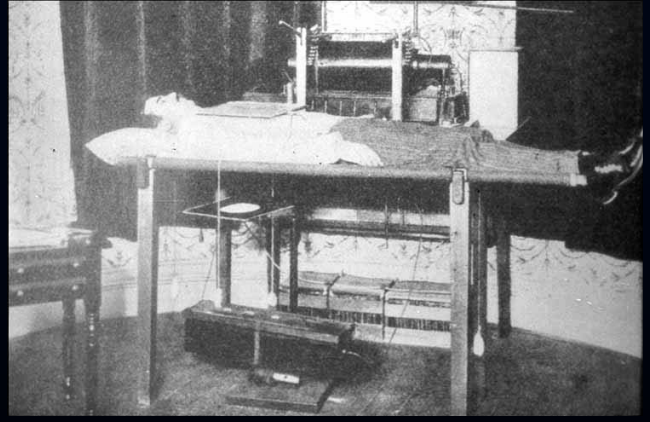
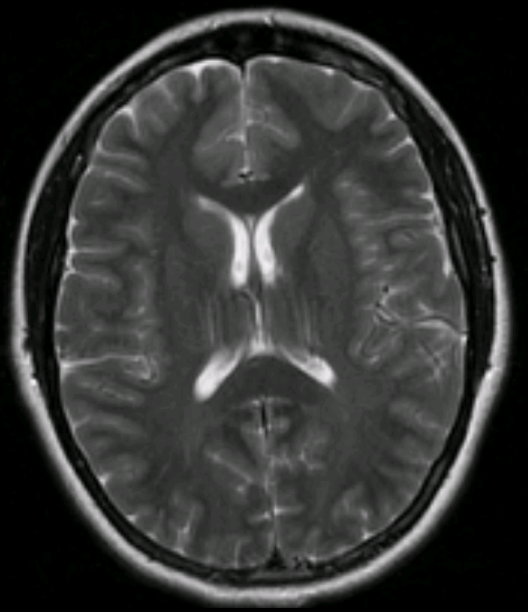


Introduction to Medical Imaging

Jeff Benseler, D.O.



Objectives

- How do x-rays create an image of internal body structures?
- What are the 5 basic radiographic densities?
- Try your hand at interpreting several medical imaging cases.

List of diagnostic imaging studies

- Plain x-rays
- CT scan
- MRI
- Nuclear imaging/PET
- Ultrasound
- Mammography
- Angiography
- Fluoroscopy

Which of these modalities use ionizing radiation?

What are x-rays?

- No mass
- No charge
- Energy

What is your diagnosis?

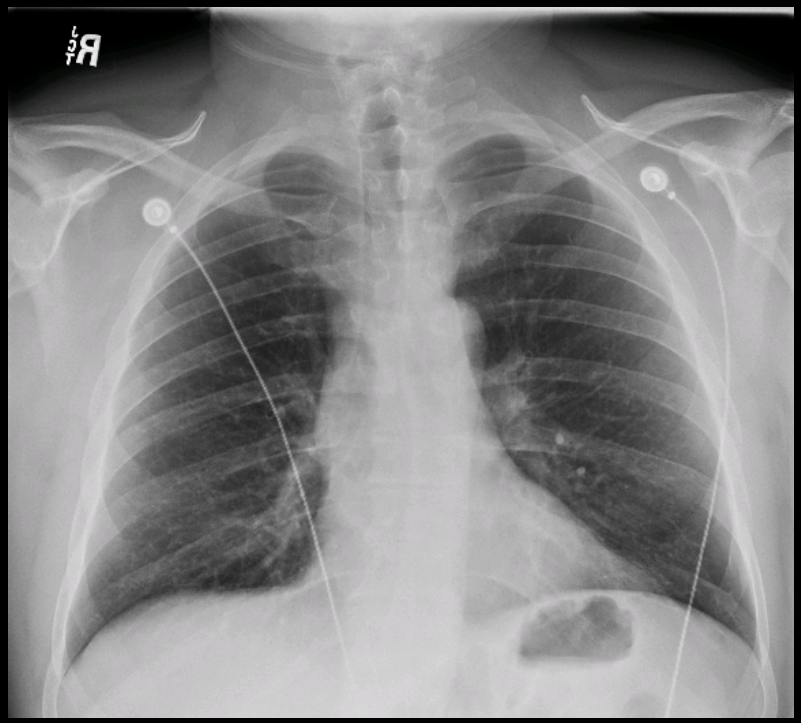
Basic x-ray physics

- X-rays: a form of electromagnetic energy
- Travel at the speed of light
- Electromagnetic spectrum
  - Gamma Rays
  - X-rays
  - Visible light
  - Infrared light
  - Microwaves
  - Radar
  - Radio waves

