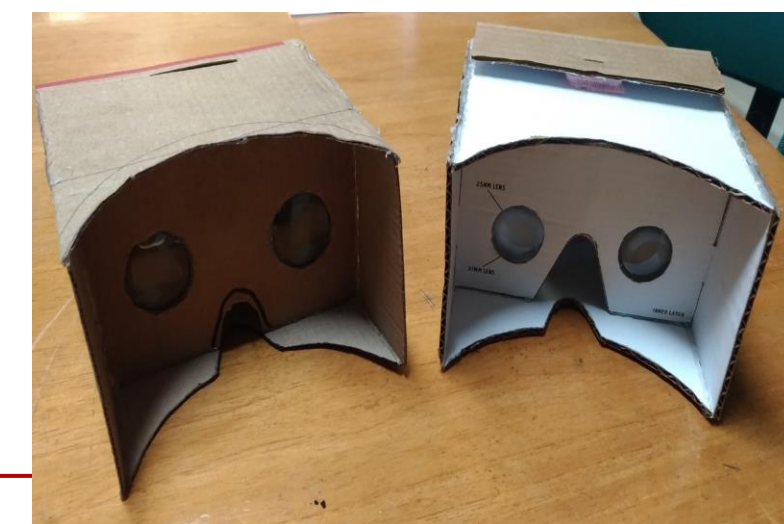
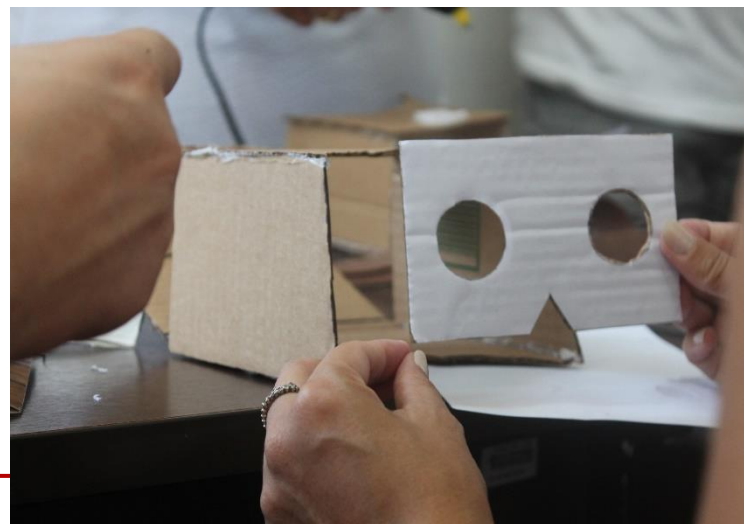
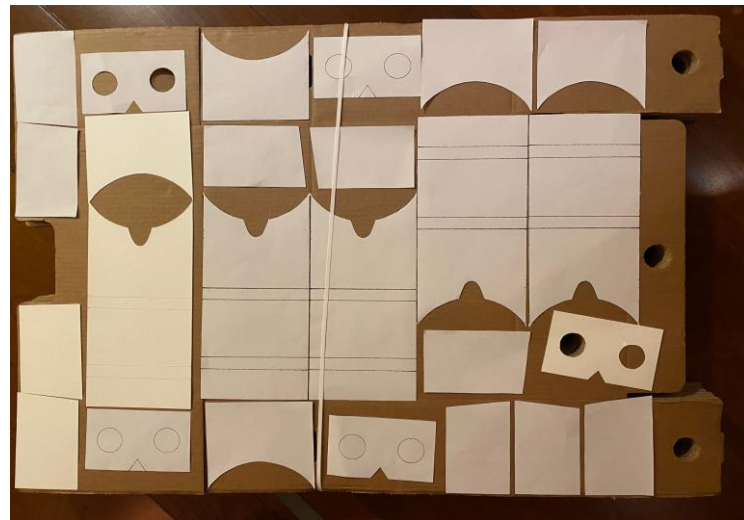


HTC VIVE – US\$ 400

Dispositivo de RV para smartphone de baixo custo acessível a alunos de baixa renda



- **Material reciclável (papelão e garrafas plásticas)**
- **Workshops sobre como construir as lentes e montá-las como um dispositivo de RV**



REALIDADE VIRTUAL NO MUNDO NANO



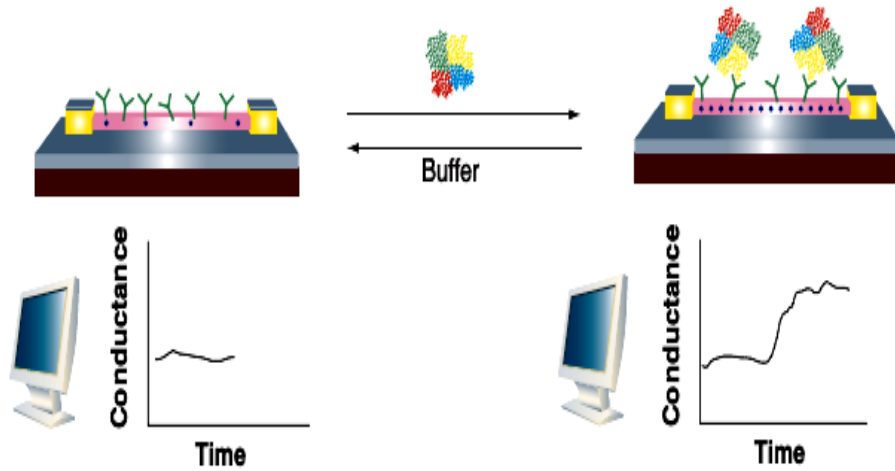
FLUÍDOS SOB CONFINAMENTO “POR MARES NUNCA DANTES NAVEGADOS”



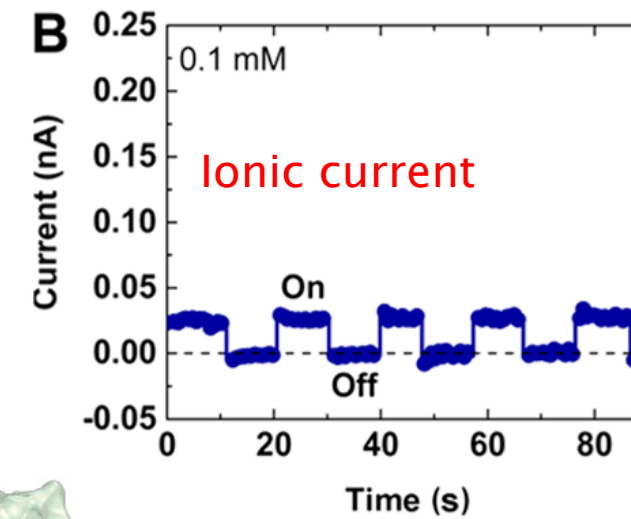
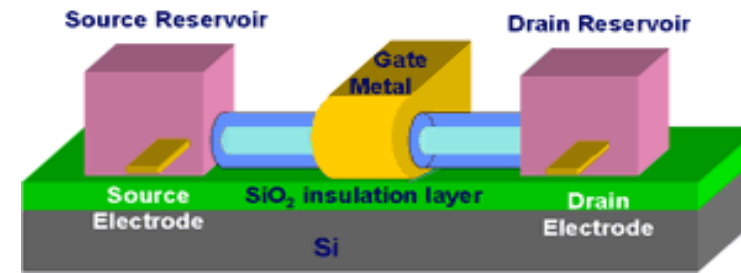
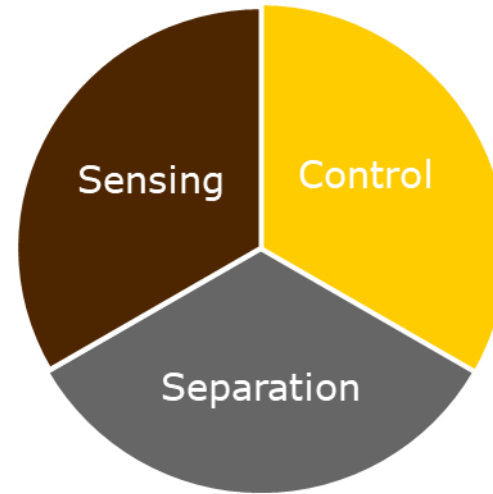
In collaboration with:

A. Kirch, T. Lanna, N. Razmara, J. Meneghini,

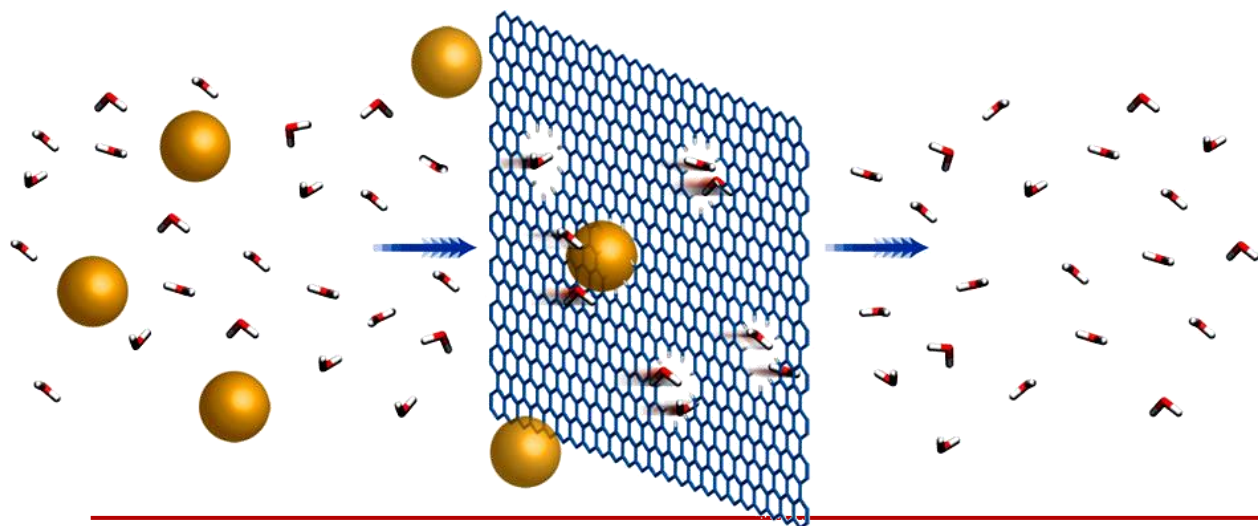
Nanofluídica



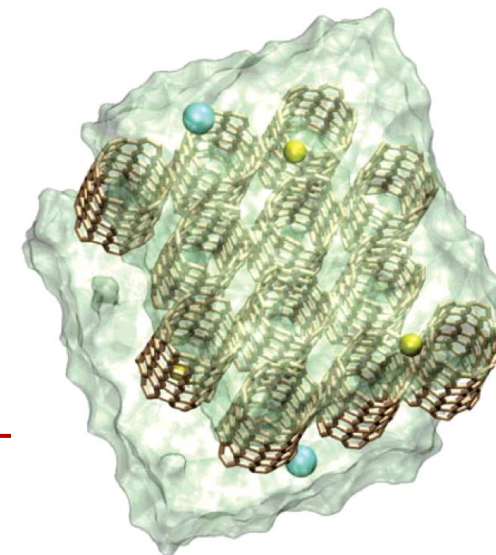
PATOLSKY, Fernando; ZHENG, Gengfeng; LIEBER, Charles M. Nanowire sensors for medicine and the life sciences. 2006.



Γ, Marie et al. A three-state nanofluidic effect switch. *Nano letters*, n. 4, p. 2365-2371, 2015.

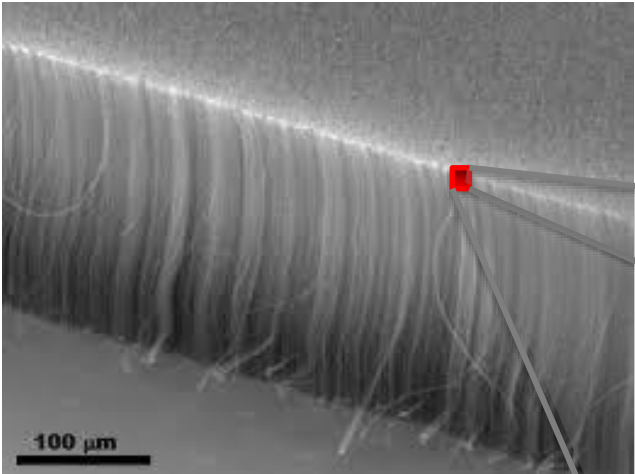


WANG, Evelyn N.; KARNIK, Rohit. Water desalination: Graphene cleans up water. *Nature nanotechnology*, v. 7, n. 9, p. 552-554, 2012.



- Projetando Membranas de Nanotubos de Carbono para Dessalinização Eficiente de Água

