



**TROX®** TECHNIK  
The art of handling air



## DISEÑOS DE SISTEMAS EN AMBIENTES CONTROLADOS:

- 1. Requisitos del diseño**
- 2. Control de zonas críticas**
- 3. Aseguramiento de la calidad del aire**
- 4. Análisis de consumos energéticos**
- 5. Criterios de diseño (sugerencia)**

AULA ONDOAN. Ambientes controlados 2018  
Javier Aramburu  
Director Técnico de TROX España

# 1. Requisitos de diseño



## 2. Control de zonas críticas. Filtración absoluta

Tabelle 1 — Klassifikation von EPA, HEPA und ULPA-Filtern

| Filtergruppe<br>Filterklasse | Integralwert         |                      | Lokalwert <sup>a,b</sup> |                      |
|------------------------------|----------------------|----------------------|--------------------------|----------------------|
|                              | Abscheidegrad<br>(%) | Durchlassgrad<br>(%) | Abscheidegrad<br>(%)     | Durchlassgrad<br>(%) |
| E10                          | ≥ 85                 | ≤ 15                 | — <sup>c</sup>           | — <sup>c</sup>       |
| E11                          | ≥ 95                 | ≤ 5                  | — <sup>c</sup>           | — <sup>c</sup>       |
| E12                          | ≥ 99,5               | ≤ 0,5                | — <sup>c</sup>           | — <sup>c</sup>       |
| H13                          | ≥ 99,95              | ≤ 0,05               | ≥ 99,75                  | ≤ 0,25               |
| H14                          | ≥ 99,995             | ≤ 0,005              | ≥ 99,975                 | ≤ 0,025              |
| U15                          | ≥ 99,999 5           | ≤ 0,000 5            | ≥ 99,997 5               | ≤ 0,002 5            |
| U16                          | ≥ 99,999 95          | ≤ 0,000 05           | ≥ 99,999 75              | ≤ 0,000 25           |
| U17                          | ≥ 99,999 995         | ≤ 0,000 005          | ≥ 99,999 9               | ≤ 0,000 1            |

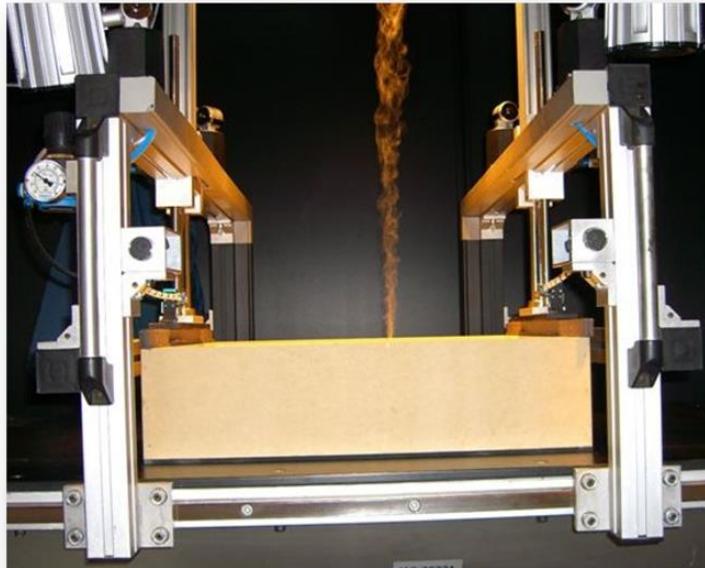
<sup>a</sup> Siehe 7.5.2 und EN 1822-4.

<sup>b</sup> Zwischen Lieferer und Käufer können niedrigere Lokalwerte als die in der Tabelle vereinbart werden.

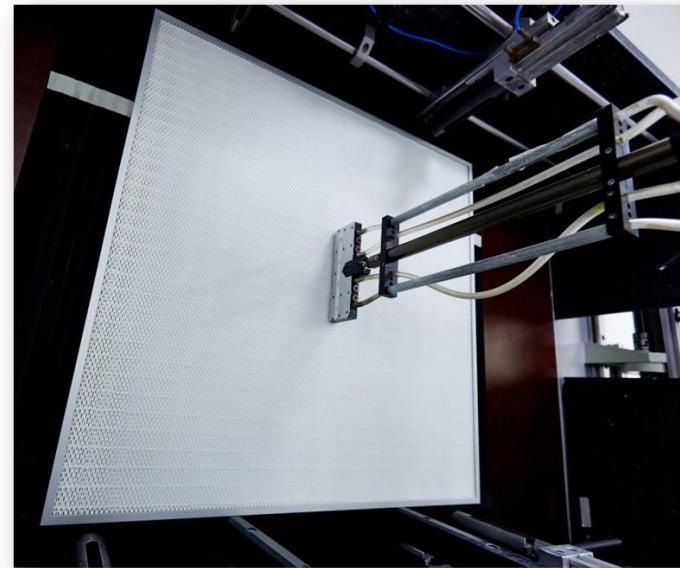
<sup>c</sup> Für die Einteilung von Filtern der Gruppe E (Klassen E10, E11 und E12) ist eine Leckprüfung nicht möglich und nicht erforderlich.



## 2. Control de zonas críticas. Filtración absoluta



Niebla de aceite, hasta H13 y  
filtros no planos

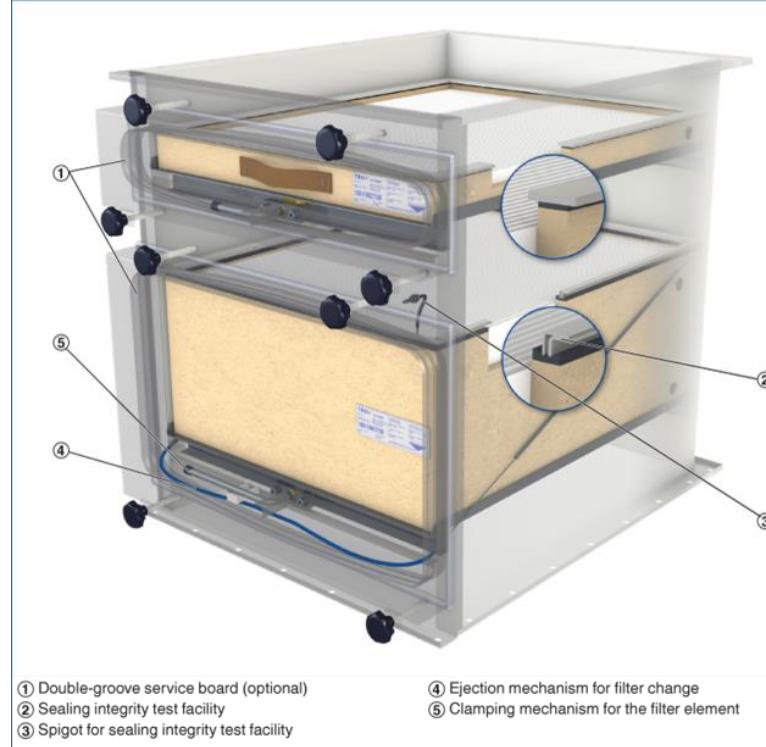


Scan test, desde H13 hasta U17

## 2. Control de zonas críticas. Filtración absoluta



Schematic illustration of KSFS



- Estanqueidad del filtro
- Eficacia del filtro
- Estanqueidad de la junta

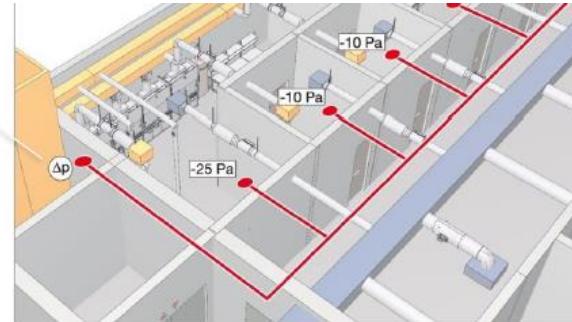
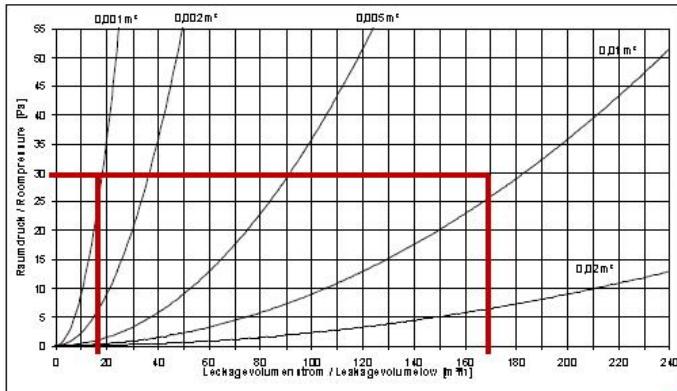
① Double-groove service board (optional)  
② Sealing integrity test facility  
③ Spigot for sealing integrity test facility

④ Ejection mechanism for filter change  
⑤ Clamping mechanism for the filter element

## 2. Control de zonas críticas. Presión diferencial

$$\Delta p = \frac{\rho}{2} * \left( \frac{V}{A * \mu} \right)^2$$

Referencia a presión constante y estable

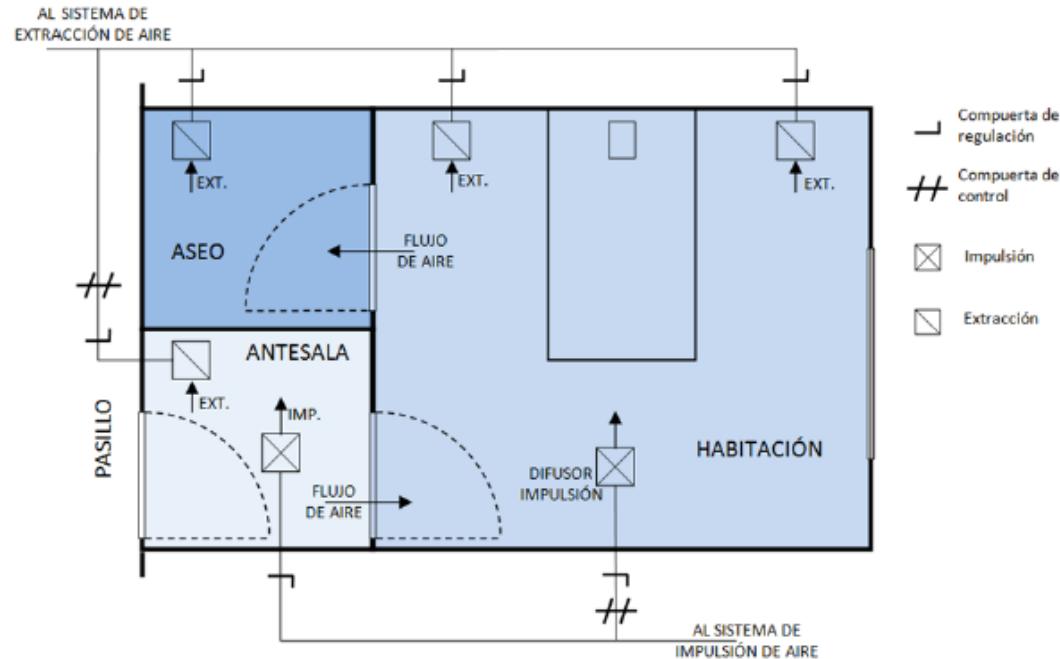


Con ranuras de sección muy pequeña se producen grandes variaciones de presión con el caudal