Three things can happen

- X-rays can:
  - **Pass** all the way **through** the body
  - Be deflected or **scattered**
  - Be **absorbed**

Where on this image have x-rays passed through the body to the greatest degree?



X-rays Passing Through Tissue

- Depends on the energy of the x-ray and the atomic number of the tissue
- Higher energy x-ray - more likely to pass through
- Higher atomic number - more likely to absorb the x-ray

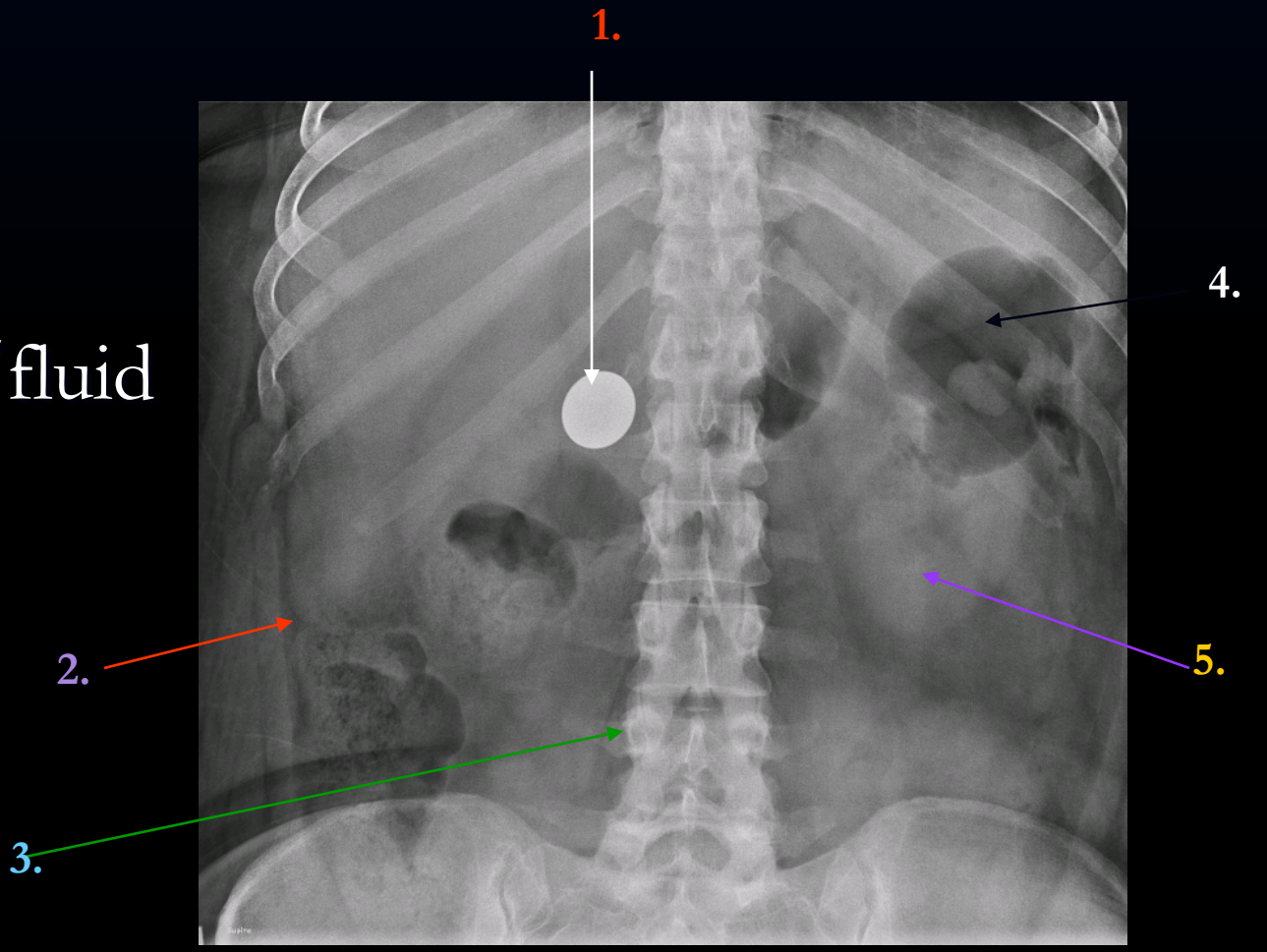
Diagnosis?