Tecnologias de separação de gases



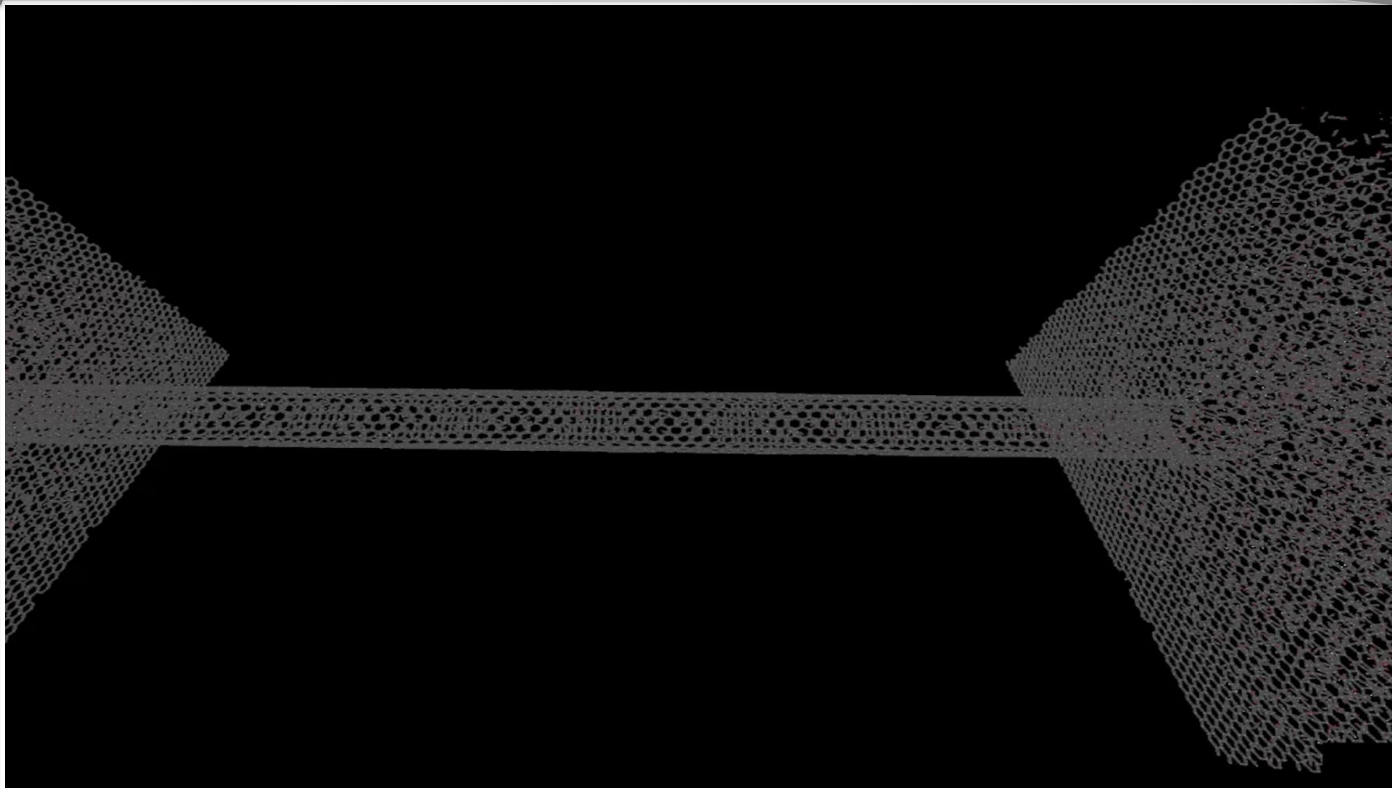
Experimental

Seletividade $N_2/CO_2/CH_4/O_2$

Tube diameter: 1.6 nm



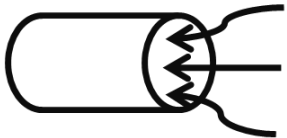
Molecular Model



Size effects



Fluid flow

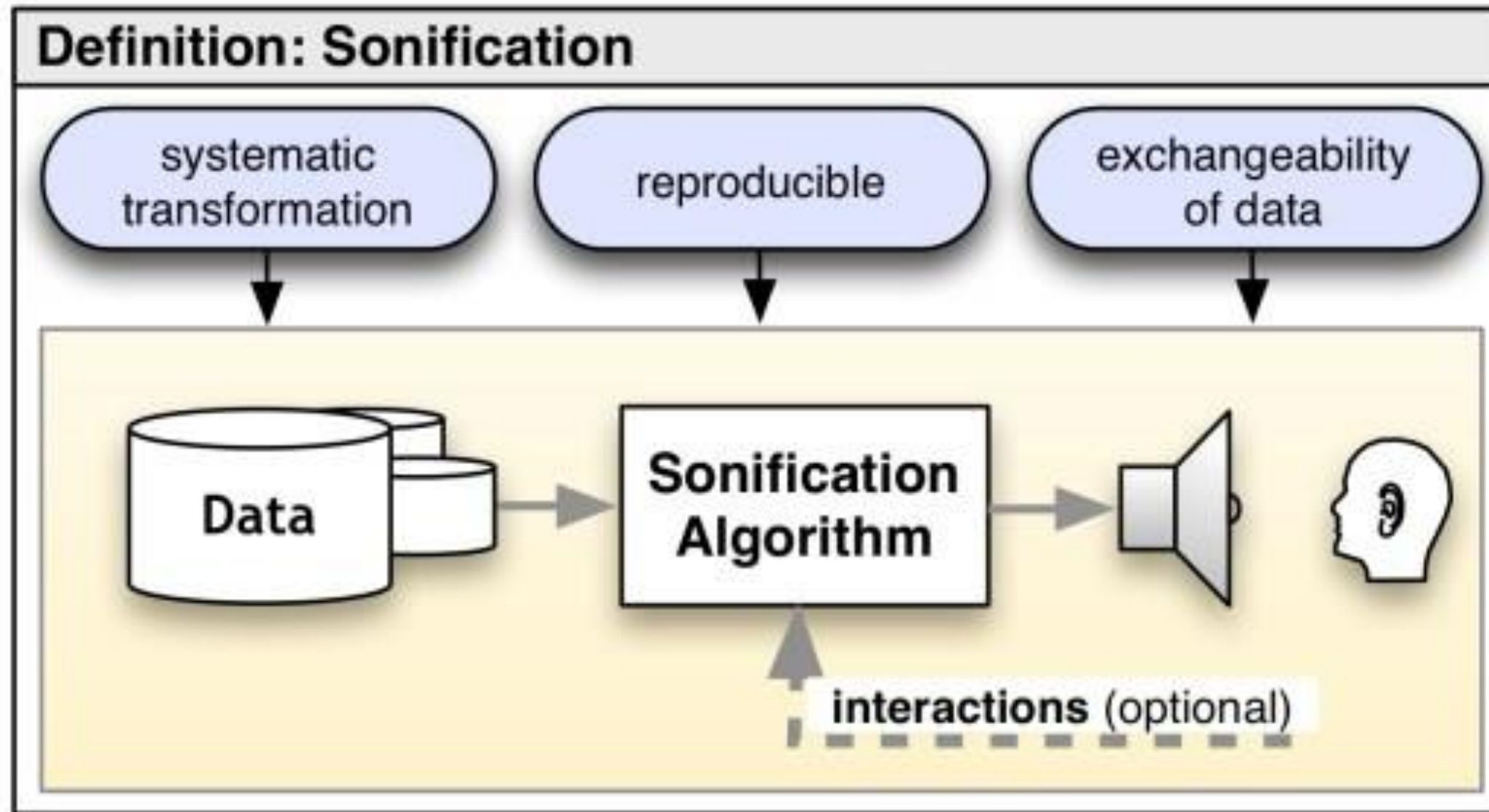


Gas composition



EXPERIMENTAÇÕES SONORAS

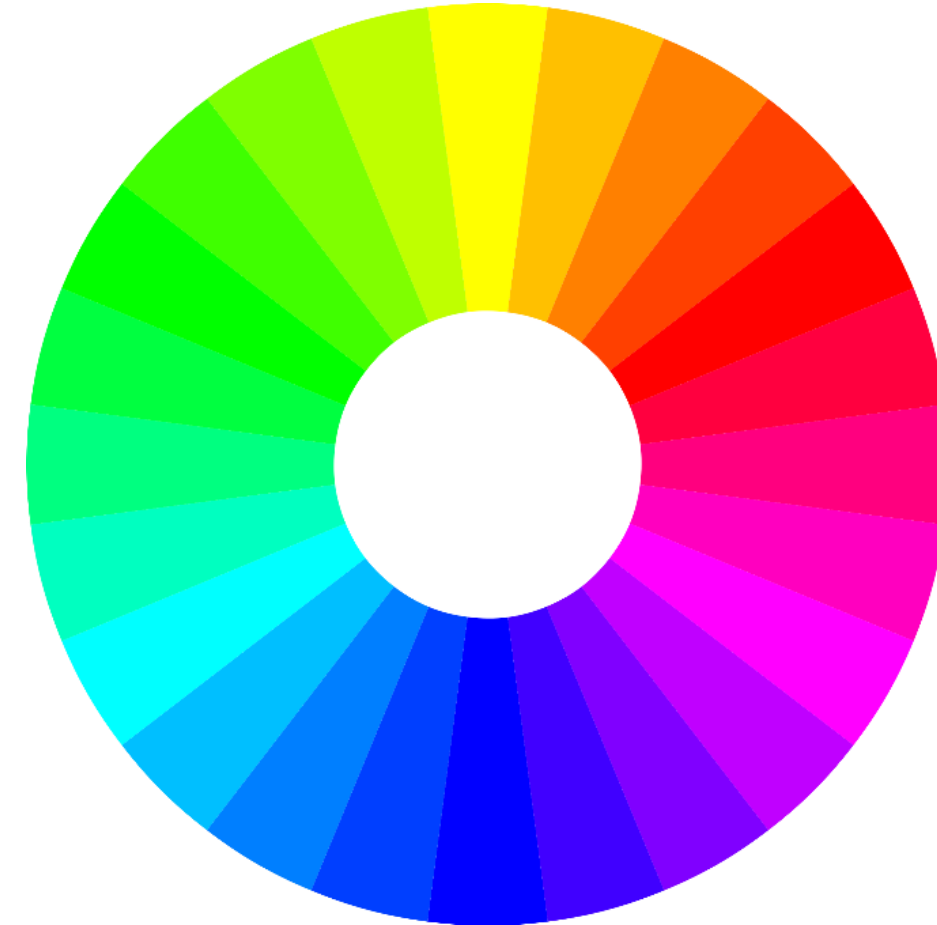
Sonificação



Source as adapted from: Thomas, H. (2008), "Taxonomy and definitions for sonification and auditory display." Proceedings of the 14th International Conference on Auditory Display, Paris, France

Paleta de Som

Location (Spatialisation)	
Loudness (Amplitude)	»AAAAAAAAAAAAA
Pitch: Relative Highness/Lowness Register (Frequency Band)	CDEFGAHC CDEFGAHCDEFGAHCDEF
Melody (sequence of sounds)	CDEFG CEDFG
Timbre: Sound quality (e.g. different instruments) Attack/Decay (often decides timbre)	A ʌ A A ʌ
Rhythm: Duration (of sound and pauses) Rate of change	



Extracted from “Sonification in computational physics”
by Katharina Vogt – SysMus08 - Based on xSonify

Motivações

Forma alternativa de representar e analisar dados

Exploração e percepção multidimensional intuitiva

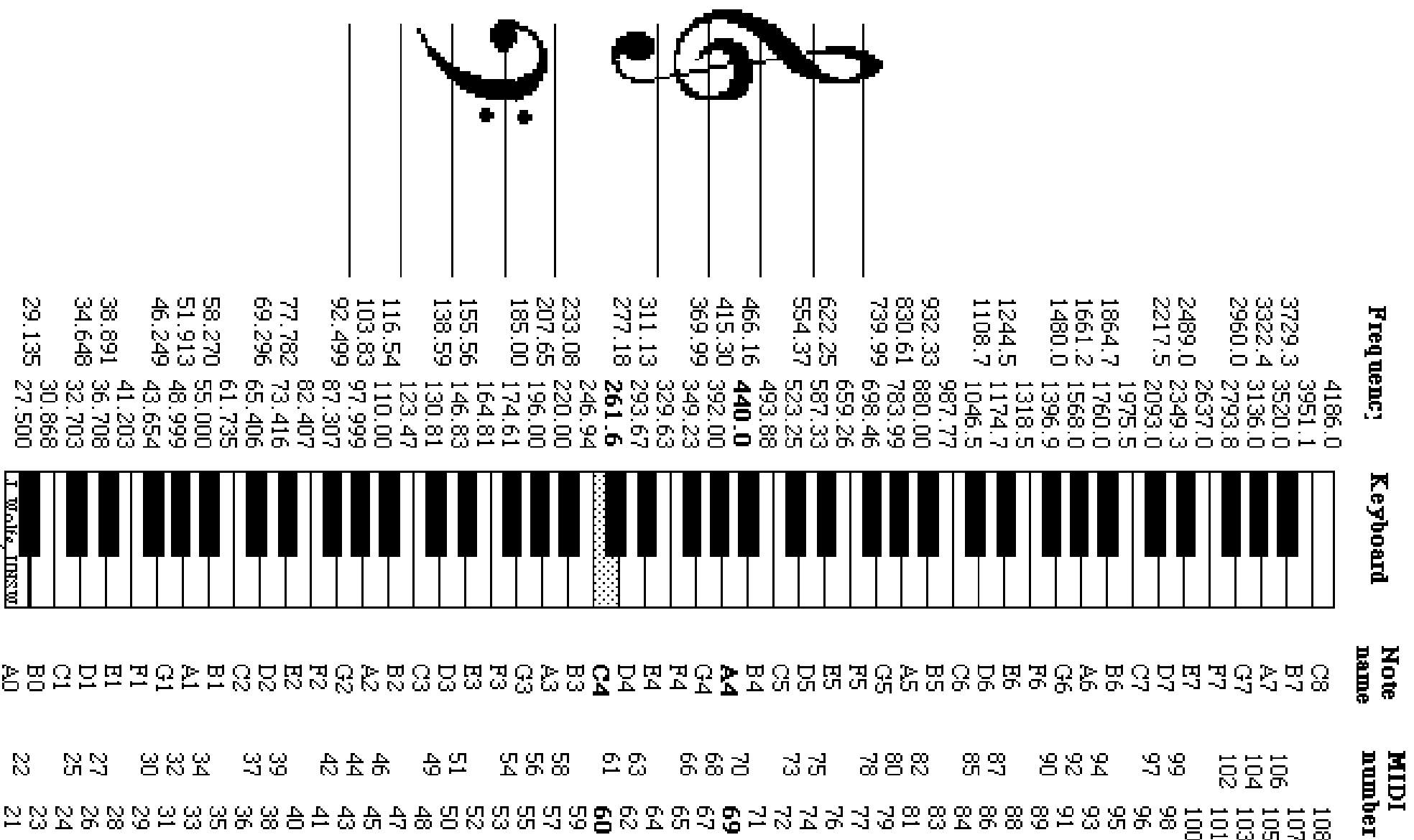
Representando o invisível

Disseminação científica e inclusão

Integrar / complementar experiências de imersão (Sound design)

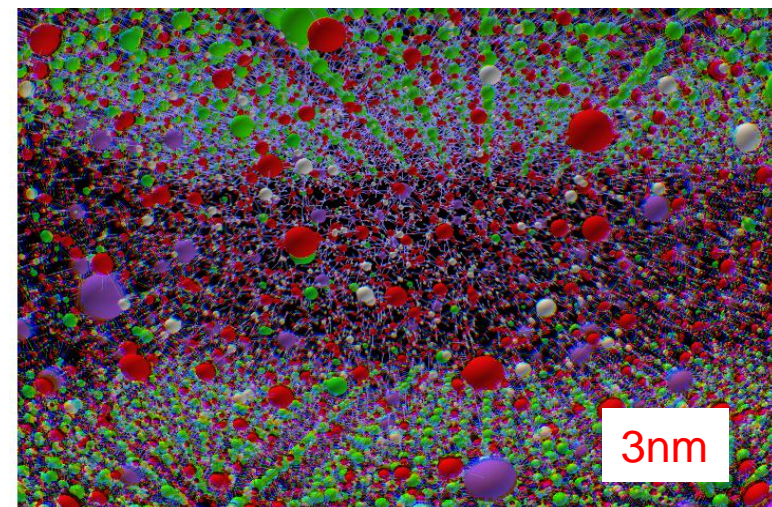
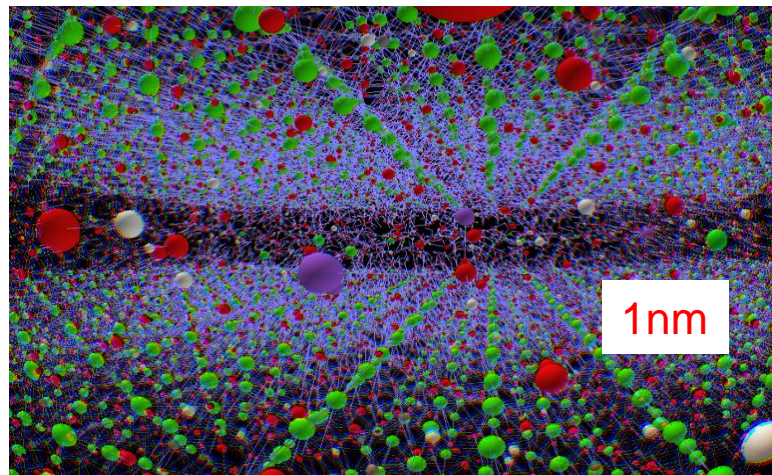
Conexão com a arte (música)

Sonificação – primeiros passos



Interfaces sólido-fluído

- Explorar os **mecanismos moleculares** subjacentes e as propriedades **físico-químicas** nas interfaces **fluido-sólido**



O usuário de RV pode navegar nas interfaces:

- estrutura cristalina de calcita
- estrutura da água confinada
- distribuição iônica e solvatação nos íons

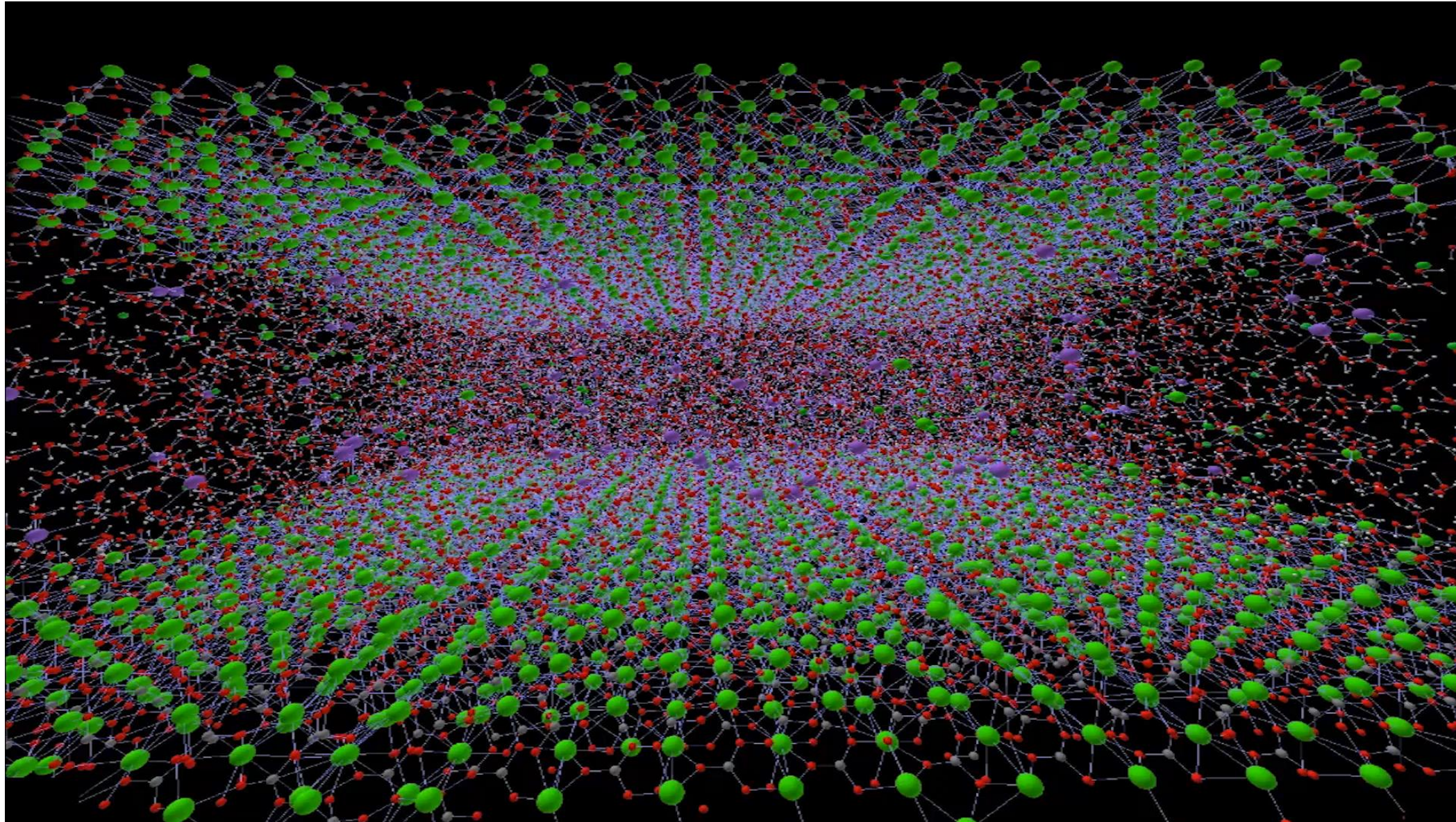
1) Nanoconfinamento

2) Injeção de fluidos com baixa salinidade

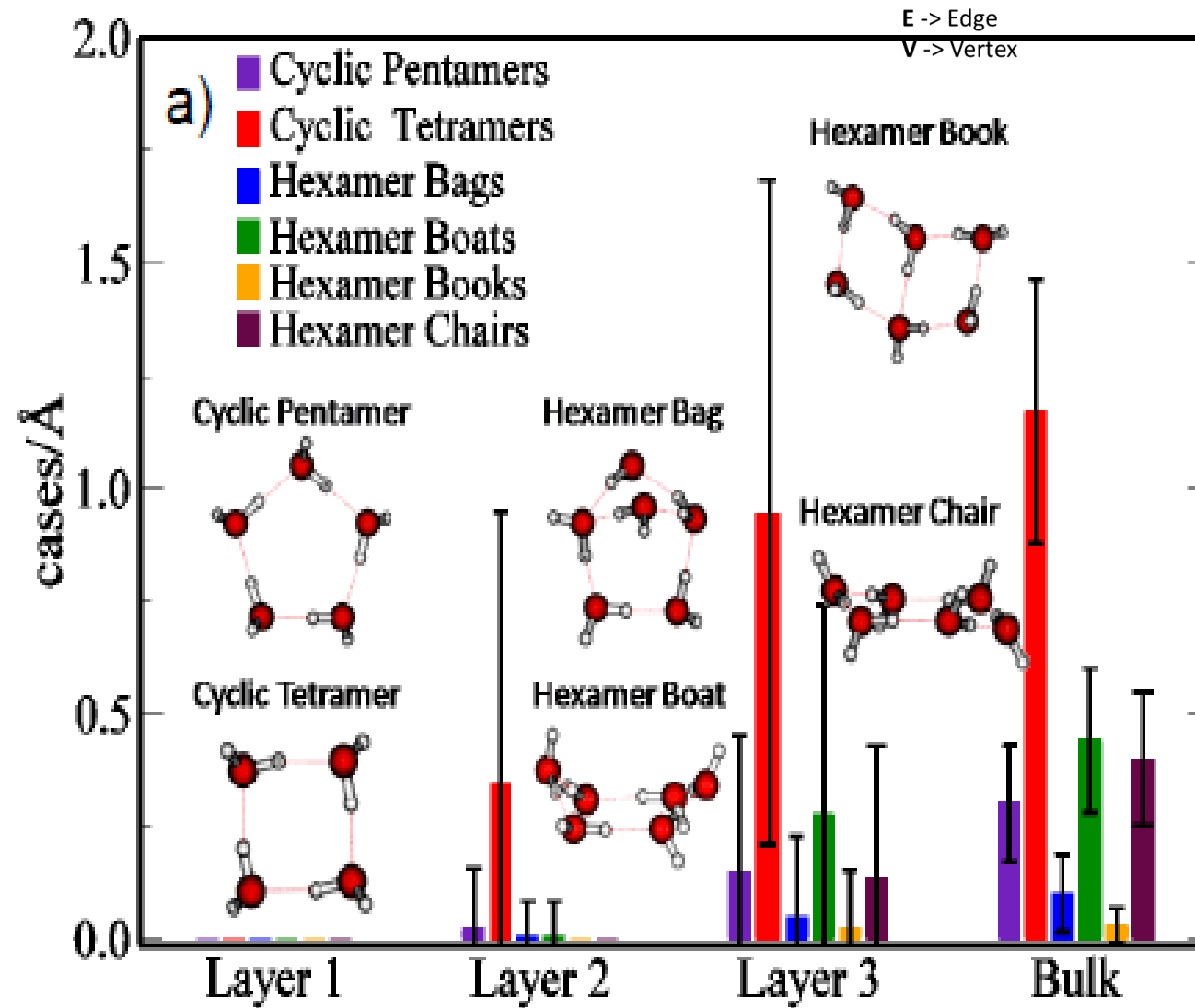
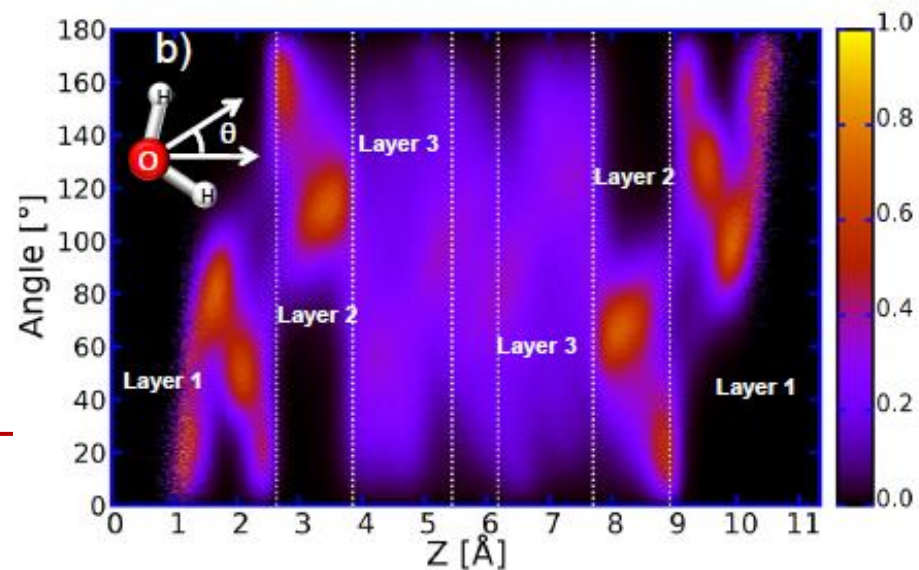
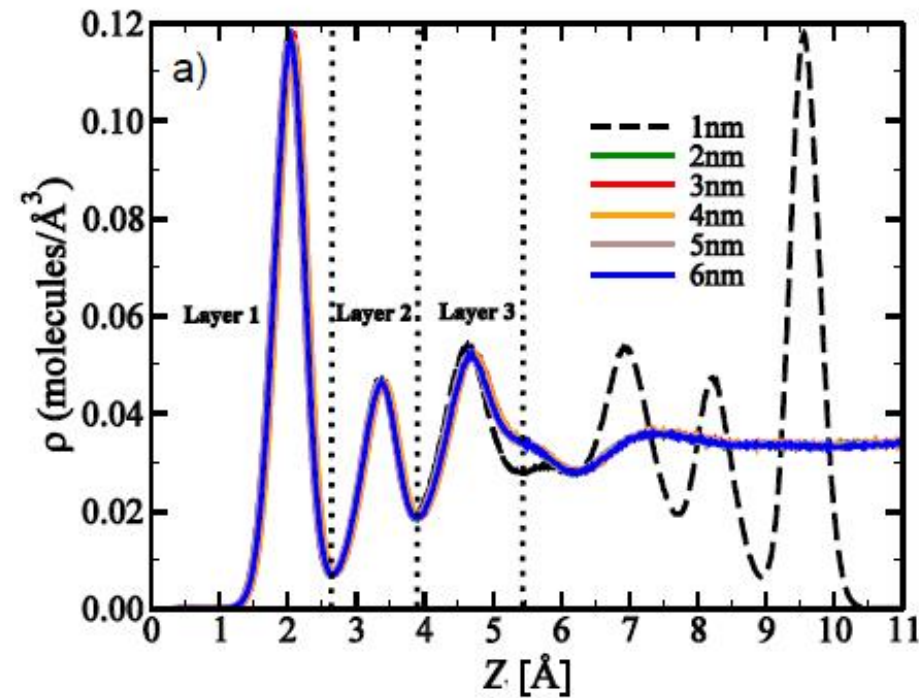
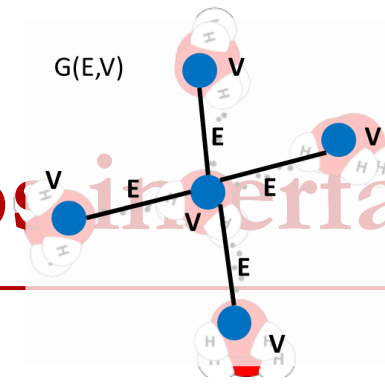
3) Biomineralização



Interface calcita-salmoura



Uma visão do Google sobre os fenômenos interfaciais



A. Kirch, S. M. Mutisya, V. M. Sánchez, J. M. de Almeida, and C. R. Miranda

J. Phys. Chem. C, 121,6674, 2017

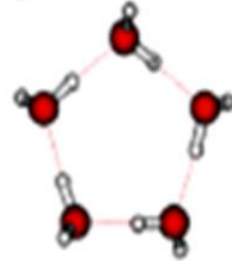
J. Phys. Chem. C, 122,6117, 2018

Mapeamento da Sonificação



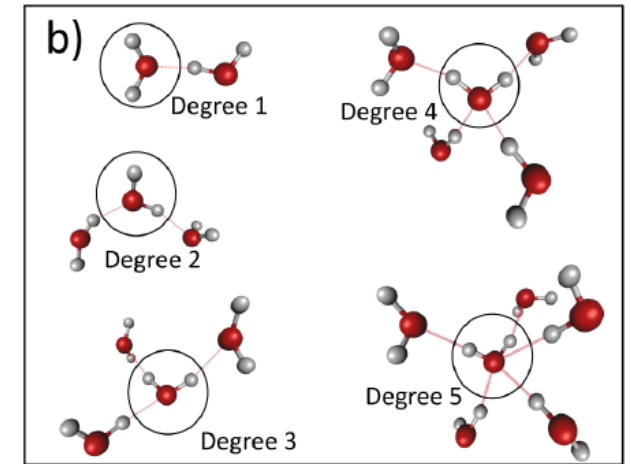
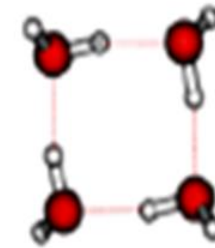
marimba

Cyclic Pentamer



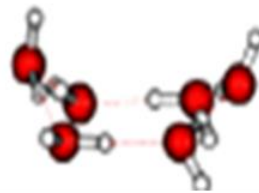
vibraphone

Cyclic Tetramer



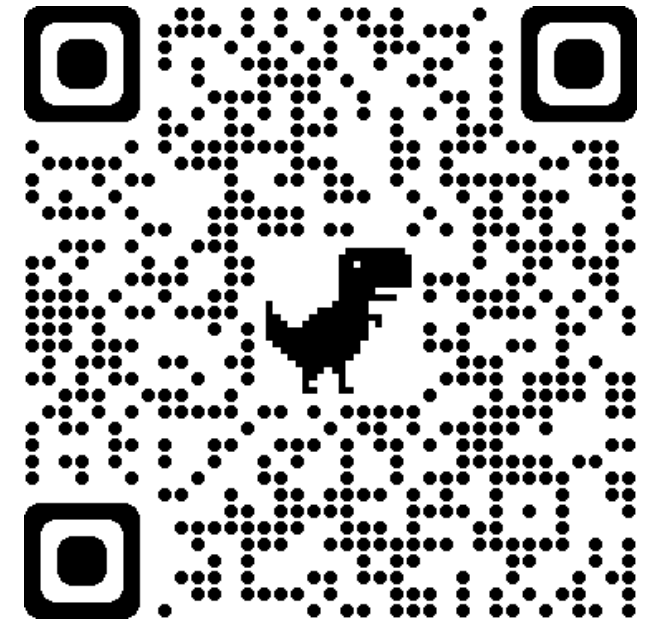
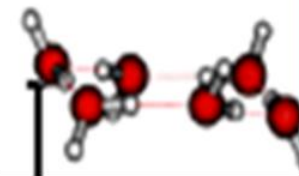
xilophone