Con ranuras de sección mayor es más fácil el control de la diferencia de presión



## 2. Control de zonas críticas.



## 2. Control de zonas críticas. Quirófano tipo B

- 2.400 m<sup>3</sup>/h
- Turbulento
- 5,0 – 6,0 m/s
- 600x600 / 625x625
- 2.400 m<sup>3</sup>/h (40 m<sup>2</sup>)

CAUDAL



- Eficacia H13-H14
- Colmatación del filtro: 600 Pa
- EN 1822

FILTRACIÓN



- Caudal en función de sobrepresión (+10 Pa)
- Retorno superior e inferior (1.200 m<sup>3</sup>/h)

RETORNO



**Aire exterior mínimo 1.200 m<sup>3</sup>/h**

**¿Recirculación?**



## 2. Control de zonas críticas. Quirófano tipo B



Tiempo de permanencia estable 30-60 s

Trayectoria de flujo errática con la mismas características en cualquier punto



## 2. Control de zonas críticas. Quirófano tipo A

- 3.600 m<sup>3</sup>/h
- Unidireccional
- 0,25 – 0,35 m/s
- 4,0 – 7,5 m<sup>2</sup>
- 8.100 m<sup>3</sup>/h

CAUDAL



- Eficacia H14
- Colmatación del filtro: 600 Pa
- EN 1822

FILTRACIÓN



- Caudal en función de sobrepresión (+20 Pa)
- Retorno superior e inferior (1.200 m<sup>3</sup>/h)

RETORNO

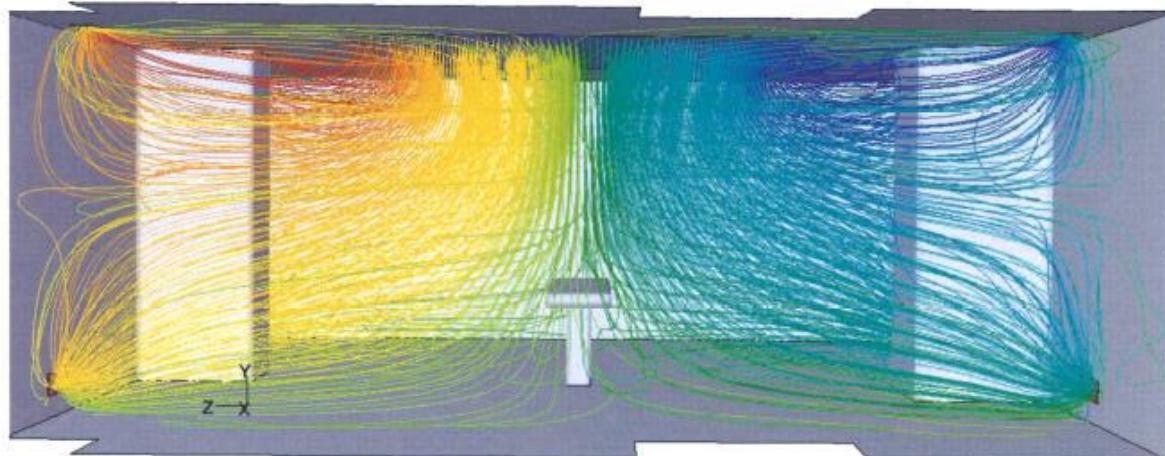


**Aire exterior mínimo 1.200 m<sup>3</sup>/h**

**¿Recirculación?**

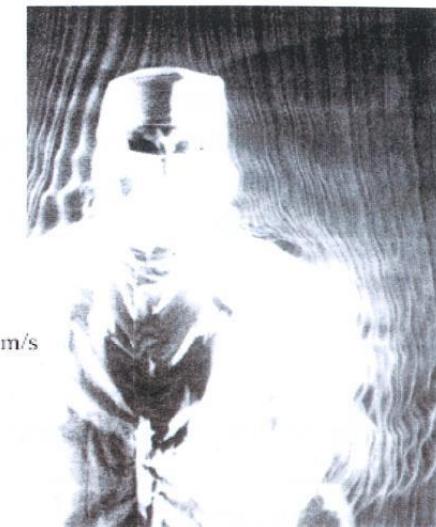


## 2. Control de zonas críticas. Quirófano tipo A



Tiempo de permanencia estable 80-120 s

Trayectoria de flujo equilibrada y protección zona de operación



## 2. Control de zonas críticas. Quirófano tipo A

- Mayores caudales de impulsión
- Mayores UTAS y consumo
- Caudal UNE 100713: 3.200/2.400 m<sup>3</sup>/h
- Recirculación en quirófano



### UNE 100713

*A pesar de la indicación de 1.200 m<sup>3</sup>/h de aire exterior, la recomendación es que la totalidad del aire impulsado en el quirófano sea del exterior.*

| PARAMETRO                  | ESPAÑA | ALEMANIA     | UK            |
|----------------------------|--------|--------------|---------------|
| CAUDAL DE AIRE EXTERIOR    | 1.200  | 1.200        | 10 - 25 Ren/h |
| CAUDAL DE IMPULSION TIPO A | 3.600  | 9.200        | 4.125 (25)    |
| CAUDAL DE IMPULSION TIPO B | 2.400  | 3.000        | 4.125 (25)    |
| TEMPERATURA AMBIENTE       | 22-26  | 19-26        | 18-25         |
| HUMEDAD AMBIENTE           | 45-55  | 30-50        | 35-60         |
| TEMPERATURA DE IMPULSION   |        | T amb - 3 °C | T amb - 7 °C  |

- UNE 100713. Instalaciones de acondicionamiento de aire en hospitales (España)
- DIN 1946-4:2008. VAC systems in buildings and rooms used in the health care sector (Alemania)
- HTM 03-01. Specialised ventilation for healthcare premises (UK)

### 3. Filtros: Nueva eficacia EN-16890

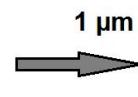
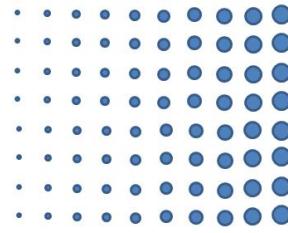
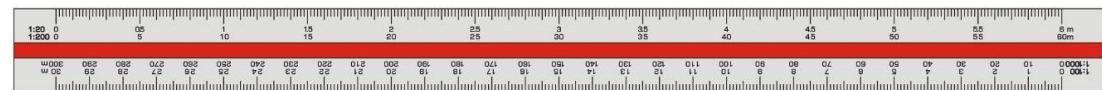
**PM (Fracción de partícula de materia)**

**Todas las partículas hasta el tamaño**

| PM1  | PM2,5  | PM10  |
|------|--------|-------|
| 1 µm | 2,5 µm | 10 µm |

Porción inhalable de emisiones.  
Contaminación de partículas de materia

- **PM1**
- **PM2,5**
- **PM10**



### 3. Filtros: Nueva eficacia EN-16890

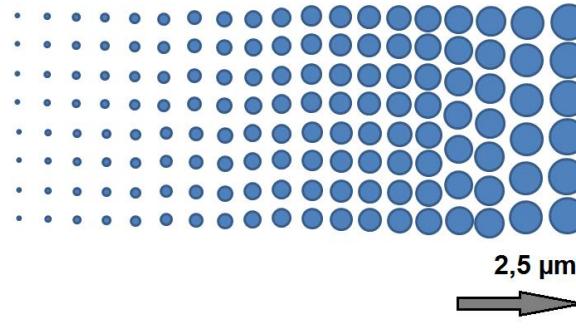
**PM (Fracción de partícula de materia)**

**Todas las partículas hasta el tamaño**

| PM1             | PM2,5             | PM10             |
|-----------------|-------------------|------------------|
| 1 $\mu\text{m}$ | 2,5 $\mu\text{m}$ | 10 $\mu\text{m}$ |

Porción inhalable de emisiones.  
Contaminación de partículas de materia

- PM1
- **PM2,5**
- PM10



### 3. Filtros: Nueva eficacia EN-16890

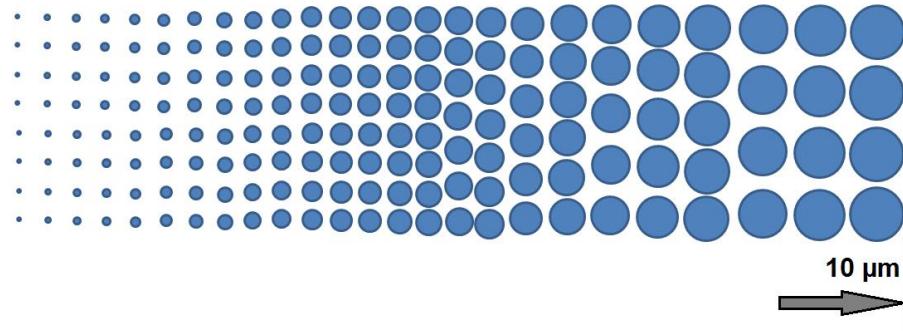
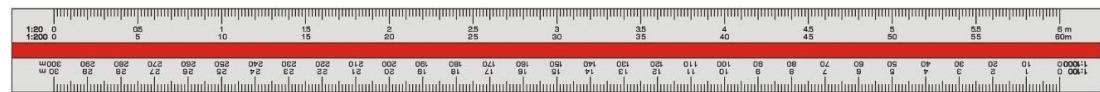
**PM (Fracción de partícula de materia)**