How do x-rays passing through the body create an image?

- X-rays that pass through the body to the film render the film dark (black)
- X-rays that are totally blocked do not reach the film and render the film light (white)
- Air = low atomic # = x-rays get through = image is dark
- Metal = high atomic # = x-rays blocked = image is light (white)

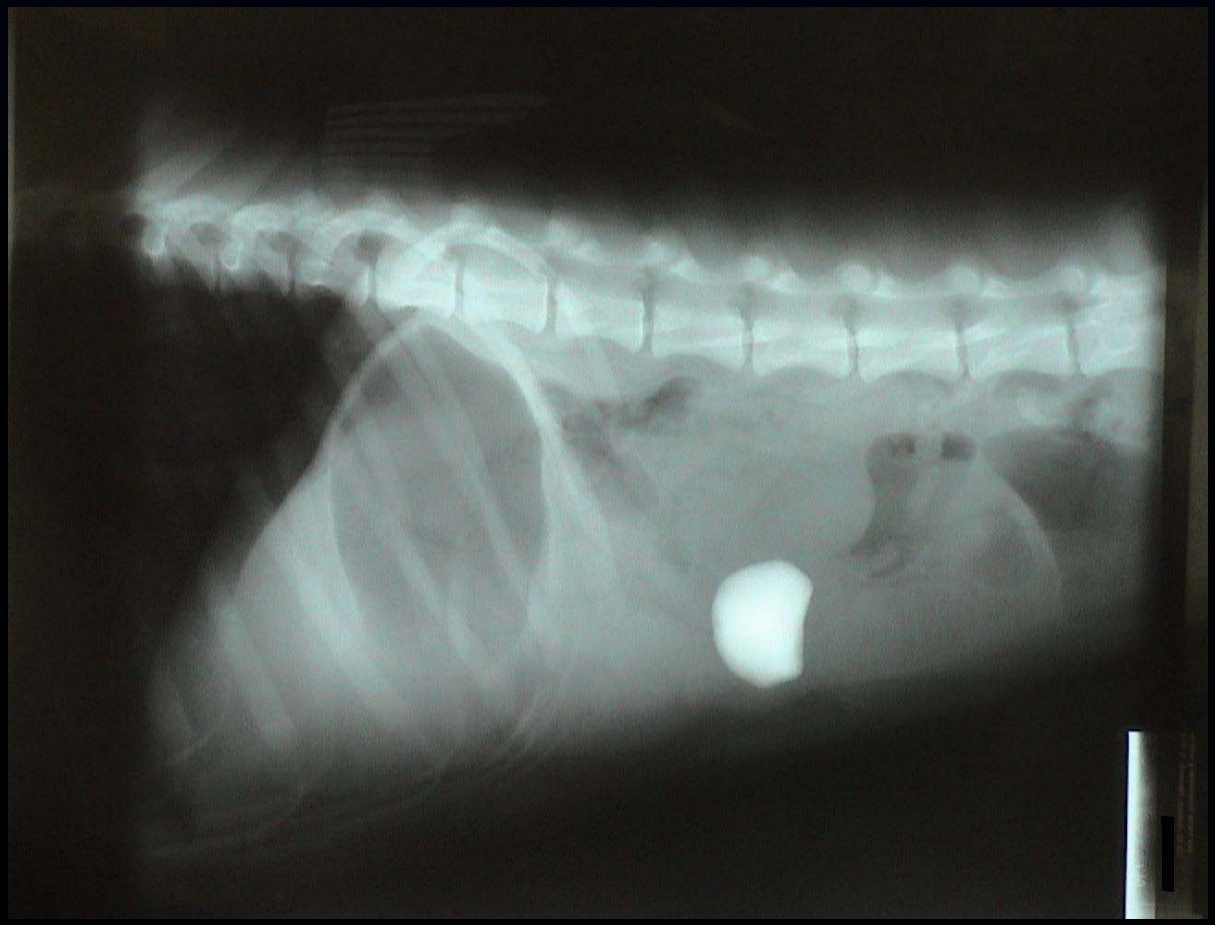
5 Basic Radiographic Densities

- Air
- Fat
- Soft tissue/fluid
- Mineral
- Metal



Name these radiographic densities.