Hexamer Boat



agogo

Hexamer Chair



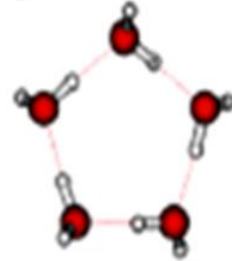
Bulk

Mapeamento da Sonificação



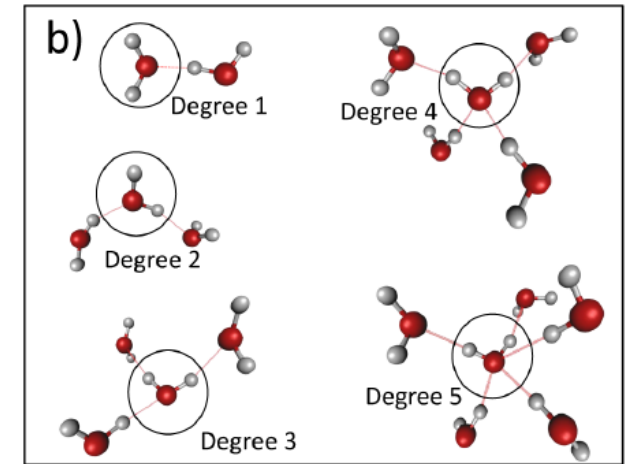
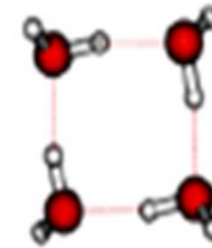
marimba

Cyclic Pentamer



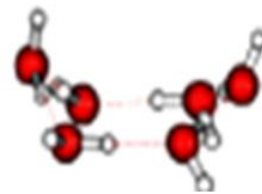
vibraphone

Cyclic Tetramer



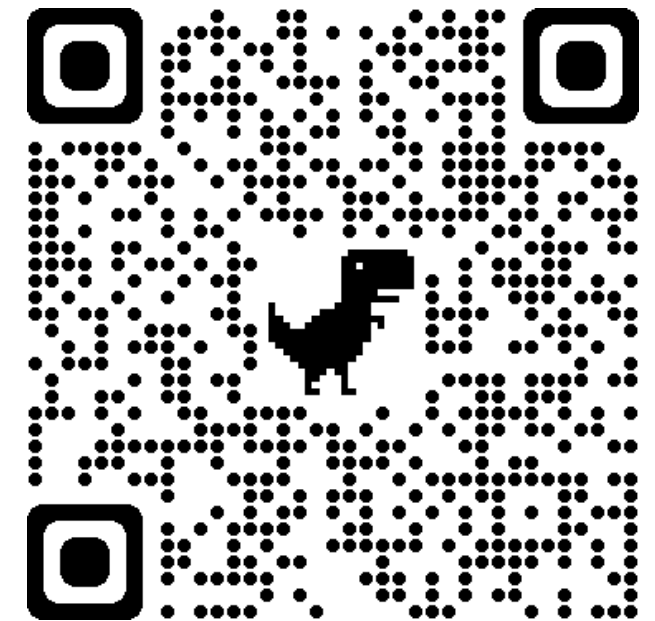
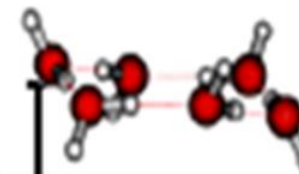
xilophone

Hexamer Boat



agogo

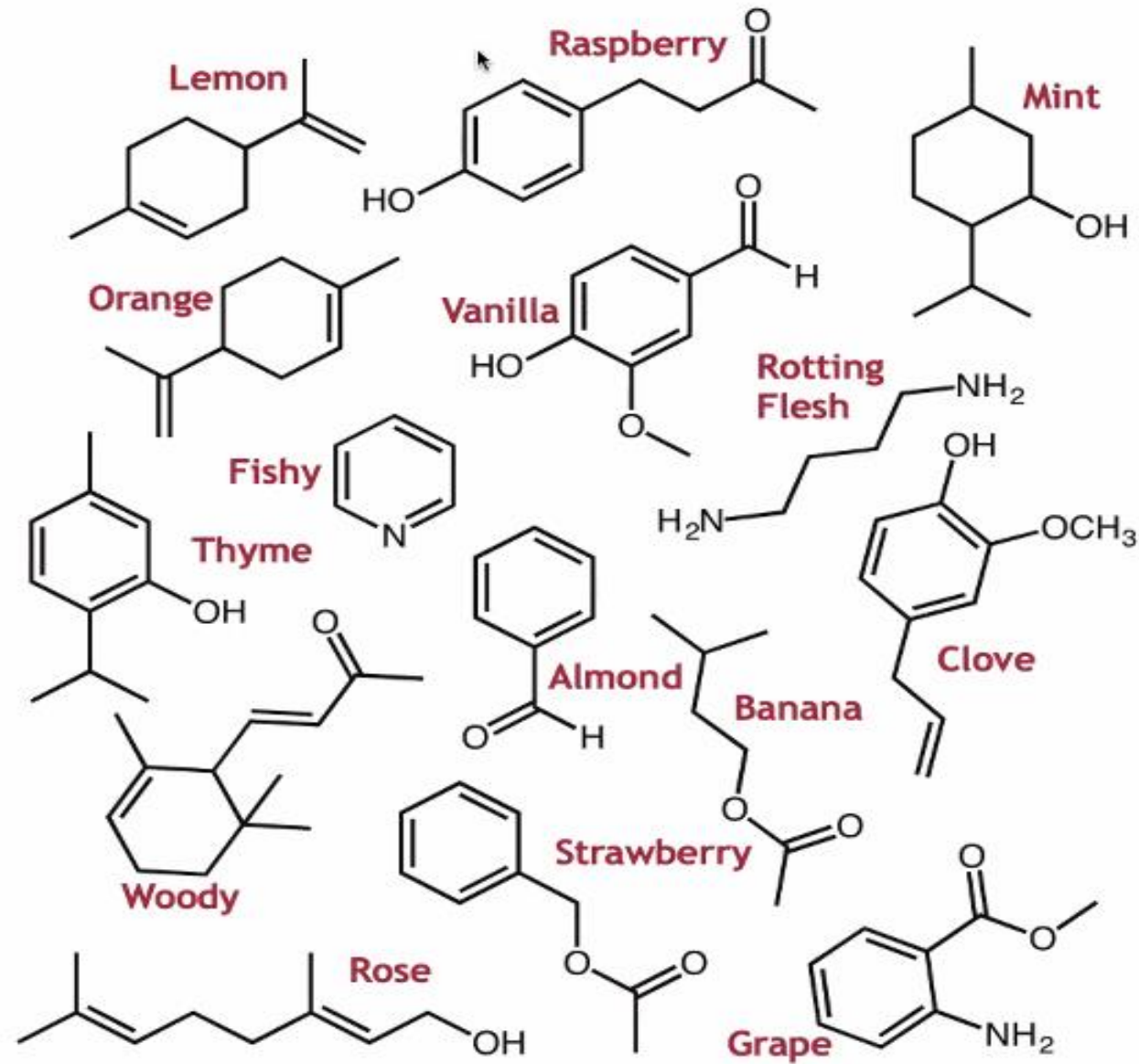
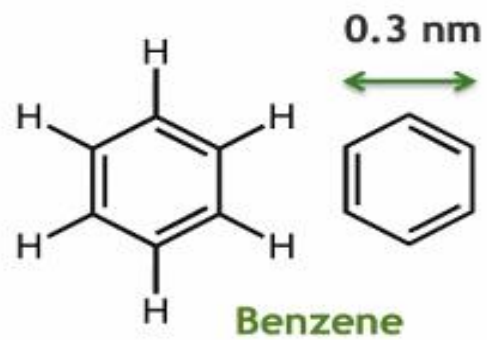
Hexamer Chair



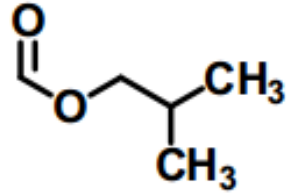
FÍSICA DOS CHEIROS

Cheiros ...

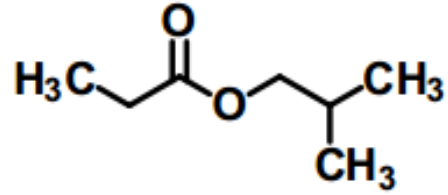
Scents are
nano-sized



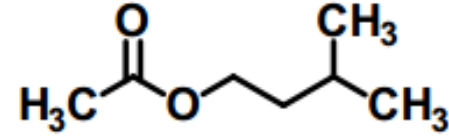
Cheiros ...