**Todas las partículas hasta el tamaño**

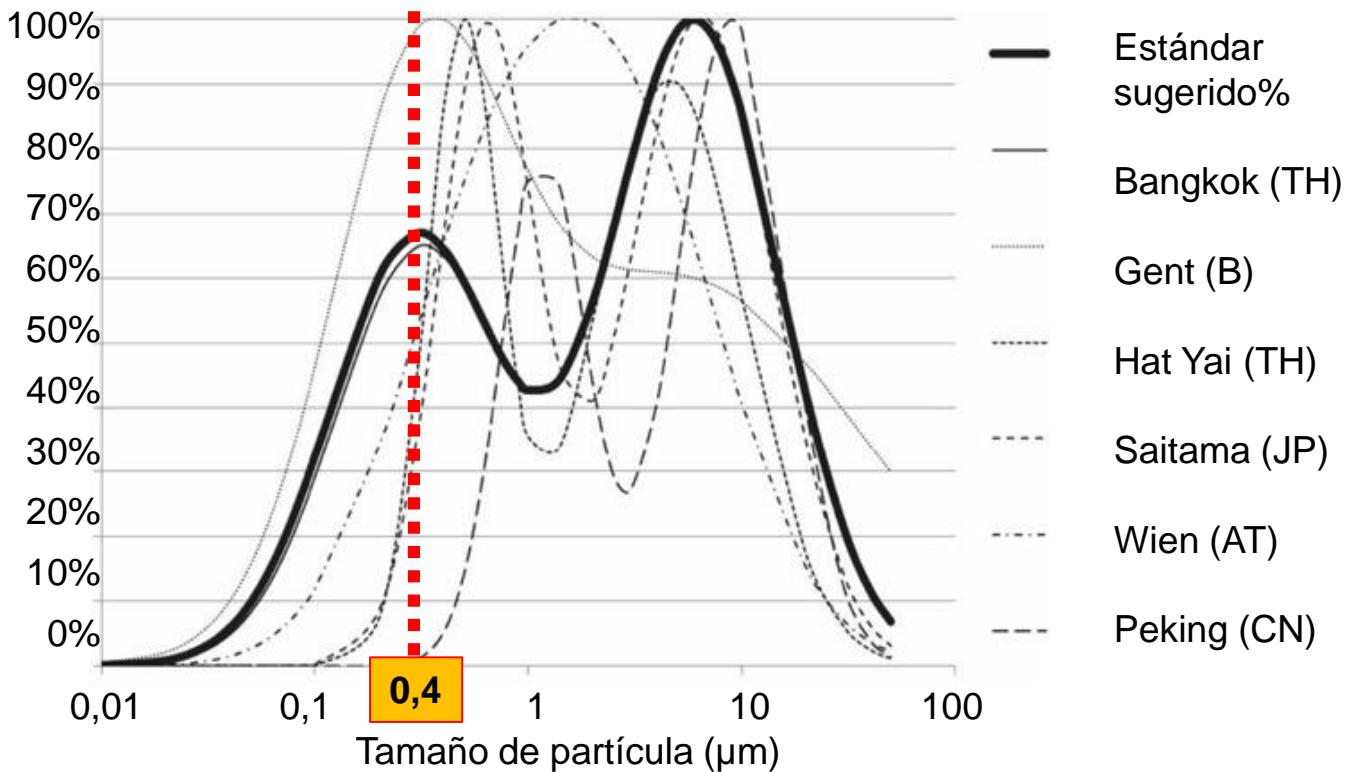
| PM1  | PM2,5  | PM10  |
|------|--------|-------|
| 1 µm | 2,5 µm | 10 µm |

Porción inhalable de emisiones.  
Contaminación de partículas de materia

- PM1
- PM2,5
- PM10



### 3. Filtros: Nueva eficacia EN-16890



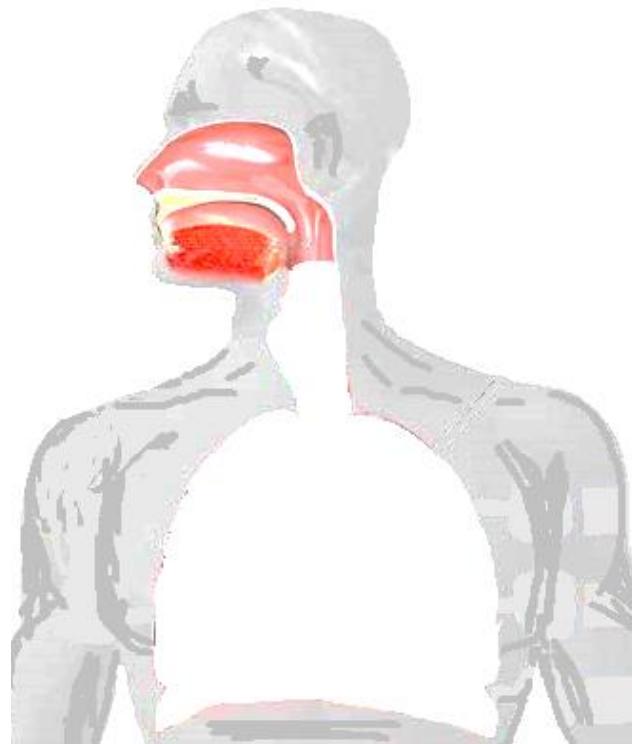
La consideración de un sólo tamaño de partícula  
(EN779 > 0,4  $\mu\text{m}$ )  
No es funcional y no representa la realidad

### 3. Filtros: Nueva eficacia EN-16890

Nariz y garganta

5 - 10  $\mu\text{m}$

PM 10  
Nariz y garganta



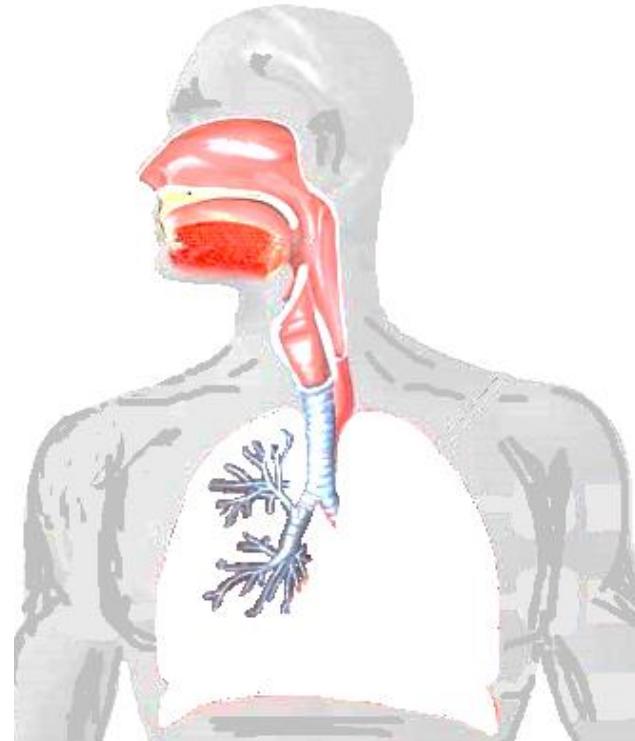
### 3. Filtros: Nueva eficacia EN-16890

|                  |           |
|------------------|-----------|
| Nariz y garganta | 5 - 10 µm |
| Tráquea          | 3 - 5 µm  |
| Bronquios        | 2 - 3 µm  |

PM 10  
Nariz y garganta

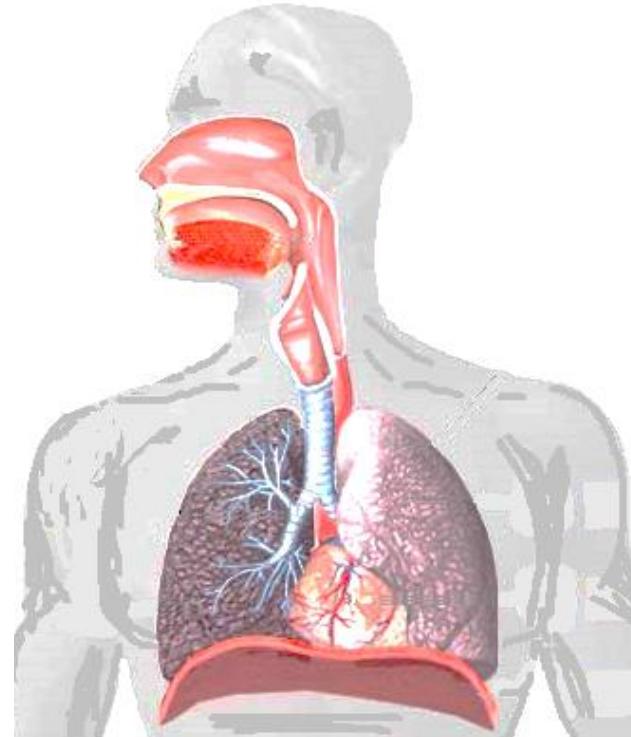
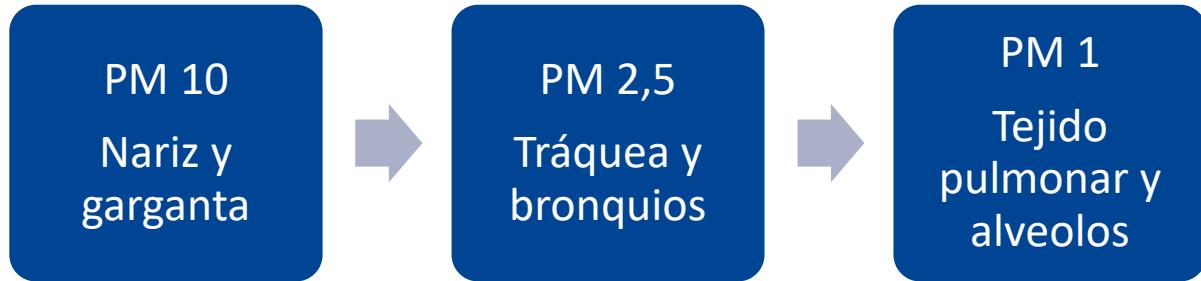


PM 2,5  
Tráquea y  
bronquios



### 3. Filtros: Nueva eficacia EN-16890

|                  |                       |
|------------------|-----------------------|
| Nariz y garganta | 5 - 10 $\mu\text{m}$  |
| Tráquea          | 3 - 5 $\mu\text{m}$   |
| Bronquios        | 2 - 3 $\mu\text{m}$   |
| Bronquiolos      | 1 - 2 $\mu\text{m}$   |
| Alveolos         | 0,1 - 1 $\mu\text{m}$ |