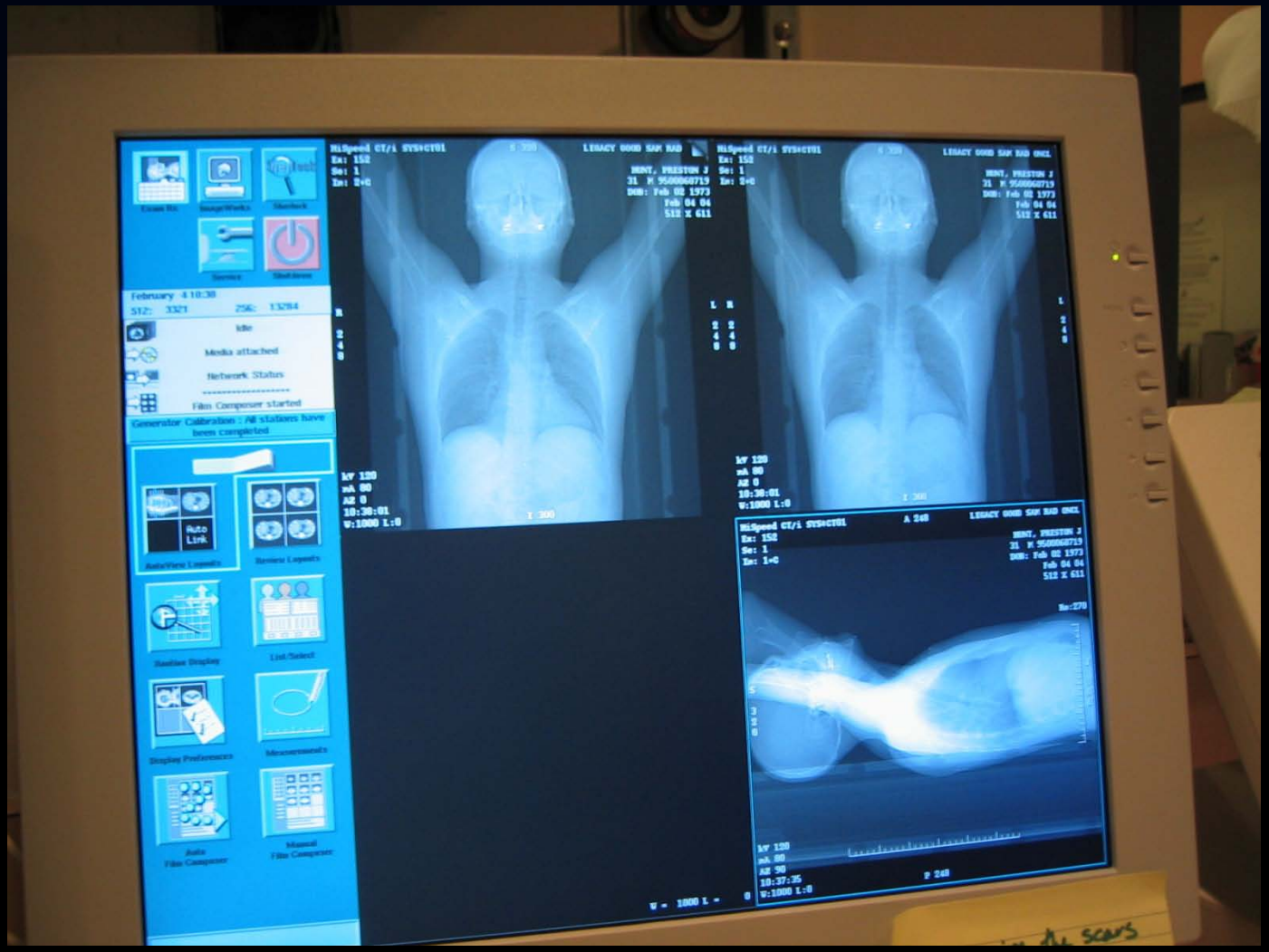
History: “I think my dog swallowed a rock”