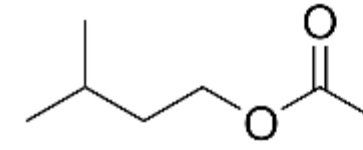
**Raspberry
Aroma**



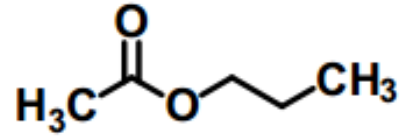
**Rum
Aroma**



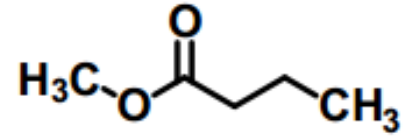
**Banana
Aroma**



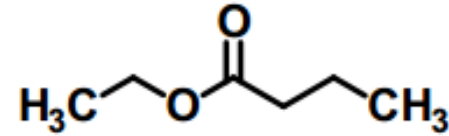
Isoamyl acetate



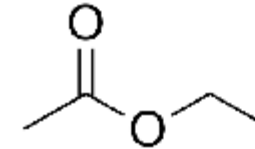
**Pear
Aroma**



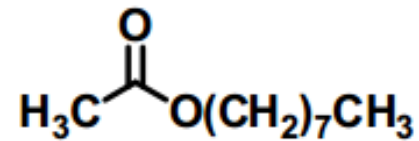
**Apple
Aroma**



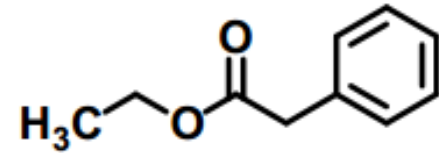
**Pineapple
Aroma**



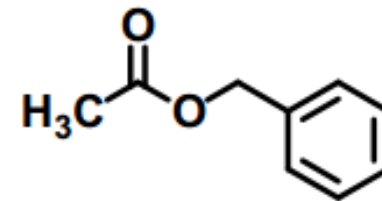
Ethyl acetate



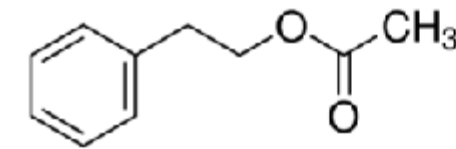
**Orange
Aroma**



**Honey
Aroma**



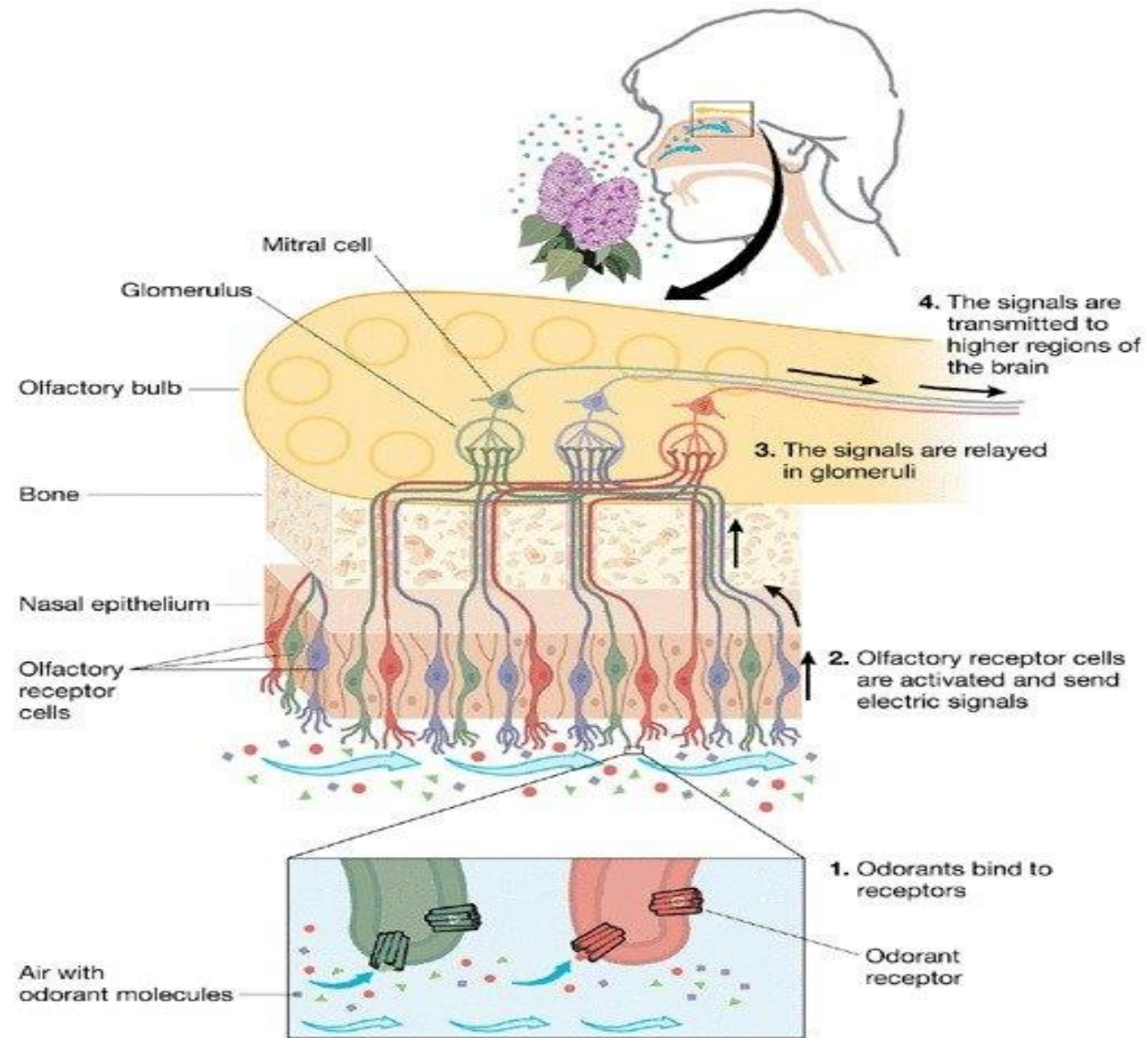
**Peach
Aroma**



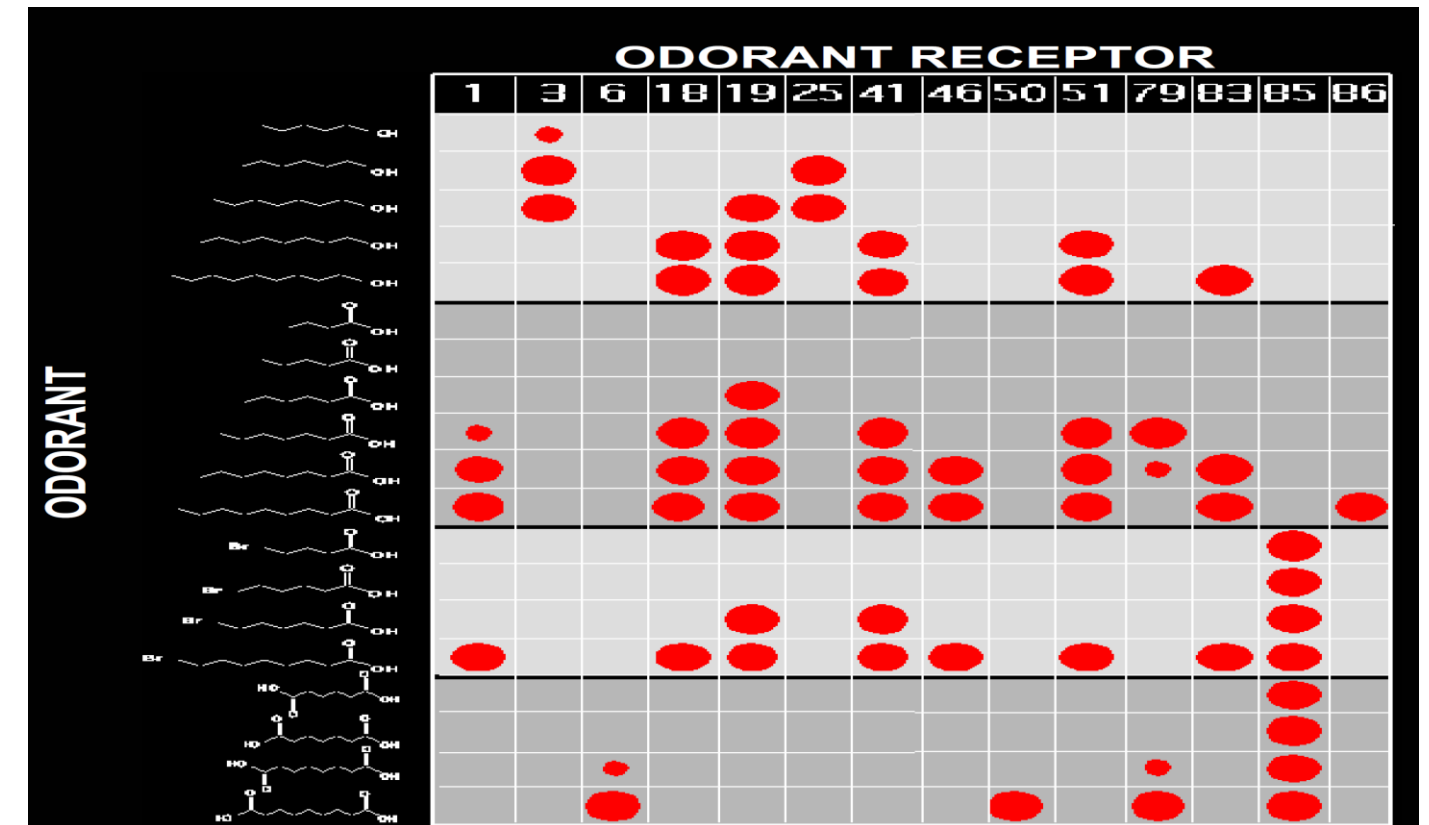
Phenylethyl acetate



Nosso sistema olfativo ...

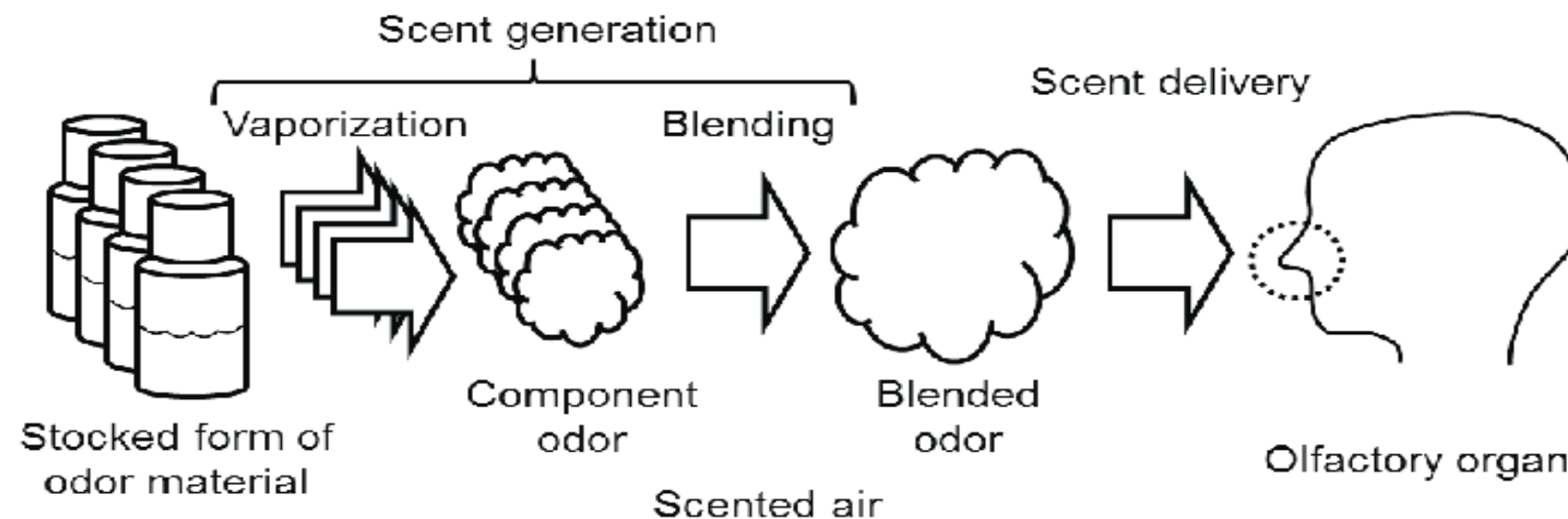


Odorantes são detectados pela combinação dos receptores



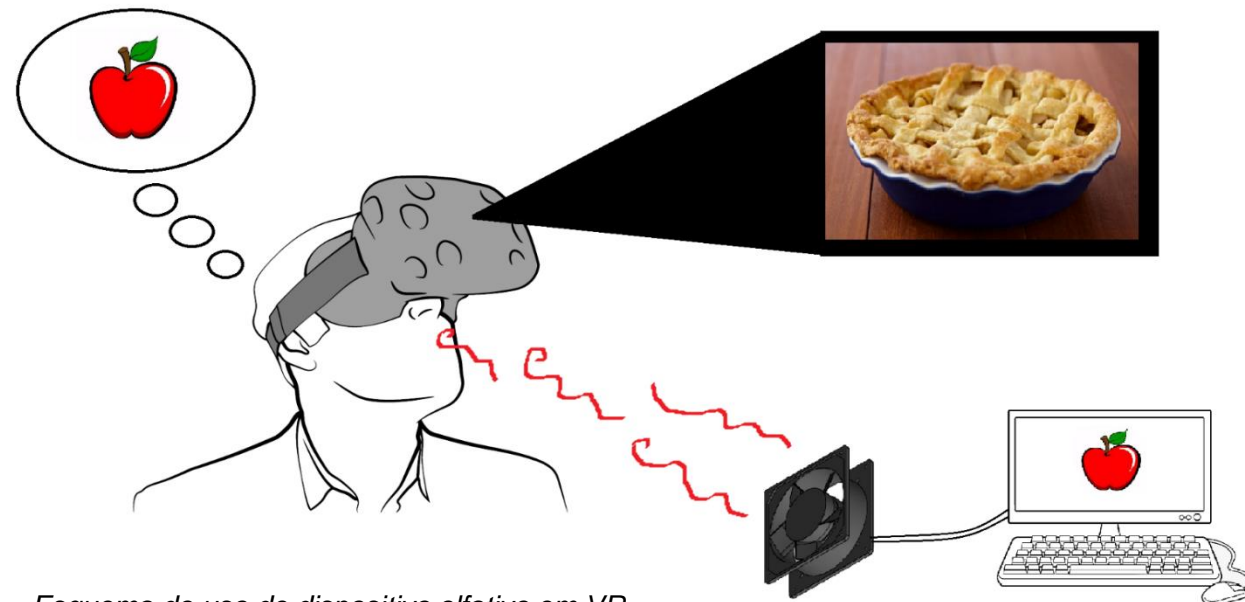
Dispositivos Aromatizadores

- A. Vaporização:** Produzir ar aromatizado a partir da sua forma estocada
- B. Mistura (Blending²):** Gerar ar aromatizado por meio da mistura dos componentes olfatórios desejados, variando sua concentração através da mistura ou troca entre os materiais emitidos.
- C. Entrega da Essência (Delivery²):** Transferência da essência do material da qual ela é emitida até o órgão olfativo humano.

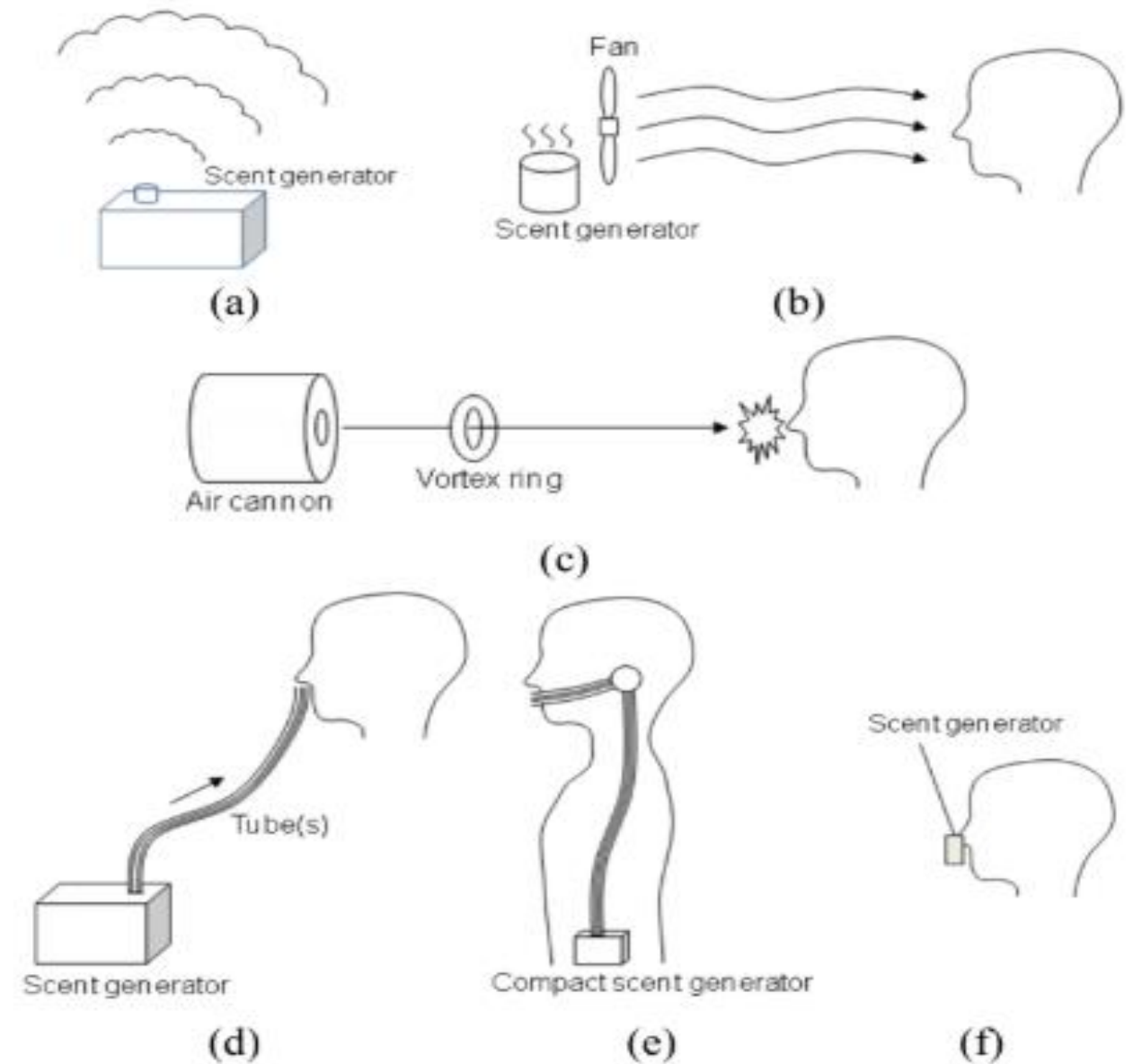
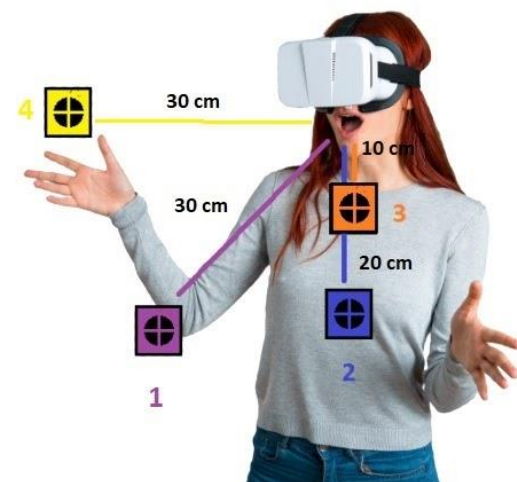
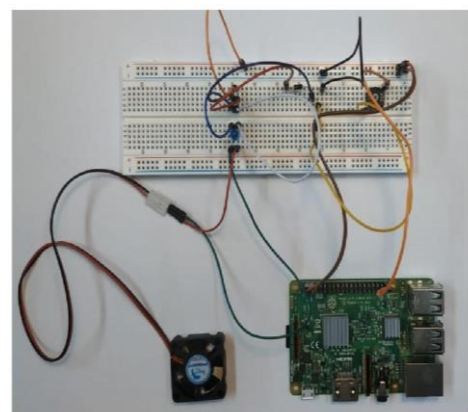


Física dos cheiros – por Dindara S. Galvão (IFUSP)

Cheiros e realidade virtual



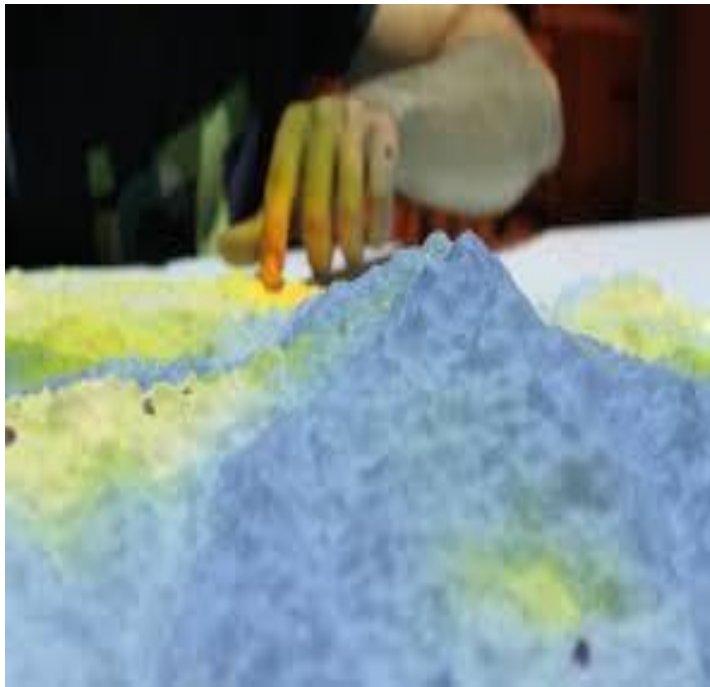
Esquema do uso de dispositivo olfativo em VR.