<http://learn.genetics.utah.edu/content/cells/scale/>



1 mm

coffee bean

12 x 8 mm

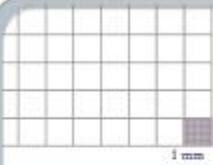


grain of rice

8 x 2.5 mm



Times regular, 12 point



coffee bean

12 x 8 mm



grain of rice

8 x 2.5 mm



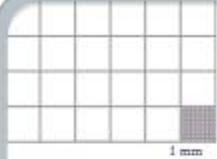
grain of salt



sesame seed

1 x 1 mm

Times regular, 12 point



coffee bean

mm



grain of rice

8 x 2.5 mm

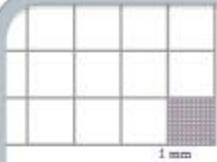


grain of salt



sesame seed  
1 x 2 mm

Times regular, 12 point



bean



grain of rice

8 x 2.5 mm

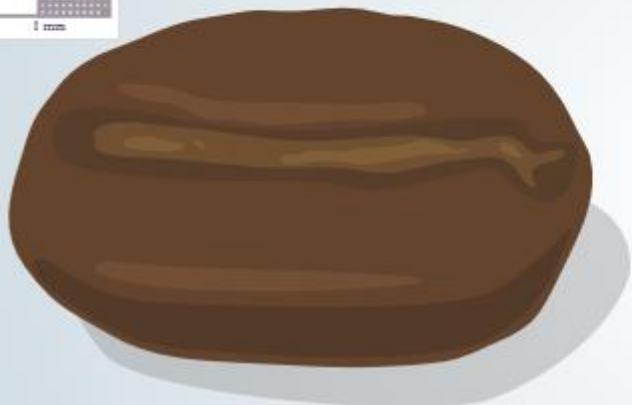
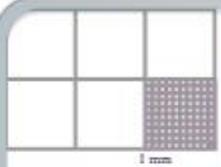
grain of salt



sesame seed

2 x 2 mm

Times regular, 12 point



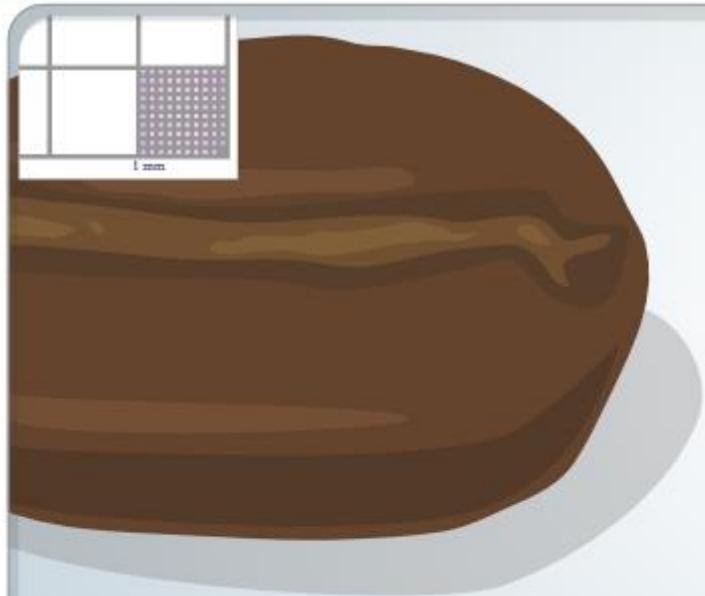
grain  
8 x 2.5 mm



grain of salt  
8 mm



sesame seed  
3 x 2 mm

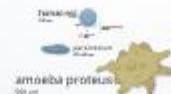
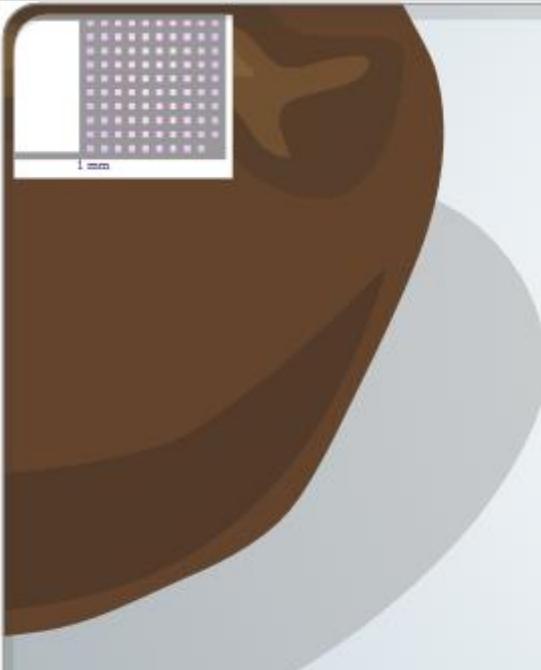


grain of salt  
0.3 mm



sesame seed  
3 x 2 mm

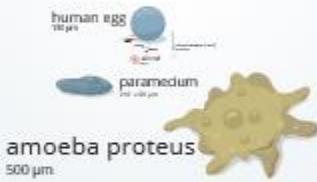
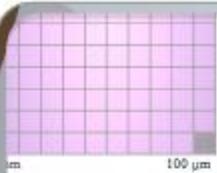




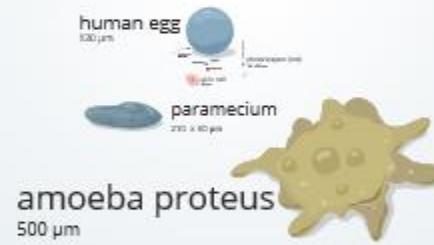
grain of salt

0.5 mm

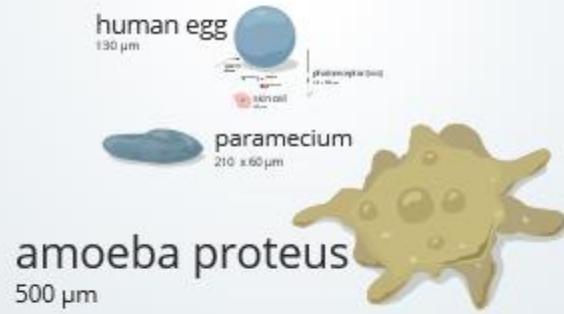
coco...cooc

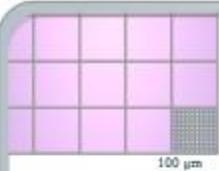


grain of s  
0.5 mm



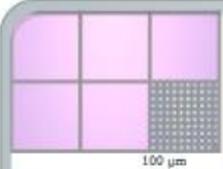
grair

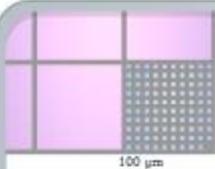




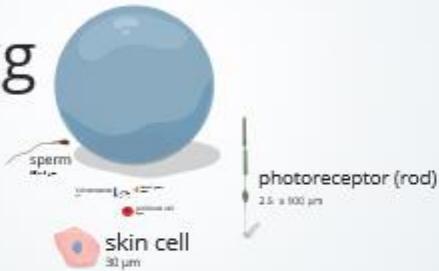
amoeba proteus  
500 µm







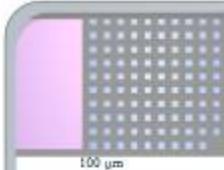
human egg  
130 µm



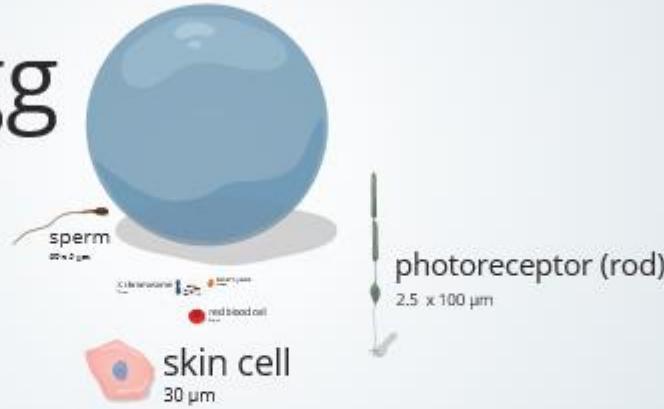
paramecium  
210 x 60 µm



amoeba proteus

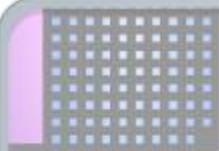


human egg  
130 µm



paramecium  
210 x 60 µm





100 µm

human egg  
130 µm



sperm  
60 x 5 µm

X chromosome  
Blood plate  
Red blood cell

skin cell  
30 µm



photoreceptor (rod)  
2.5 x 100 µm



paramecium  
210 x 60 µm





than an egg

0 µm



sperm  
 $60 \times 5 \mu\text{m}$

X chromosome  
 $1 \mu\text{m}$

red blood cell  
 $7.5 \mu\text{m}$

skin cell  
 $30 \mu\text{m}$



photoreceptor (rod)  
 $2.5 \times 100 \mu\text{m}$

paramecium

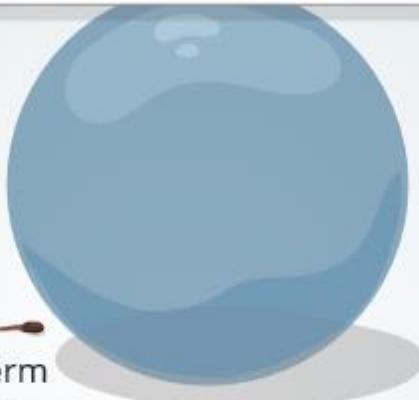


# an egg

μm



sperm  
 $60 \times 5 \mu\text{m}$



X chromosome 1 μm  
lysosome 1 μm

red blood cell 8 μm



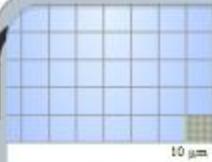
skin cell  
 $30 \mu\text{m}$



photoreceptor (rod)  
 $2.5 \times 100 \mu\text{m}$

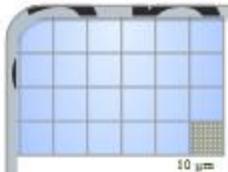
# paramecium

# 1 egg



photoreceptor (rod)  
2.5 x 100 µm

# paramecium



# egg



60 x 5  $\mu\text{m}$



X chromosome 1  $\mu\text{m}$



baker's yeast 1  $\mu\text{m}$



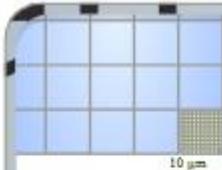
red blood cell 1  $\mu\text{m}$



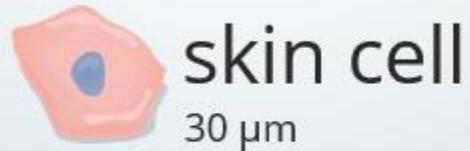
skin cell  
30  $\mu\text{m}$



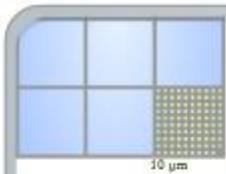
photoreceptor (r)  
2.5 x 100  $\mu\text{m}$



egg



photoreceptor  
2.5 x 100 μm



sperm  
60 x 5 µm

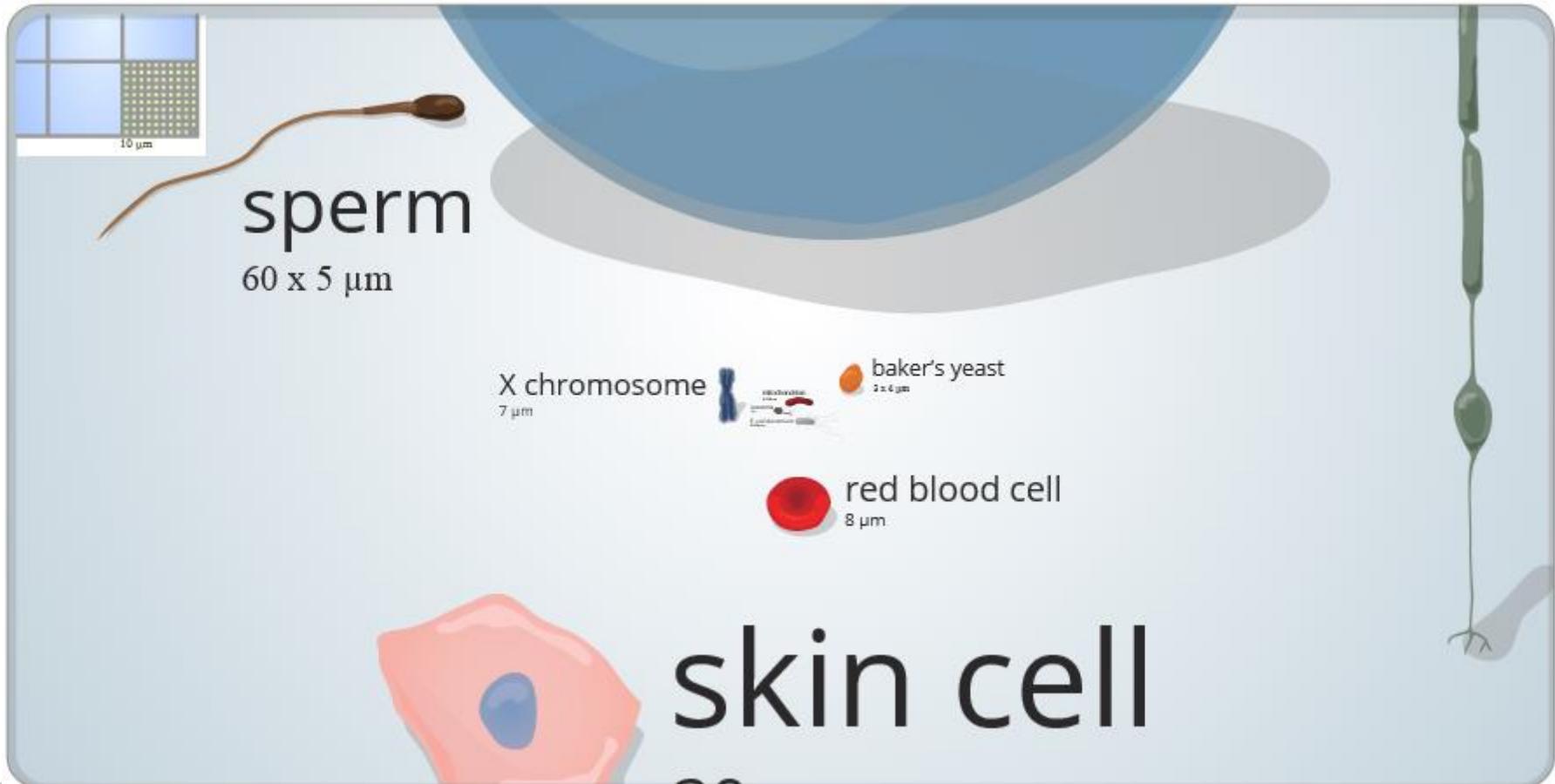
X chromosome  
7 µm

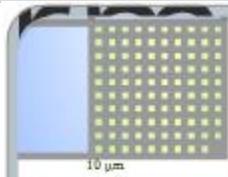
baker's yeast  
2.5 µm

red blood cell  
8 µm

skin cell  
30 µm

photo  
2.5 x 100





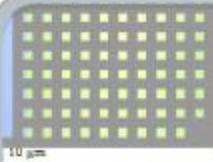
n

X chromosome  
7 µm



baker's yeast  
3 x 4 µm

red blood cell  
8 µm



chromosome  
um



baker's yeast  
3 x 4  $\mu\text{m}$

red blood cell  
8  $\mu\text{m}$



chromosome



baker's yeast

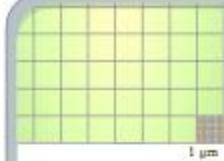


3 x 4 μm

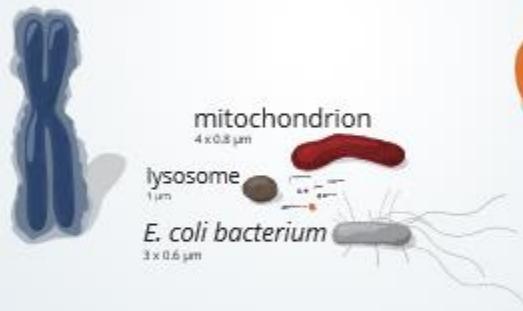


red blood ce

8 μm



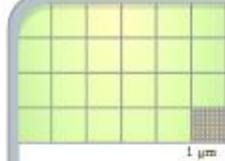
chromosome



baker's yeast  
 $3 \times 4 \mu\text{m}$



red blood

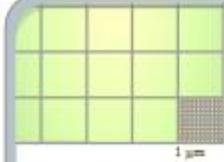


osome

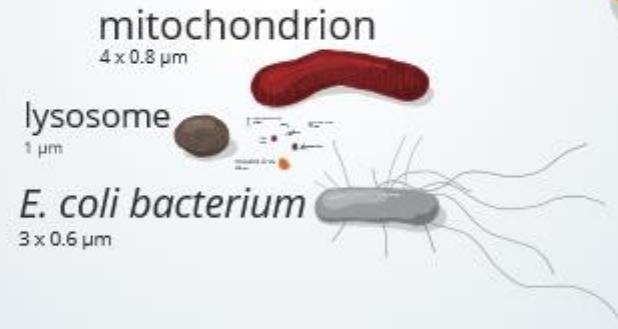


baker's ye  
3 x 4 µm

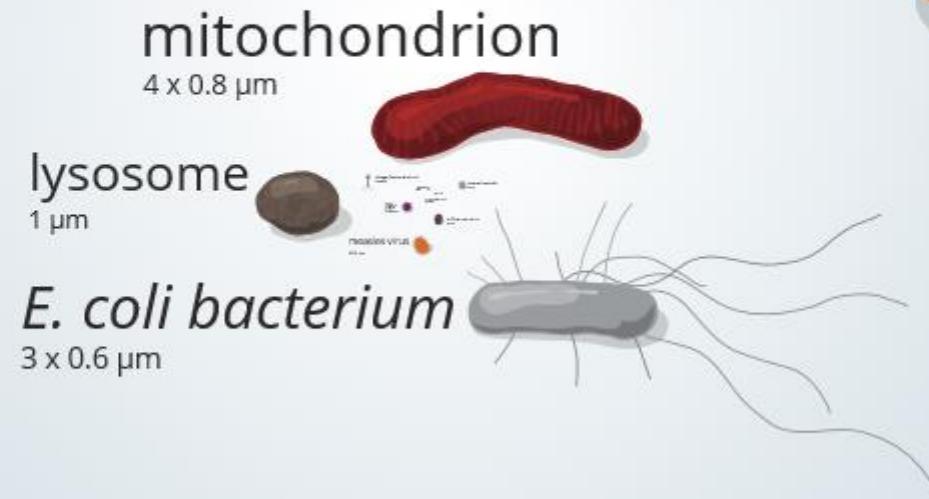
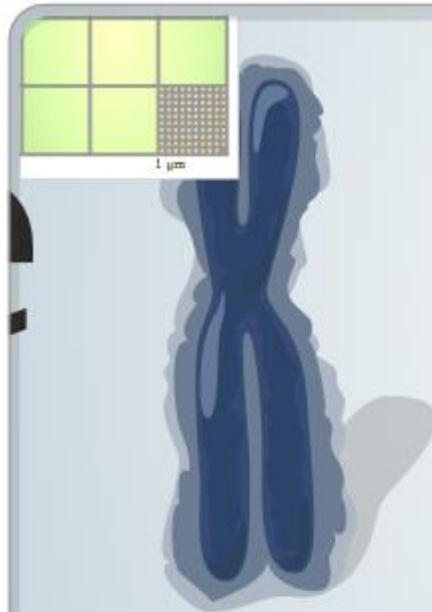
red blo