OUTRAS EXPERIMENTAÇÕES

Outras experiências ...

Tabletop Visual Analytics



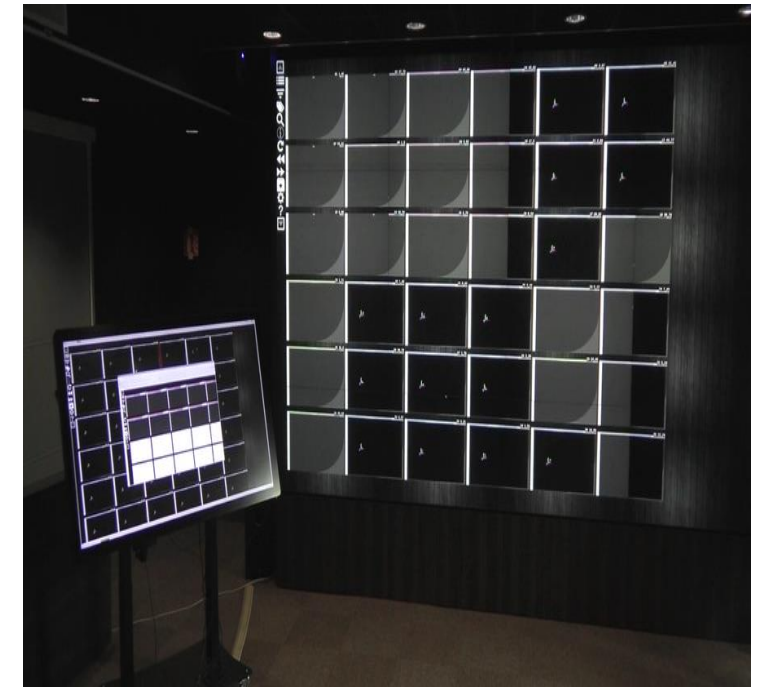
The concept of touching the data
Incorporating Tabletop Visual
Analytics into the Decision-making
Process. Turkey

Protein Wars



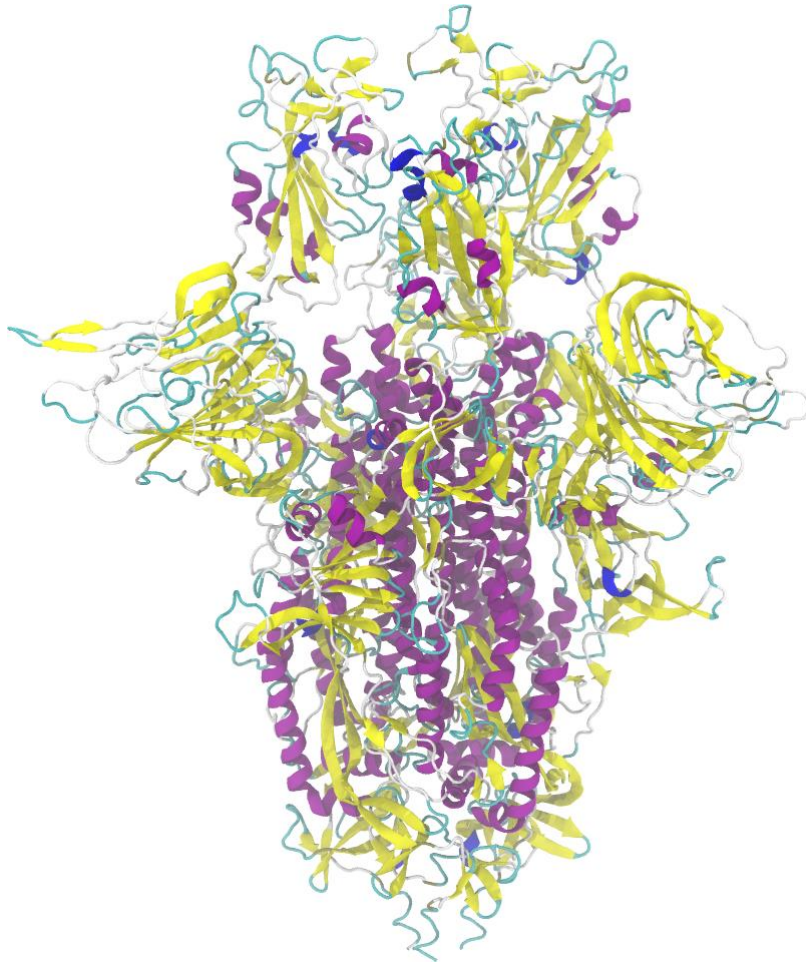
VMD based - Falcon Console
Controller - Feel the "Force"
Univ. do Porto - Portugal

TileViz

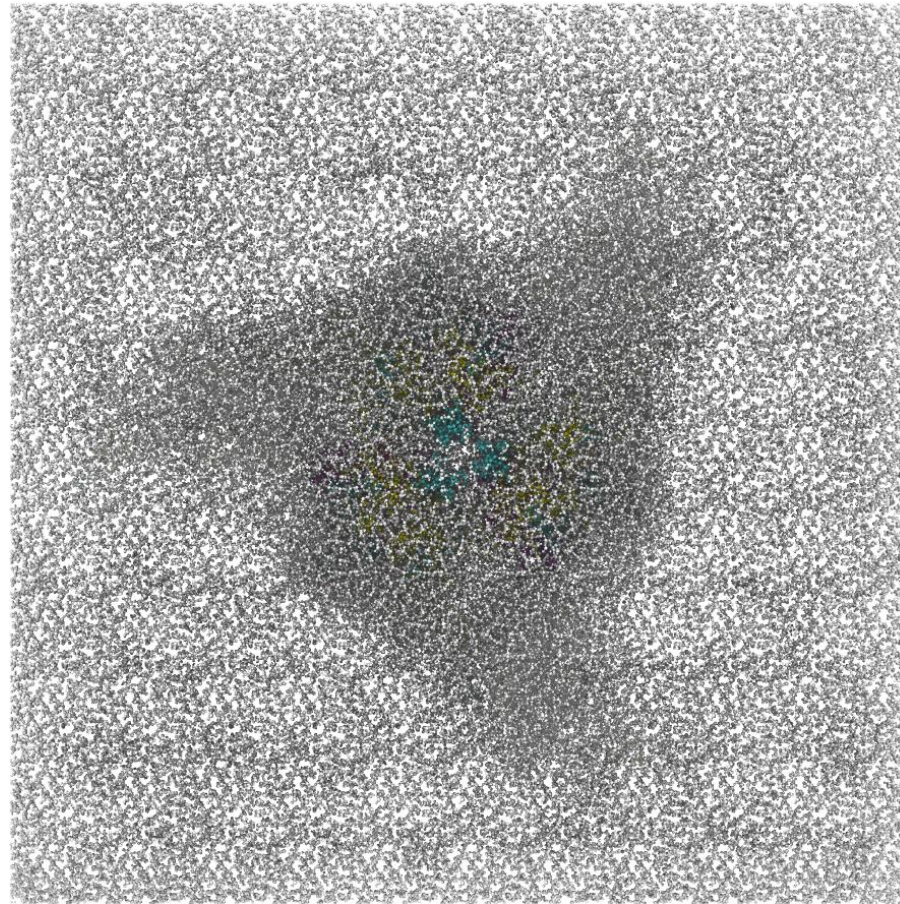


Tiled visualization and parallel
interactions for chemical reactions
Maison de la Simulation - France

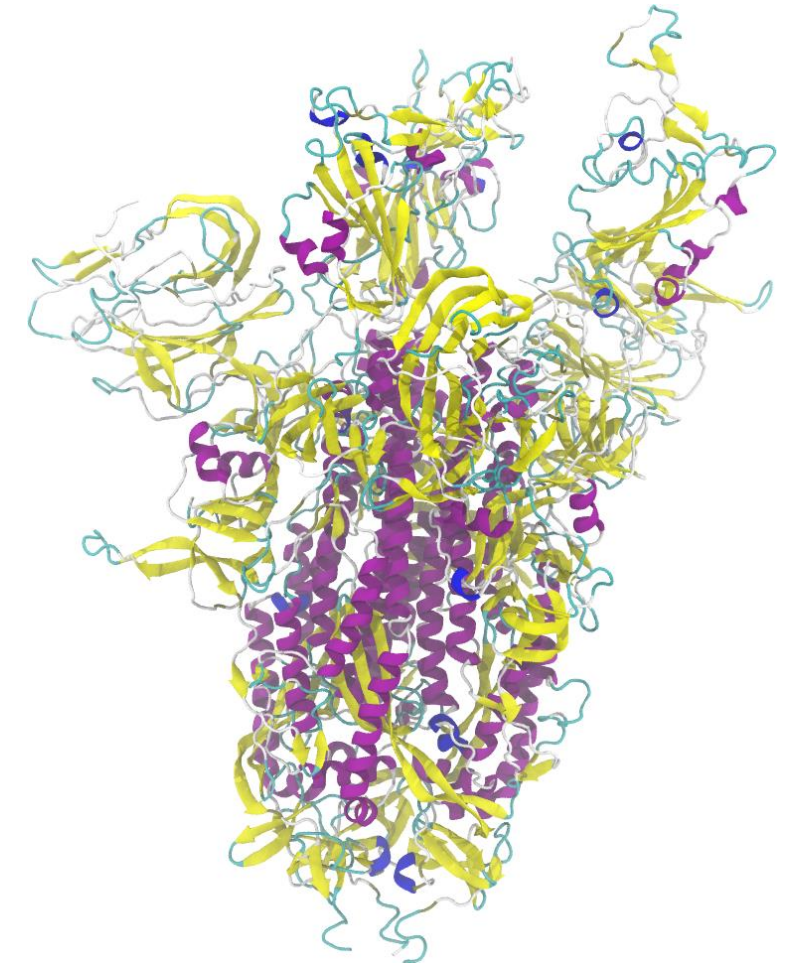
Sars-Cov-2 trimer spike protein



Crystallographic structure



Solvated protein



After 10 ns MD

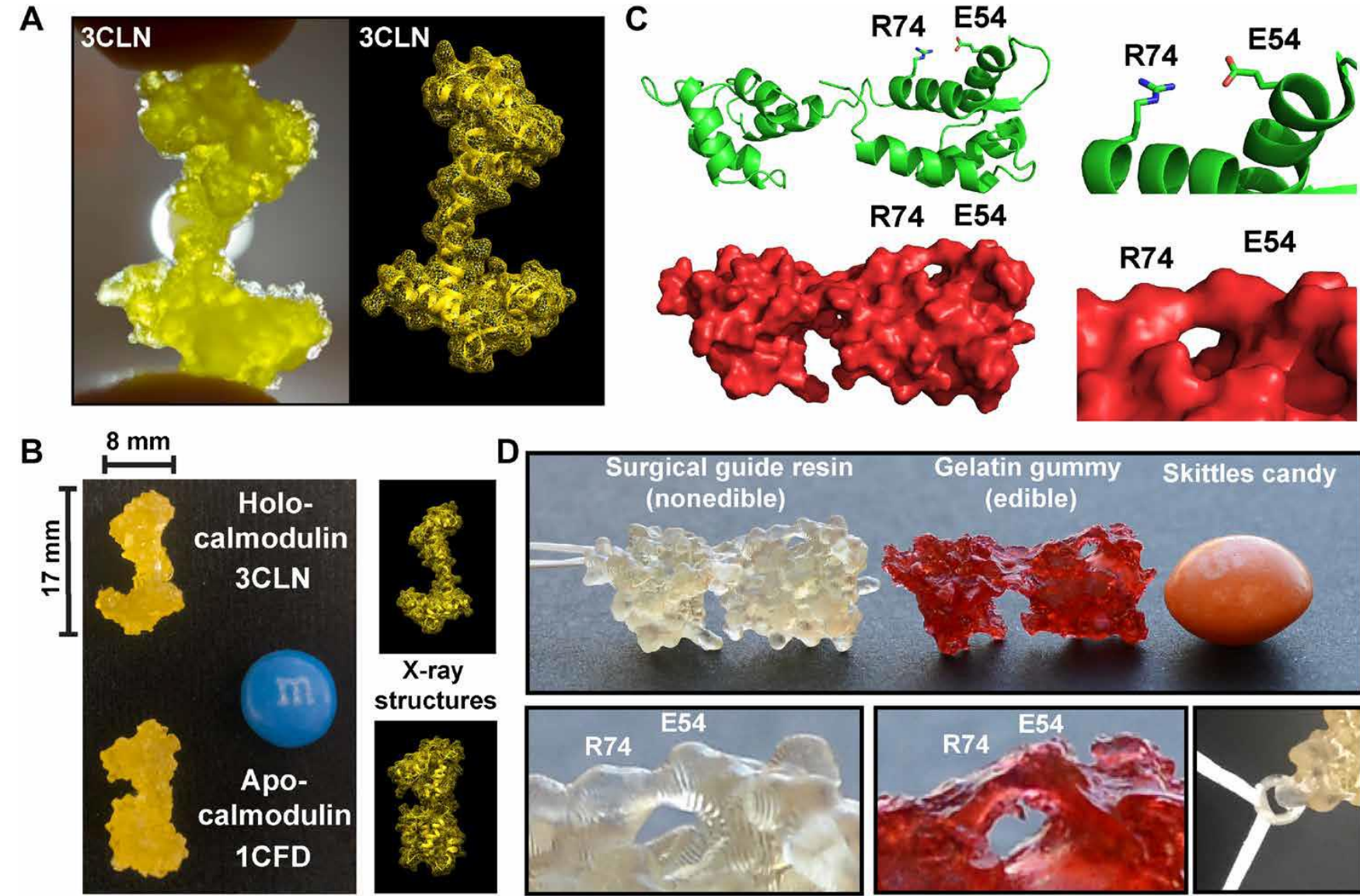
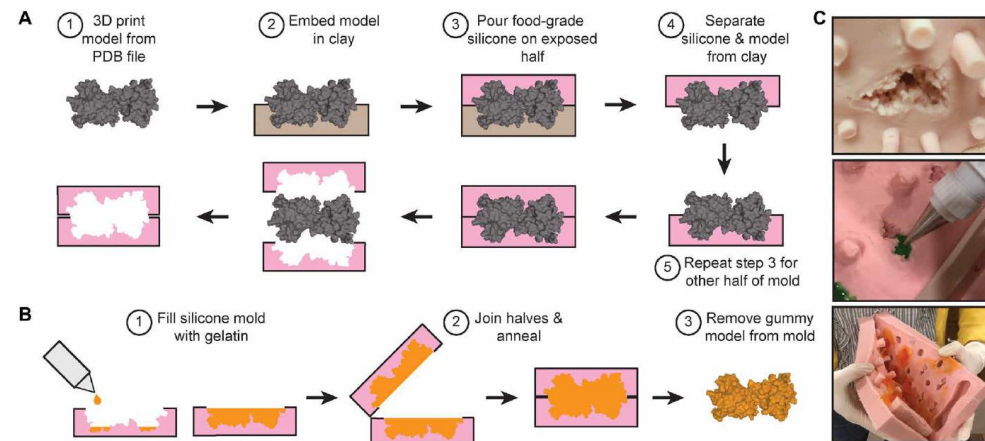
Reconhecendo modelos moleculares com as mãos e boca