ome

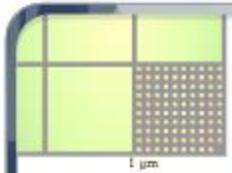


baker  
3 x 4 μm



b

3



mitochondrion

$4 \times 0.8 \mu\text{m}$



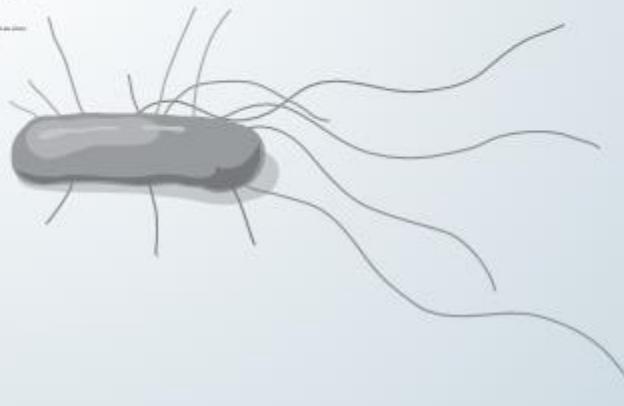
lysosome

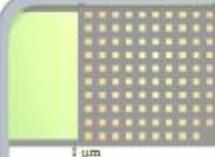
$1 \mu\text{m}$



*E. coli* bacterium

$3 \times 0.6 \mu\text{m}$





# mitochondrion

4 x 0.8 μm



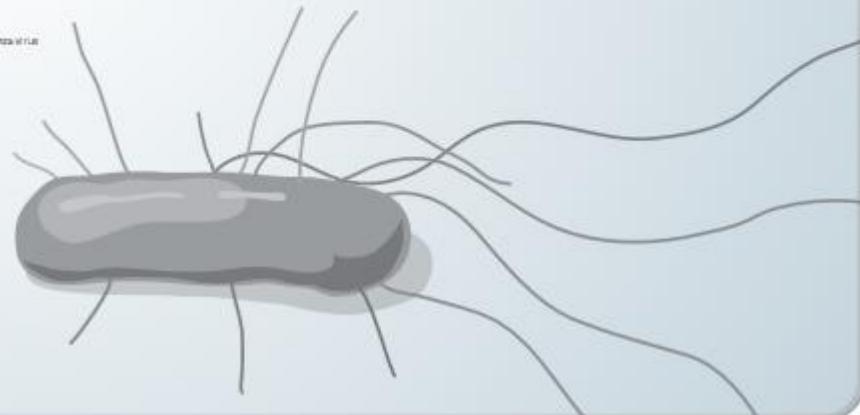
# lysosome

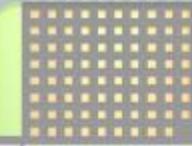
1 μm



# *E. coli* bacterium

3 x 0.6 μm





# mitochondrion

4 x 0.8 μm

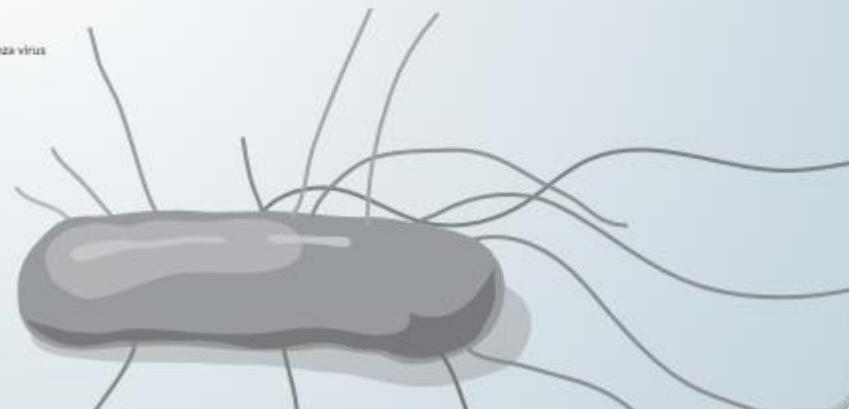


# lysosome



# coli bacterium

1 μm





phage (bacteria virus)  
10-100 nm



hiv  
100 nm



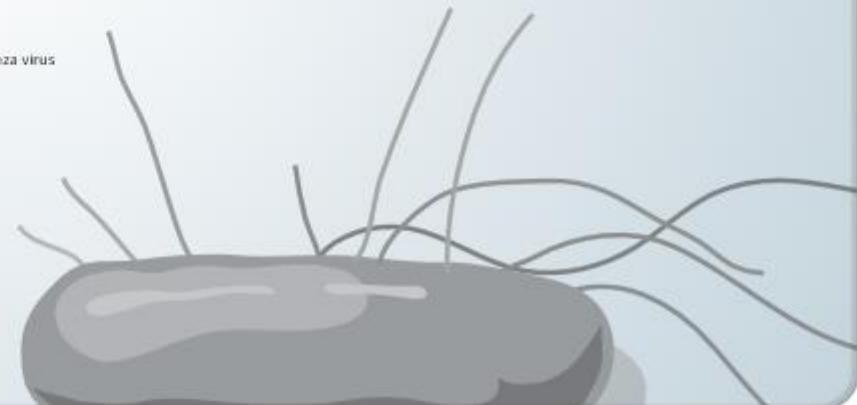
coated vesicle  
100 nm



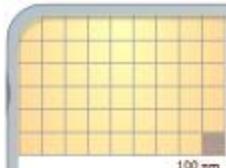
influenza virus  
100 nm



measles virus  
220 nm



bacterium



ne



phage (bacteria virus)  
70 x 200 nm



hiv  
120 nm



coated vesicle  
50 nm

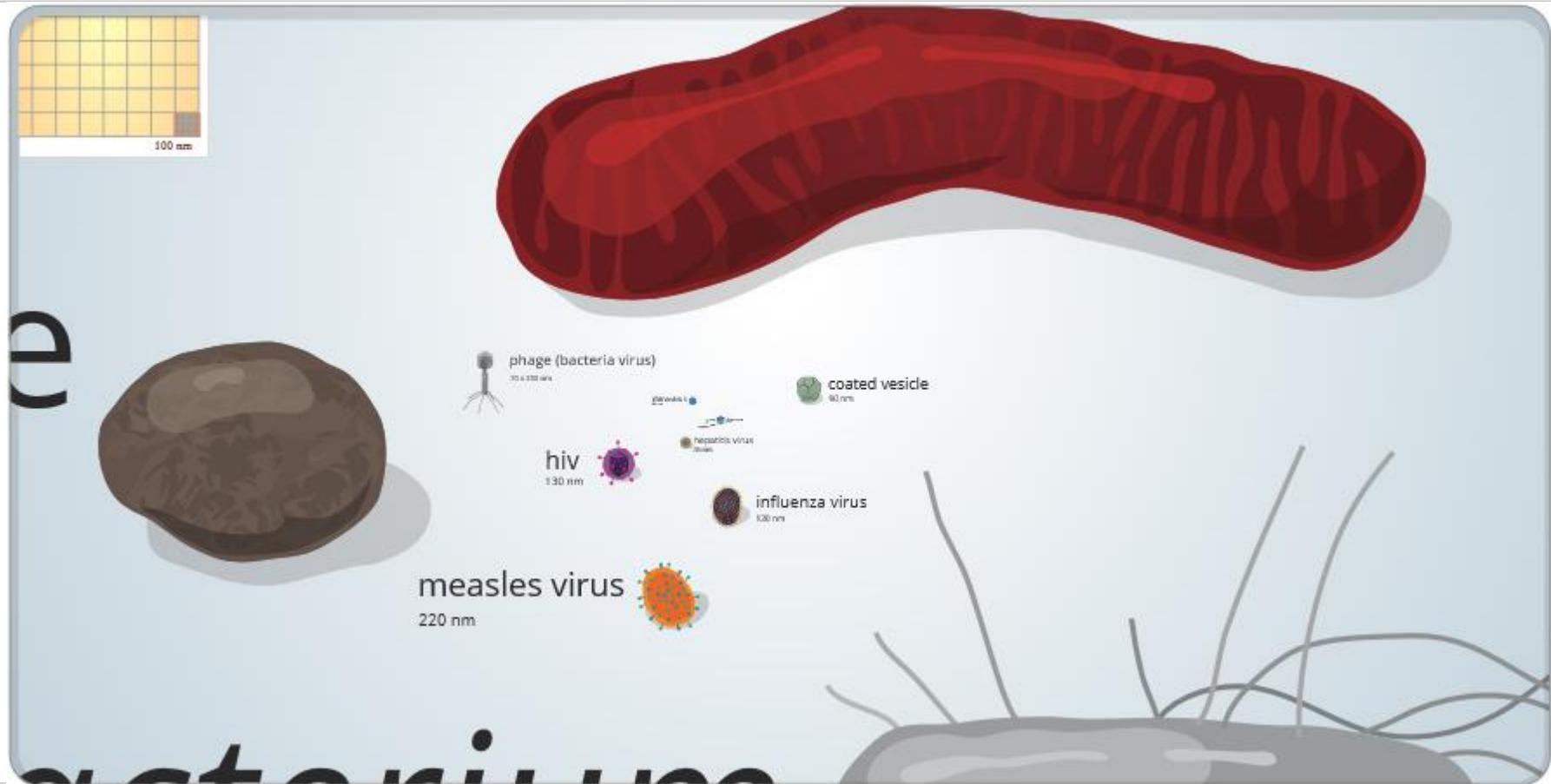


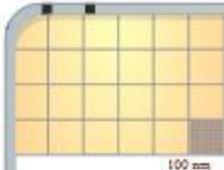
influenza virus  
120 nm



measles virus  
220 nm



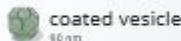




phage (bacteria virus)  
30 x 200 nm



hiv  
130 nm



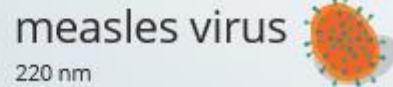
coated vesicle  
40 nm



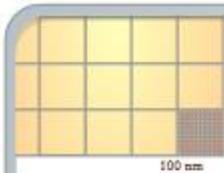
hepatitis virus  
25 nm



influenza virus  
130 nm



measles virus  
220 nm



phage (bacteria virus)  
70 x 200 nm



coated vesicle  
90 nm



hiv  
130 nm



rhinovirus



hepatitis virus  
45 nm

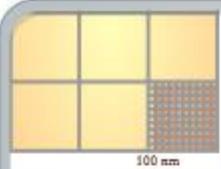


influenza virus  
130 nm



measles virus

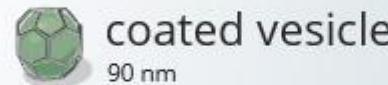
220 nm



phage (bacteria virus)

70 x 200 nm

rhinovirus  
30 nm



coated vesicle

90 nm

ribosome

hepatitis virus  
45 nm



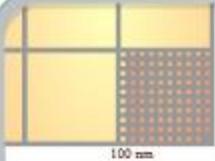
hiv

130 nm



influenza virus

130 nm



## phage (bacteria virus)

70 x 200 nm

hiv

130 nm



rhinovirus  
30 nm



hepatitis virus  
45 nm



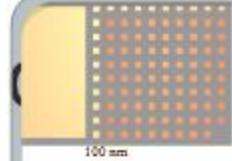
influenza virus

130 nm

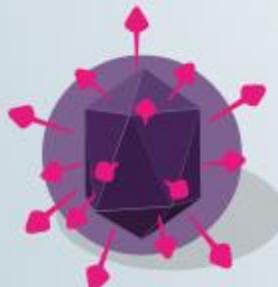


coated vesicle

90 nm



virus)



rhinovirus  
30 nm



hepatitis virus  
45 nm



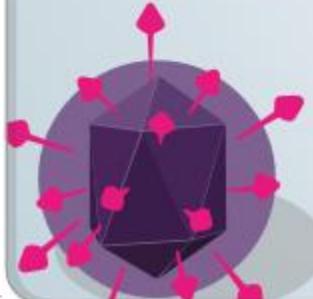
coated  
90 nm

# (VIRUS)



rhinovirus  
30 nm

hepatitis virus  
45 nm

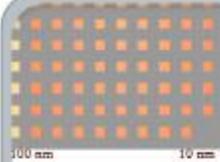


ribosome  
30 nm



antibody  
hemoglobin  
DNA

CO  
90

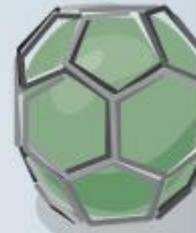


rhinovirus  
30 nm

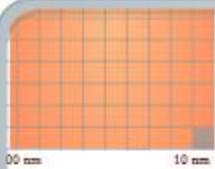
hepatitis virus  
45 nm



ribosome  
30 nm



antibody  
hemagglutinin  
tRNA



rhinovirus  
30 nm



antibody  
ribosome  
hemagglutinin  
tRNA

30 nm



hepatitis virus  
45 nm





rhinovirus  
30 nm

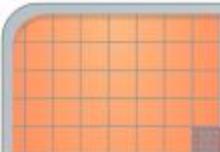


antibody  
hemoglobin  
tRNA  
ribosome  
30 nm



hepatitis virus  
45 nm





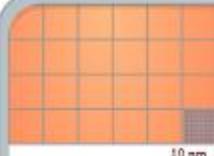
rninovirus  
30 nm



antibody  
hemoglobin  
tRNA  
ribosome  
30 nm



hepatitis virus  
45 nm



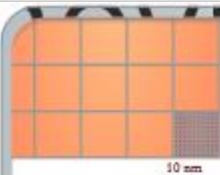
30 nm

ovirus



hepatitis virus

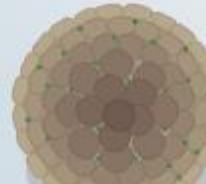
45 nm



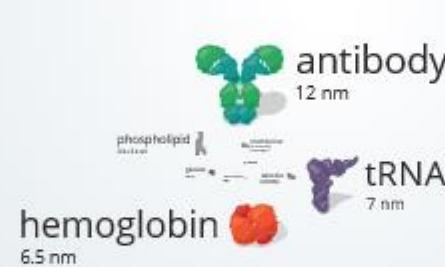
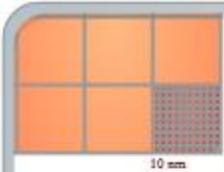
virus