SCIENCE ADVANCES | RESEARCH ARTICLE

NEUROSCIENCE

Visualizing 3D imagery by mouth using candy-like models

Katelyn M. Baumer, Juan J. Lopez, Surabi V. Naidu, Sanjana Rajendran, Miguel A. Iglesias, Kathleen M. Carleton, Cheyanne J. Eisenmann, Lillian R. Carter, Bryan F. Shaw*





O PAPEL SOCIAL DA FÍSICA

CONTRIBUIÇÕES EM ENSINO E EXTENSÃO

Em colaboração com: Dindara S. Galvão, Guilherme S. Santos, Gustavo Chagas, Raíssa S. Borges, Renata Biazzi, Suryendrani Baptistuta, Teresa D. Lanna

Graduação: Física Experimental (básico)

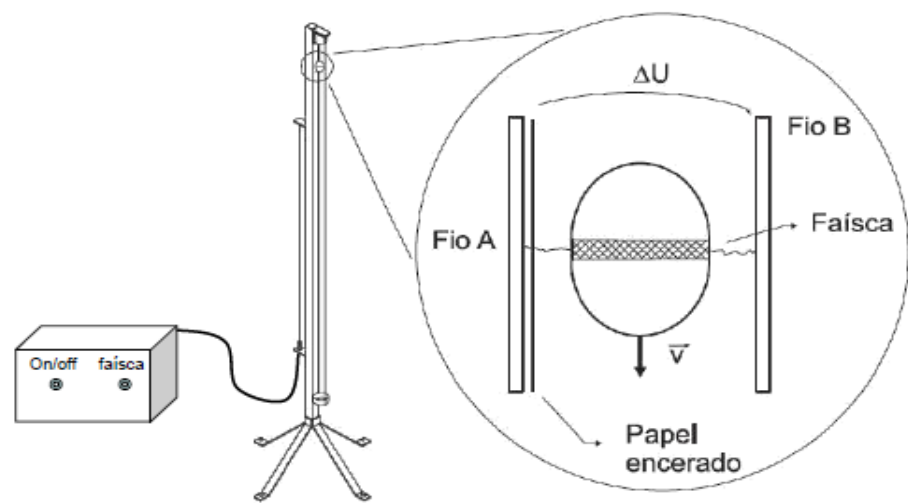
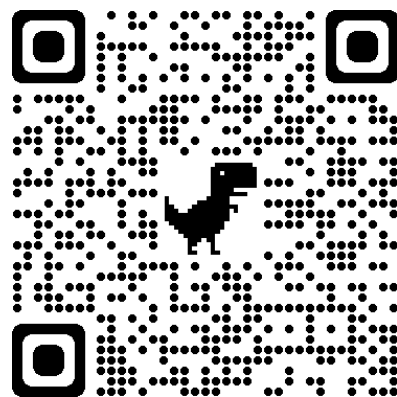


Figura 1. Detalhes do arranjo do experimento de queda livre. As faíscas provocadas pelos pulsos de alta tensão entre os dois fios marcam um papel termossensível colocado entre o "ovo" e o fio preso na coluna.

Conjuntos de dados

Para realizar as atividades, cada estudante deverá utilizar o arquivo de dados correspondendo ao algarismo final do seu número USP.

- dados distâncias de queda livre final 0.txt
- dados distâncias de queda livre final 1.txt
- dados distâncias de queda livre final 2.txt
- dados distâncias de queda livre final 3.txt
- dados distâncias de queda livre final 4.txt
- dados distâncias de queda livre final 5.txt
- dados distâncias de queda livre final 6.txt
- dados distâncias de queda livre final 7.txt
- dados distâncias de queda livre final 8.txt
- dados distâncias de queda livre final 9.txt



MARIAS: Transformando Realidades Através de Tecnologias Imersivas na Educação

Plataforma para recursos de aprendizado inclusivos e interativos

META: Promover, incentivar e apoiar estudantes de **baixa renda** e, principalmente, **mulheres e meninas** em C & T.

Experiências perceptivas e tecnologias emergentes usando:

1) Realidade virtual e sonificação

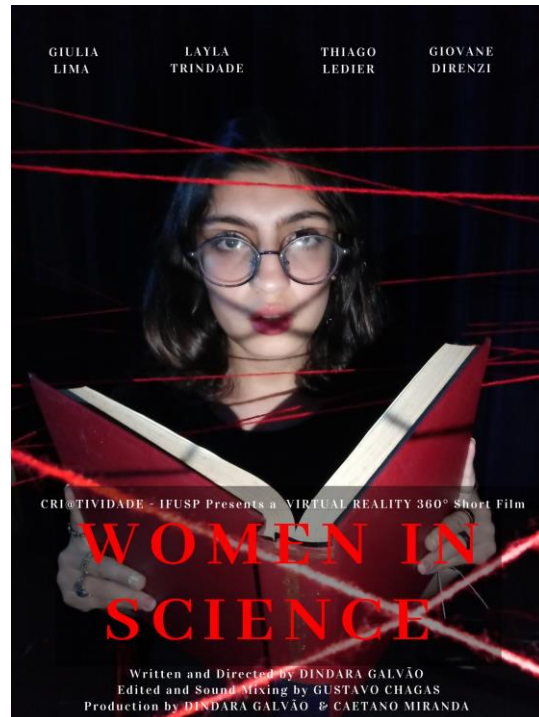
2) Experiências imersivas e inclusivas de baixo custo



Diversidade através de narrativas imersivas usando vídeos 360° Videos e Teatro de sombras



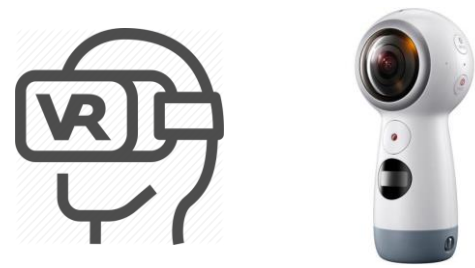
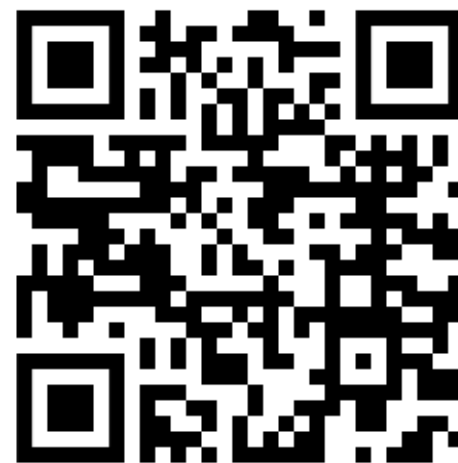
“Women in Science” por Dindara S. Galvão.



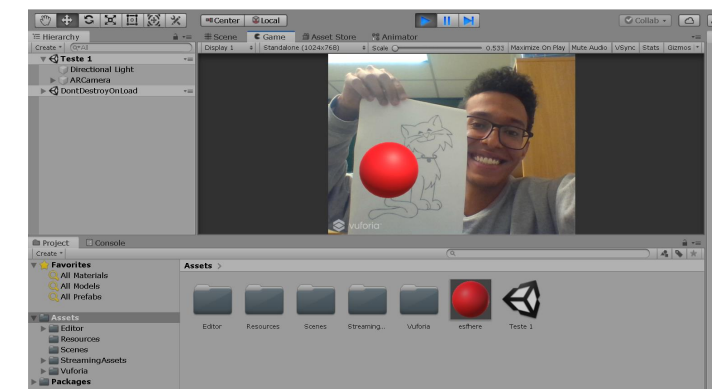
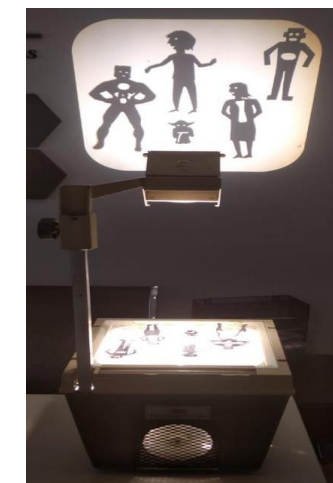
Teatro de sombras



Aventuras de Sofia: do átomo à nanotecnologia



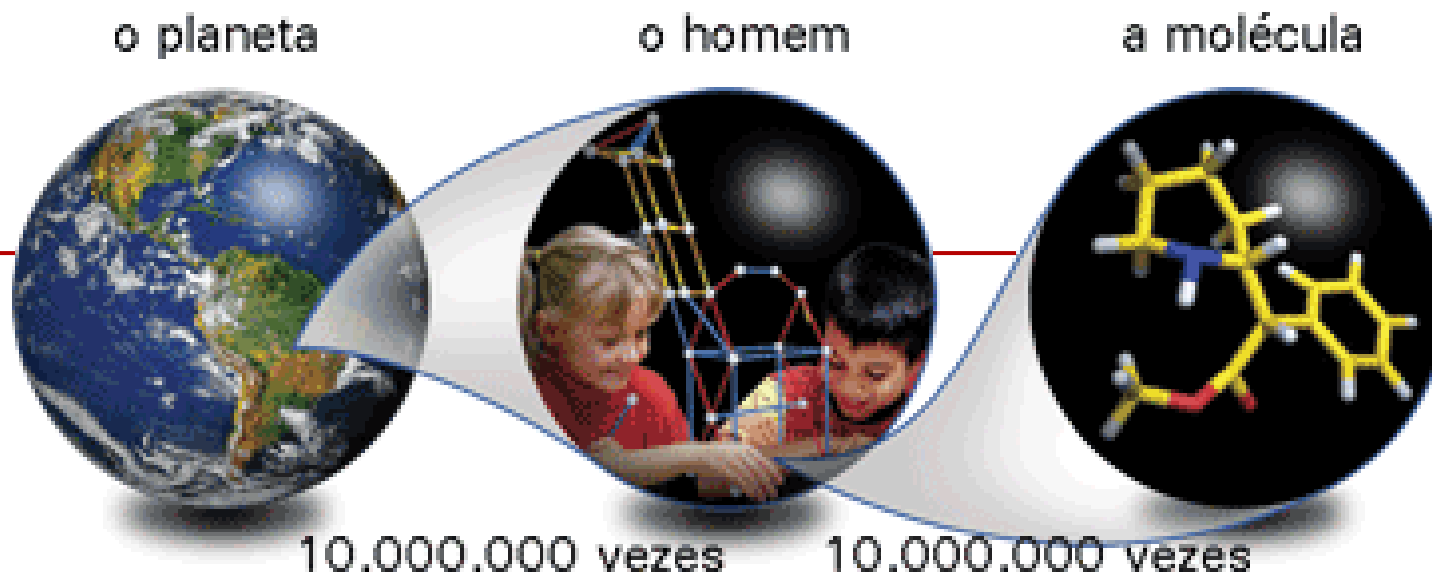
Camera Gear 360.



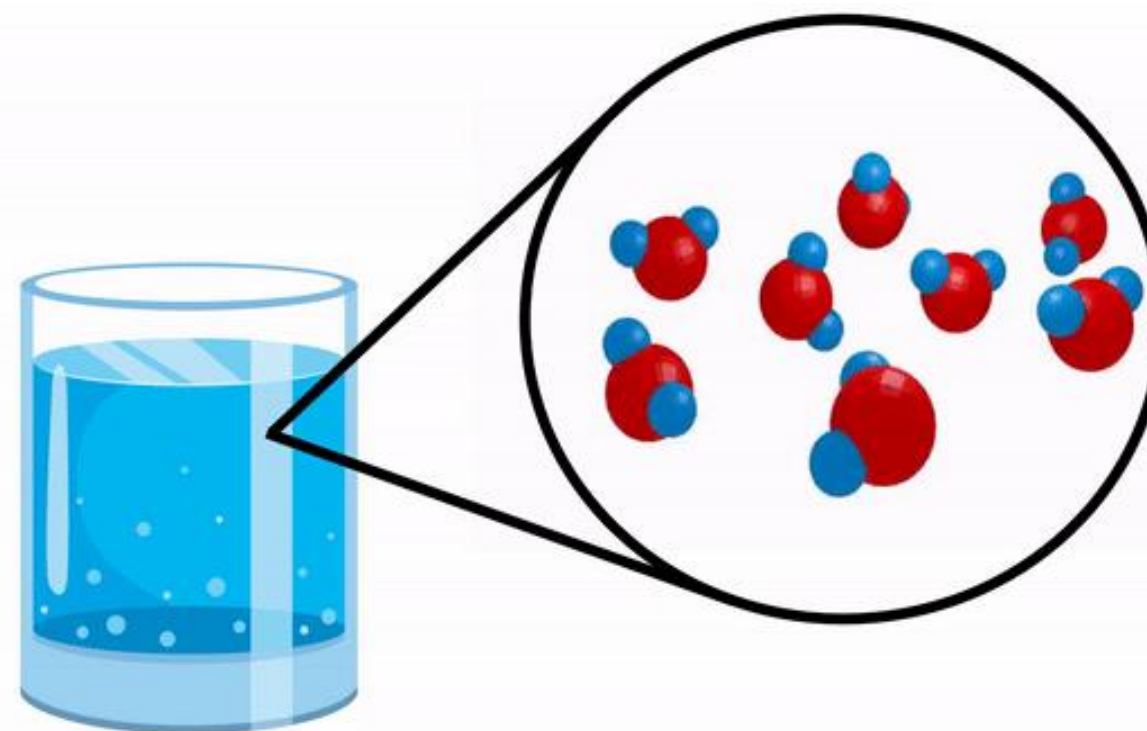
Grupos sub-representados no IFUSP

Moleculário

Planetário



⌘ O que é o Moleculário?



Conclusões

Forma alternativa de representar e analisar dados

Vivenciar escalas, lugares, situações e eventos dentro da sala de aula.