10 nm



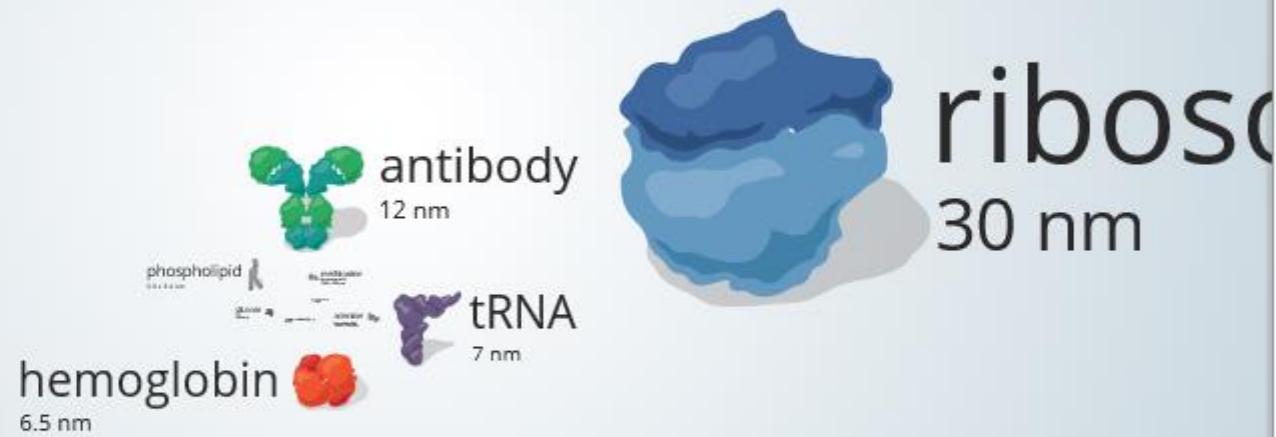
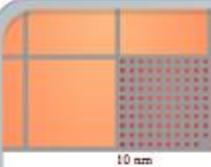
hepatitis virus

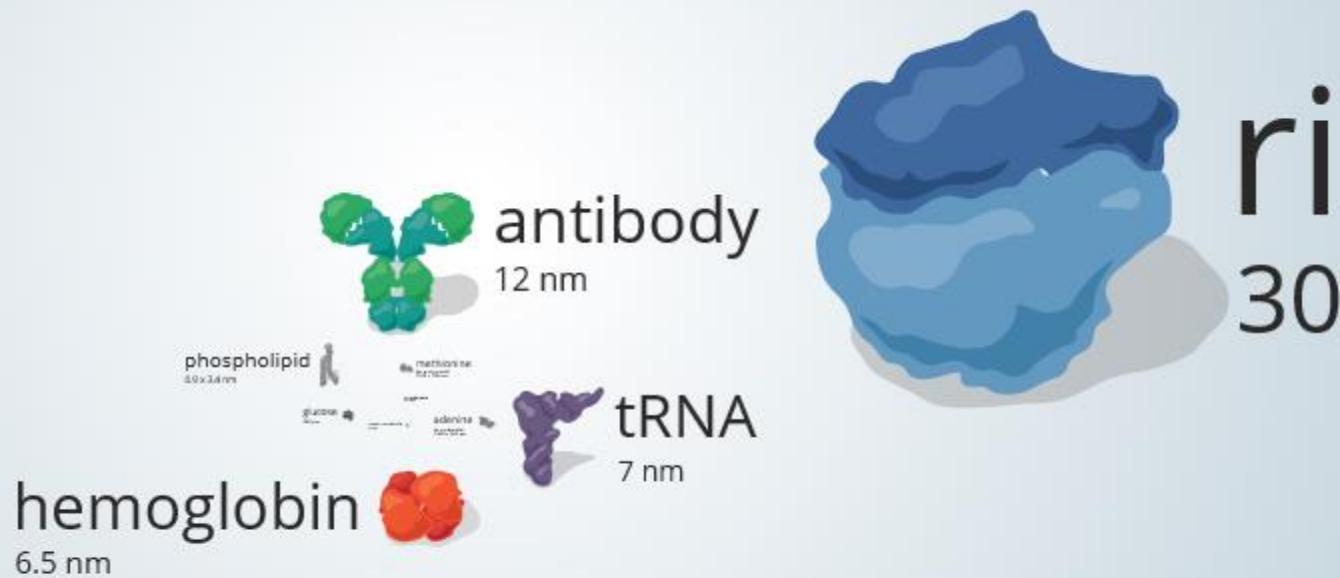
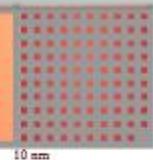


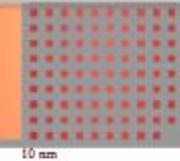
ribosome  
30 nm



hepatitis virus







hemoglobin  
6.5 nm

phospholipid  
0.9 x 3.6 nm

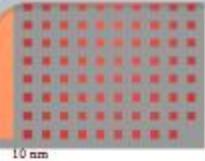
methionine  
amide

glucose

tRNA  
7 nm

antibody  
12 nm





hemoglobin  
6.5 nm



phospholipid  
0.9 x 3.4 nm



glucose  
0.5 nm

methionine  
0.3 nm x 0.3 nm

tRNA  
7 nm



antibody  
12 nm





hemoglobin  
6.5 nm



phospholipid  
0.9 x 3.4 nm



glucose

methionine  
(molar mass: 110.20 g/mol)  
1000x 200 pm



water molecule



adenine



tRNA  
7 nm

antibody  
12 nm





antibody  
12 nm

phospholipid  
0.9 x 3.4 nm



methionine  
Data available at 40°  
1130 x 1020 pm

glucose  
0.075 μm

adenine  
Data available at 40°  
1822 x 702 pm



tRNA  
7 nm

hemoglobin  
6.5 nm





hemoglobin

6.5 nm



phospholipid

0.9 x 3.4 nm



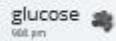
methionine

1.1 nm



glucose

0.9 nm



water molecule

0.3 nm



adenine

0.3 nm



antibody

12 nm



tRNA

7 nm





12 nm

phospholipid  
0.9 x 3.4 nm



methionine  
(an amino acid)  
1100 x 300 pm

glucose  
900 pm



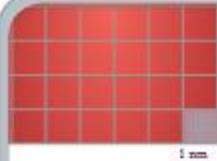
adenine  
(a nucleobase)  
1200 x 760 pm



hemoglobin  
5 nm



tRNA  
7 nm



antibody  
12 nm

phospholipid  
0.9 x 3.4 nm



methionine  
(an amino acid)  
1700 x 700 pm

glutamic acid

glucose  
900 pm

water molecule  
270 pm

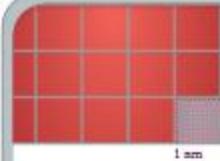
adenine  
(a nucleotide)  
1300 x 750 pm



tRNA  
7 nm

hämoglobin





12 nm

phospholipid

0.9 x 3.4 nm



methionine  
(an amino acid)  
1100 x 700 pm

carbon atom  
400 pm

glucose

900 pm



water molecule  
226 pm

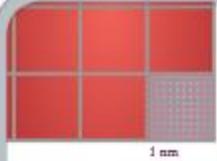
adenine  
(a nucleotide)  
1300 x 760 pm



tF  
7 nm

globin





# olipid



glucose

900 pm



water molecule

275 pm

● carbon atom  
240 pm



# methionine

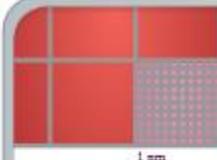
(an amino acid)  
1100 x 700 pm



# adenine

(a nucleotide)  
1300 x 760 pm





glucose

900 pm



water molecule

275 pm

● carbon atom  
340 pm



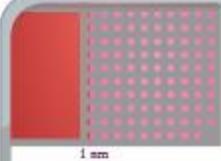
methionine

(an amino acid)  
1100 x 700 pm

adenine

(a nucleotide)  
1300 x 760 pm





# methionine

(an amino acid)  
1100 x 700 pm



carbon atom  
340 pm



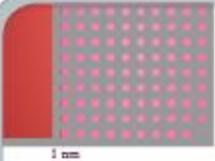
water molecule  
275 pm



# adenine

(a nucleotide)  
1300 x 760 pm





water molecule  
275 pm

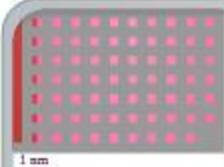


alanine  
(an amino acid)  
1100 x 700 pm



carbon atom  
340 pm

adenine  
(a nucleotide)



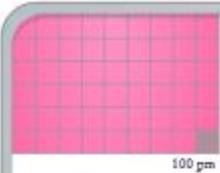
(adenine molecule)  
1100 x 700 pm



carbon atom  
340 pm

water molecule

adeni

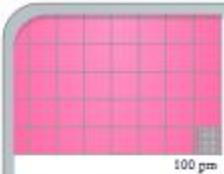


1100 x 700 pm

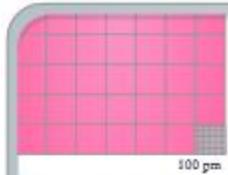


carbon atom  
340 pm

ade



carbon atom  
340 pm



carbon atom  
340 pm

<http://learn.genetics.utah.edu/content/cells/scale/>

### 3. Filtros: Nueva eficacia EN-16890

| Grupo      | Requisito                       |                                   |                   | Clasificación   |
|------------|---------------------------------|-----------------------------------|-------------------|-----------------|
|            | ePM <sub>1</sub> <sub>min</sub> | ePM <sub>2,5</sub> <sub>min</sub> | ePM <sub>10</sub> | Ejemplos        |
| ISO PM 1   | ≥ 50 %                          | -                                 | -                 | ePM1 60 %       |
| ISO PM 2,5 | -                               | ≥ 50 %                            | -                 | ePM2,5 65 %     |
| ISO PM 10  | -                               | -                                 | ≥ 50 %            | ePM10 55 %      |
| ISO Coarse | -                               | -                                 | < 50 %            | ISO Coarse 75 % |