Exploração e percepção multidimensional intuitiva

Representando o invisível

Ciência de disseminação e melhoria da acessibilidade

Integrar / complementar experiências de imersão

Conexão com a arte (música)

Oportunidades de bolsas

Mestrado, Doutorado, Pós-doc

Grupo Sampa – IFUSP

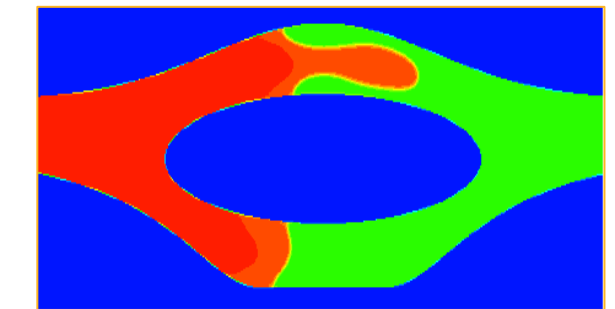
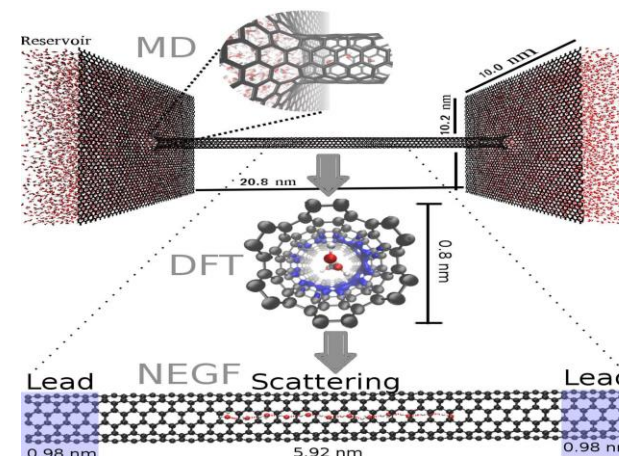
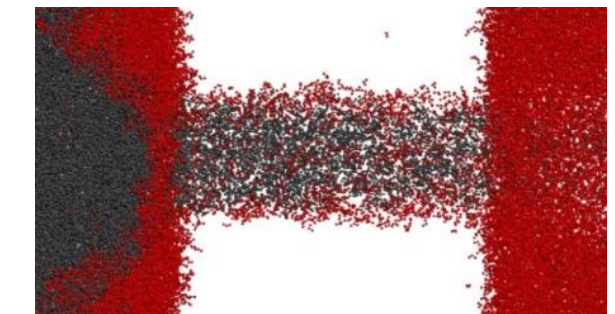
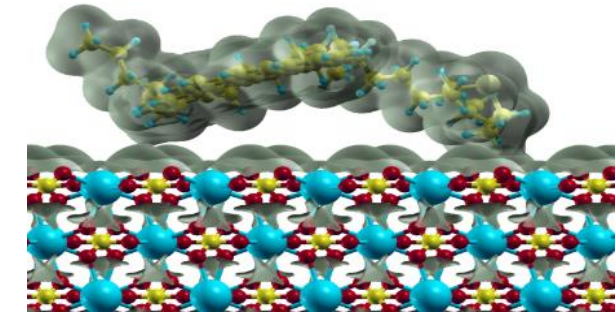


Nanotecnologia, Física dos Materiais e Tecnologias Imersivas

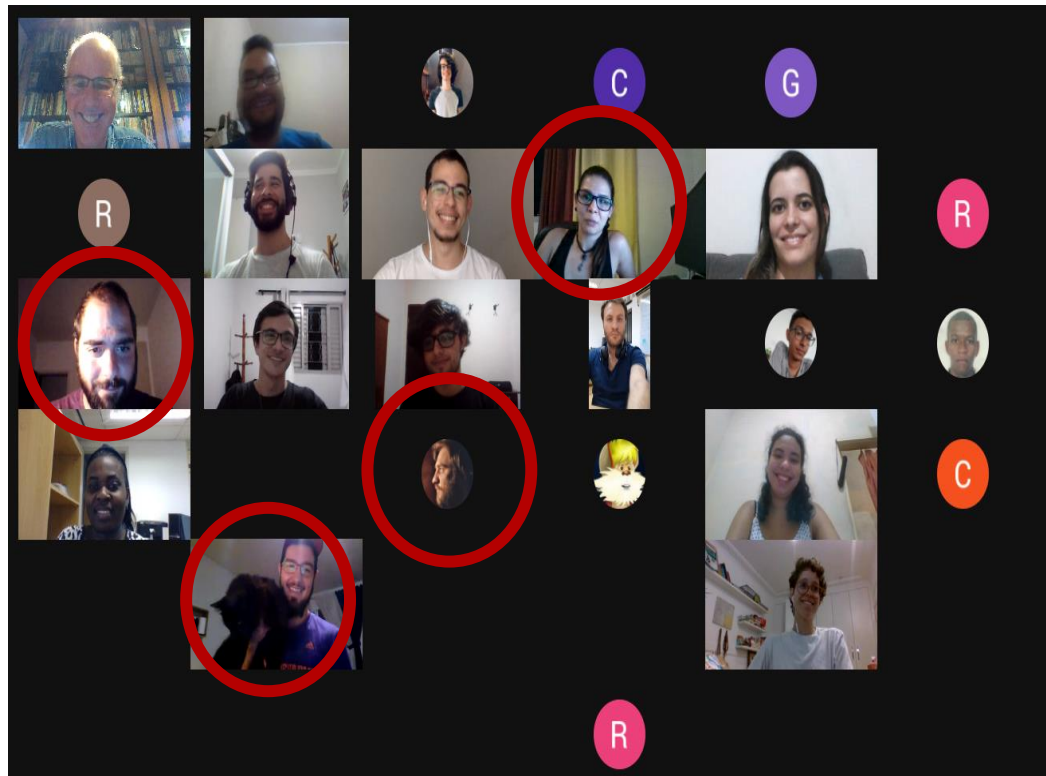
Contato: Prof. Caetano R. Miranda - crmiranda@usp.br

Financiamento: Temático FAPESP, CNPq, Bolsas de convenios Petrobras/Repsol/Shell

- **Nanotecnologia aplicada a Indústria do Petróleo e Gás, Energia renováveis, Infraestrutura e Alimentos**
- **Simulações computacionais em Multiescala e Aprendizado de Máquina**
- **Materiais sob condições extremas e nanofluídica**
- **Física Perceptiva, Realidade Virtual e Sonificação**



Team @ NanoPetro / Sampa



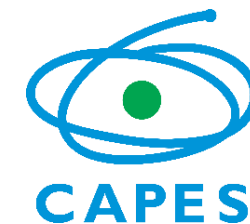
Dan Ni Li
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Dindara S. Galvão
Guilherme S. Santos
Gustavo Chagas
Gustavo Kenzo
Matheus Marim Silva
Otávio Augusto
Rafael dos Santos
Raíssa S. Borges
Renan Sampaio

Angele Aja Fowe
Carlos Martins
Jacqueline Teixeira
Matheus Finamor
Teresa D. Lanna
V. F. S. Mamani
Wellington Luiz

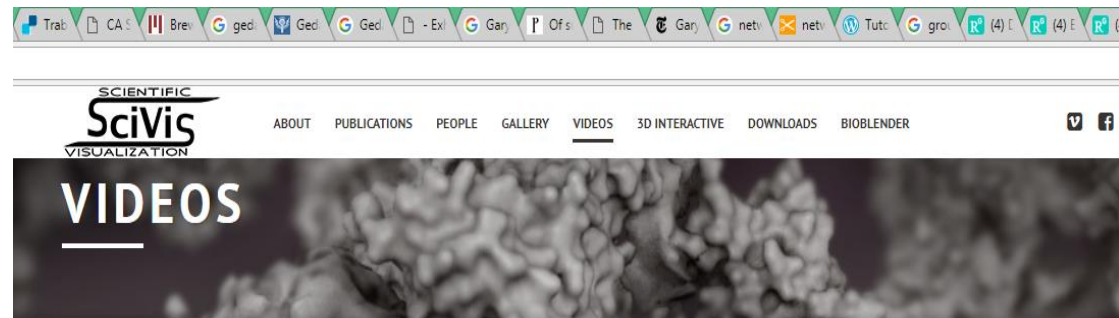
Alexsandro Kirch
Alvaro Torrez
Bruno F. Zornio
Camilo A. F. Salvador
Daniela A. Damasceno
Henrique M. Cezar
Paulo Amaral



PETROBRAS



Animações e jogos



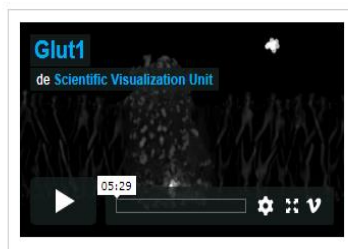
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DARK ANIM



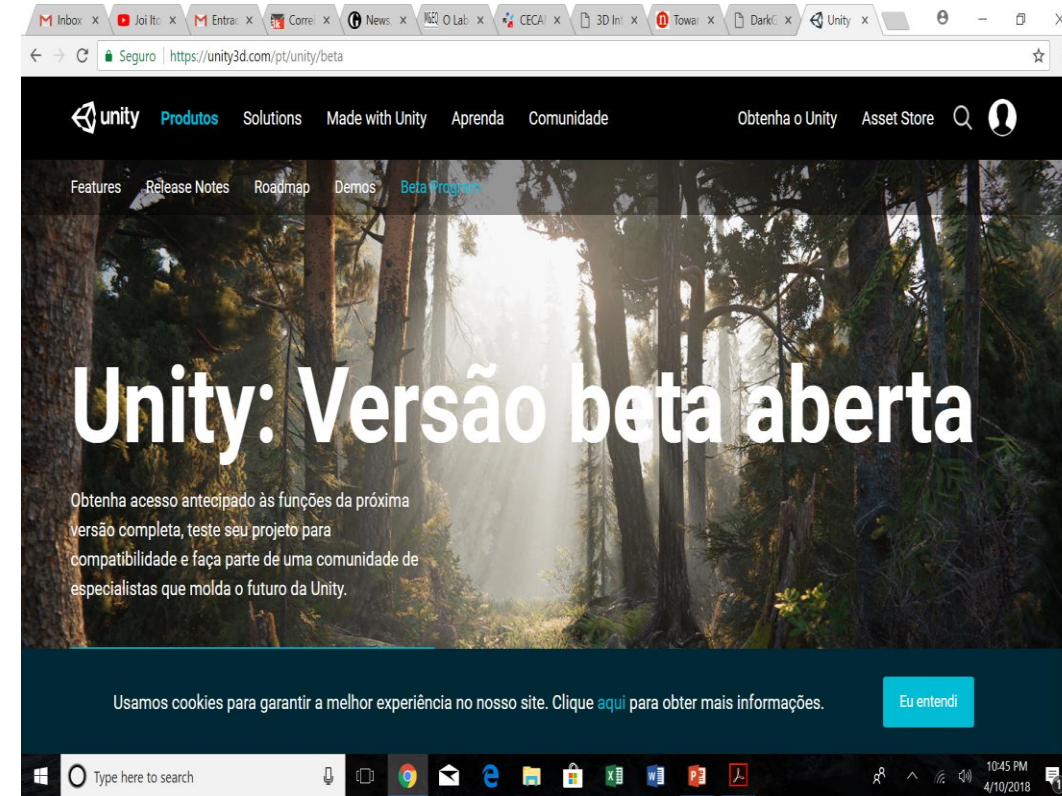
THE CHALLENGE OF HIV RESEARCH



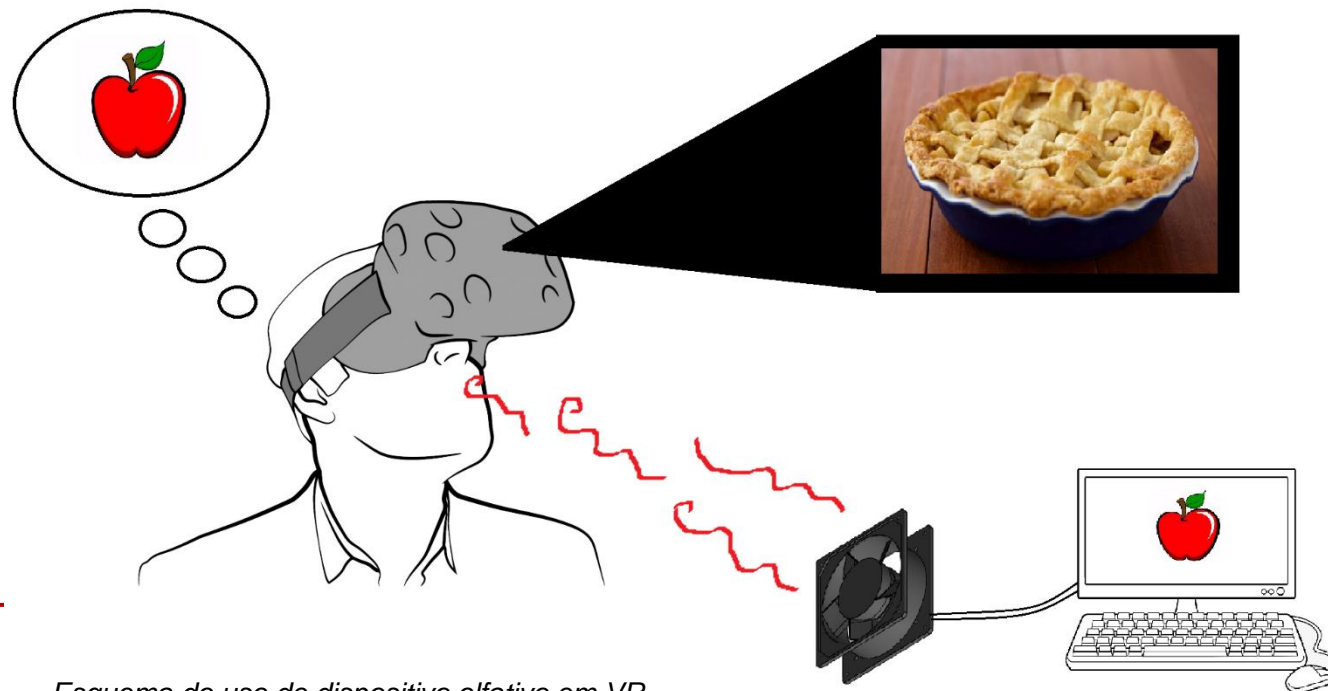
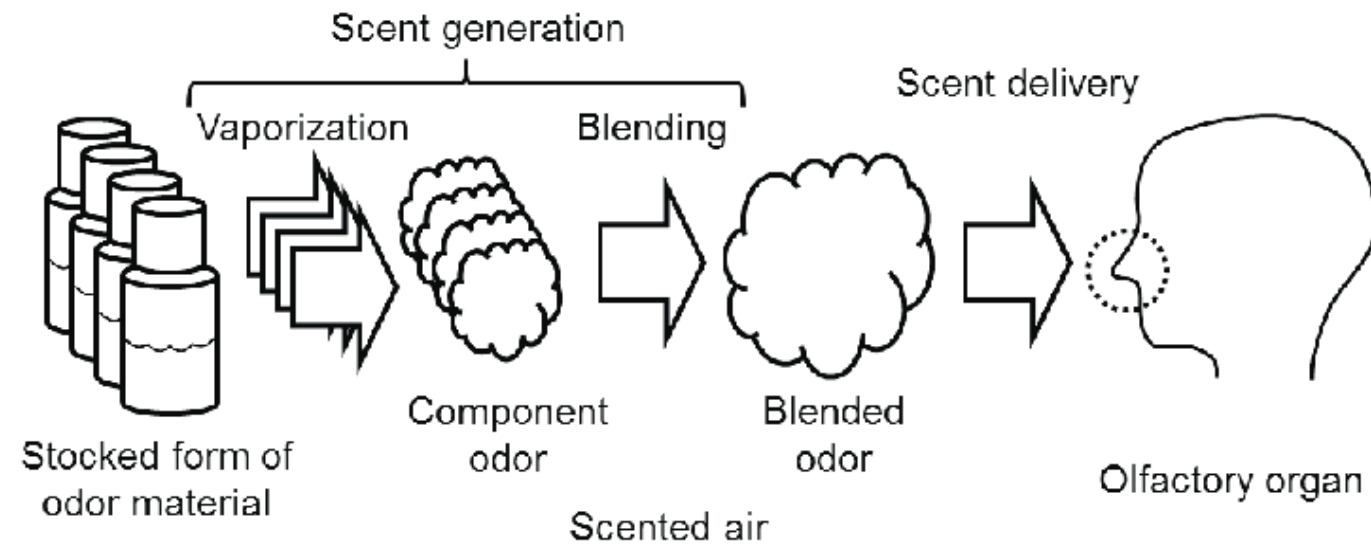
GLUT1 - GLUCOSE TRANSPORTER



DILATED CARDIOMYOPATHY - A MOLECULAR VIEW



Física dos cheiros – por Dindara S. Galvão (IFUSP)



Esquema do uso de dispositivo olfativo em VR.