La eficacia conseguida se redondeará en saltos de 5%

### 3. Filtros: Nueva eficacia EN-16890

| EN 779 | ePM1 [%]                   | ePM2.5 [%]                   | ePM10 [%]   |
|--------|----------------------------|------------------------------|---|
| M5     | -                          | -                            | ISO ePM10 ( $\geq 50\%$ ) *   |
| F7     | ISO ePM1 ( $\geq 50\%$ ) * | ISO ePM2.5 ( $\geq 65\%$ ) * |  |
| F9     | ISO ePM1 ( $\geq 80\%$ ) * |                              |   |

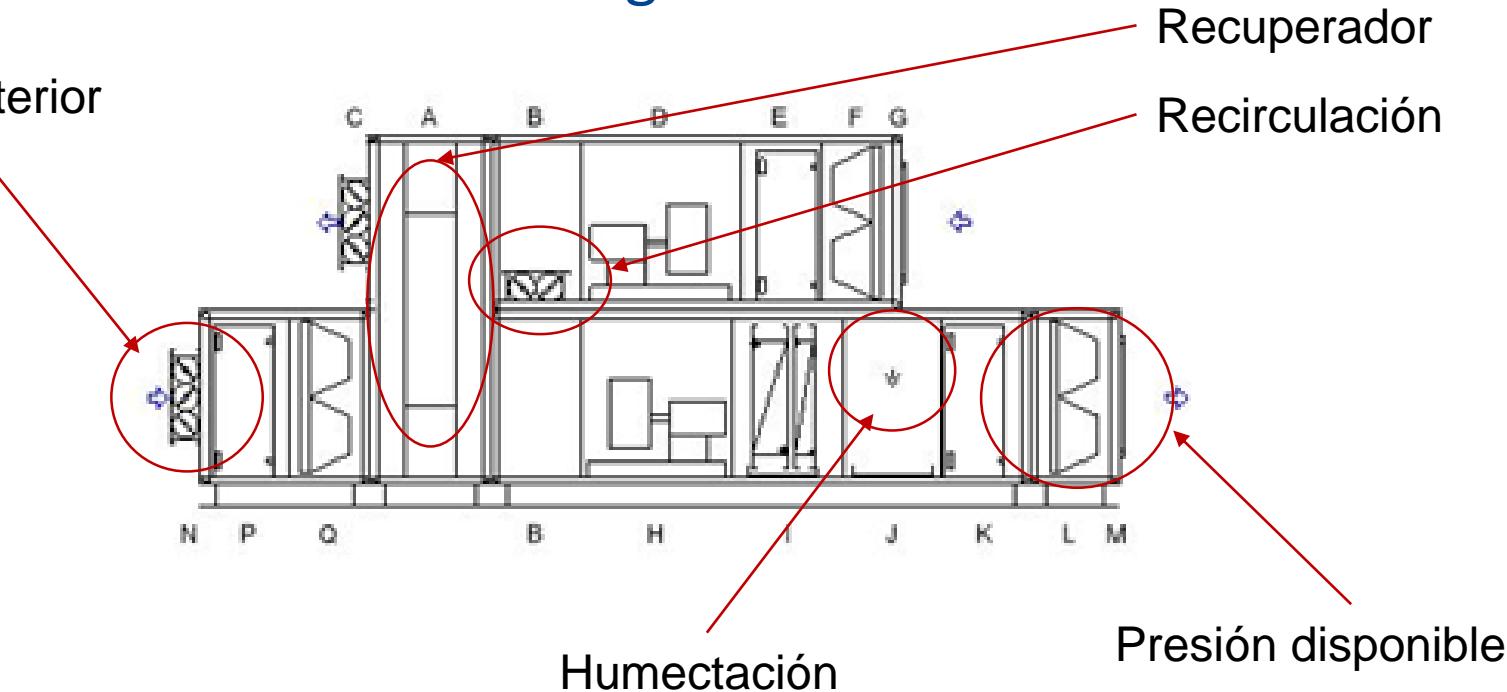
\* The final filter stage has to be at least an ISO ePM1  $\geq 50\%$  filter.

| Filter class EN 779 | EVIA recommendation  |                        |                       |             |
|---------------------|----------------------|------------------------|-----------------------|-------------|
|                     | ISO ePM <sub>1</sub> | ISO ePM <sub>2,5</sub> | ISO ePM <sub>10</sub> | ISO Coarse  |
| G2                  |                      |                        |                       | $\geq 30\%$ |
| G3                  |                      |                        |                       | $\geq 45\%$ |
| G4                  |                      |                        |                       | $\geq 60\%$ |
| M5                  |                      |                        | $\geq 50\%$           |             |
| M6                  |                      | $\geq 50\%$            |                       |             |
| F7                  | $\geq 50\%$          |                        |                       |             |
| F8                  | $\geq 70\%$          |                        |                       |             |
| F9                  | $\geq 80\%$          |                        |                       |             |


  
 European Ventilation Industry Association

## 4. Análisis de consumos energéticos

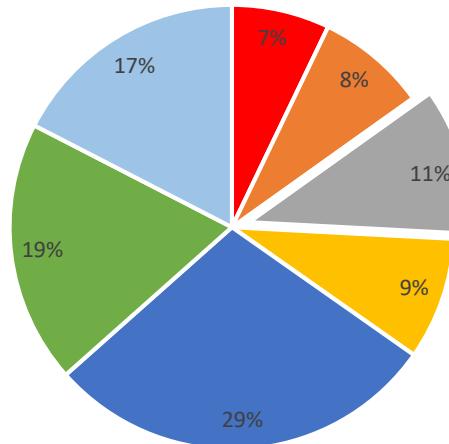
Aire exterior



## 4. Análisis de consumos energéticos



Origen consumos UTA Crítica



- Presión recuperador
- Presión disponible absolutos
- Pérdidas internas
- Presión disponible normal
- Ajuste temperaturas interiores
- Ajuste temperaturas exteriores
- Ajuste humedad

## 4. Análisis de consumos energéticos

- Tipos de recuperador: baterías, placas y rotativos
- Nuevo Reglamento ErP
- Pérdida de carga en recuperador y en compuerta de recirculación
- By-pass de recuperación
- Ventilación a demanda (DCV)



## 4. Análisis de consumos energéticos

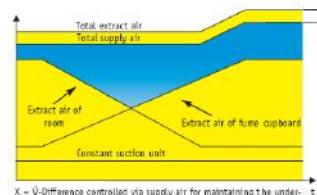
Laboratorios



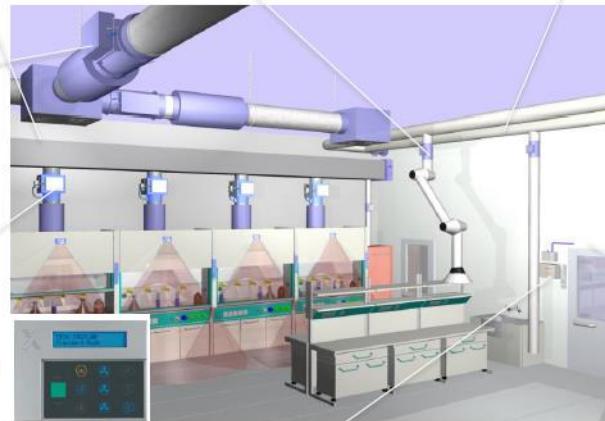
**Regulador VAV**  
serie TVRK-Easylab  
extracción

**Regulador VAV**  
serie TVRK-Easylab  
impulsión

**Regulador VAV tipo**  
**TVLK para control de**  
**extracción en**  
**vitrinas de gases**



**Regulador VAV tipo TVRK**  
para control de  
extracciones localizadas



**Sonda de Presión para controlar la sobrepresión /**  
**depresión respecto a locales anexos.**

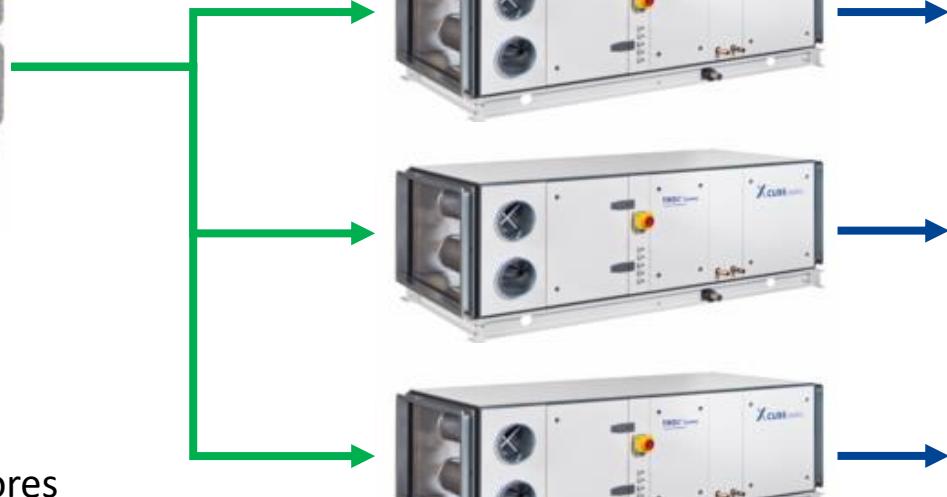
**Impulsión por mezcla de**  
**aire**  
Tipo rotacional  
20 renovaciones/hora



**Filtración H13 – ISO 7:**  
Fecundación in Vitro  
Lab. Células madre  
Farmacia  
( **Sobrepresión > 6 Pa** )

**Filtración F9:**  
Lab. General  
Lab. Bioquímica  
Lab. Anatomía Patológica  
Lab. Microbiología  
( **Depresión > 6 Pa** )

## 4. UTA: Ventilación para bloques quirúrgicos/ salas blancas



- Aire exterior en función de actividad y IAQ
- Control de caudal
- Control de presión diferencial
- Ventilación/ recirculación en unidades interiores
- Aprovechamiento de simultaneidades
- Reducción de consumo térmico y eléctrico

# TROX® TECHNIK

The art of handling air

*for indoor life quality*