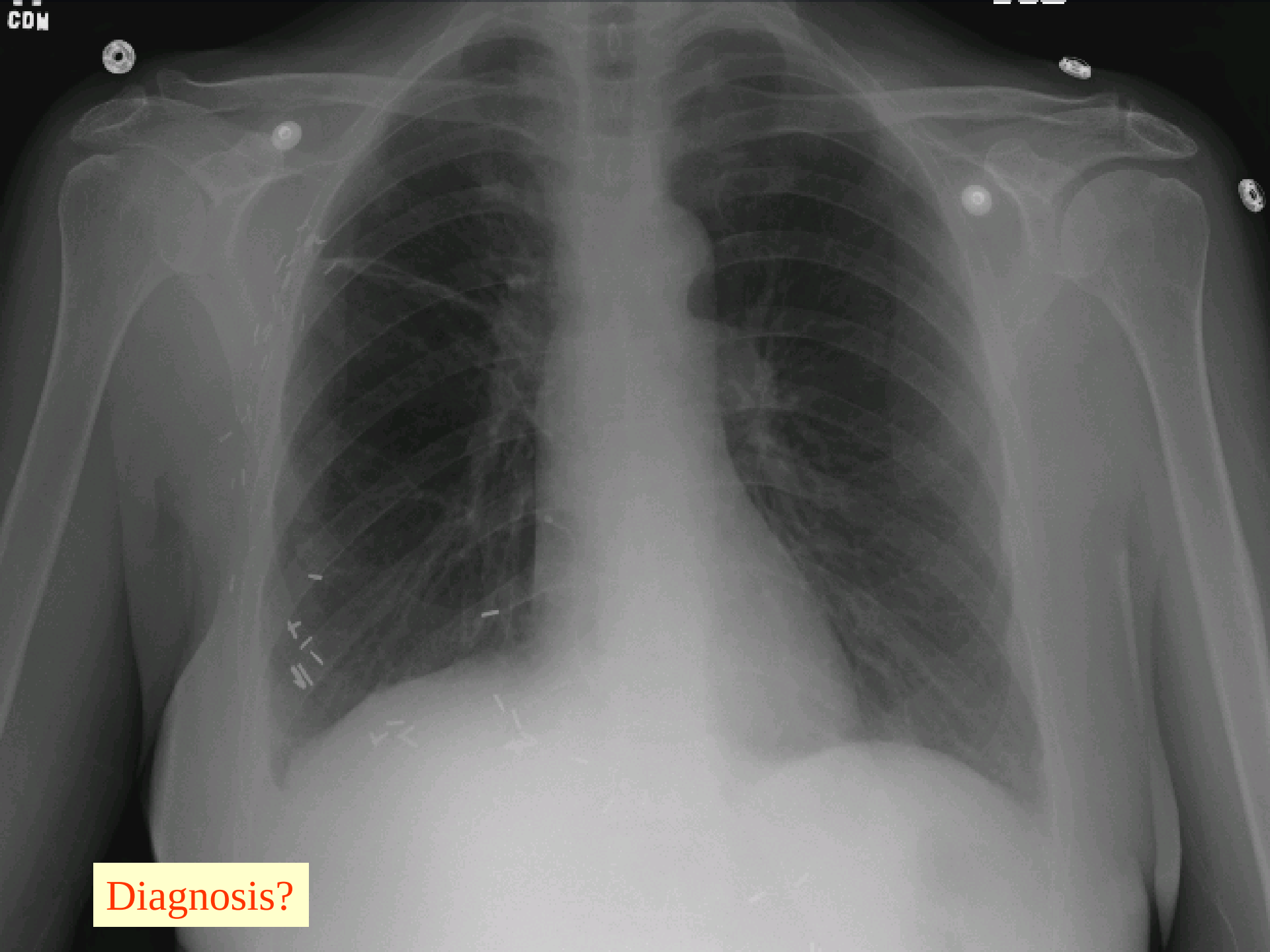
Diagnosis: “Yes, he did.”

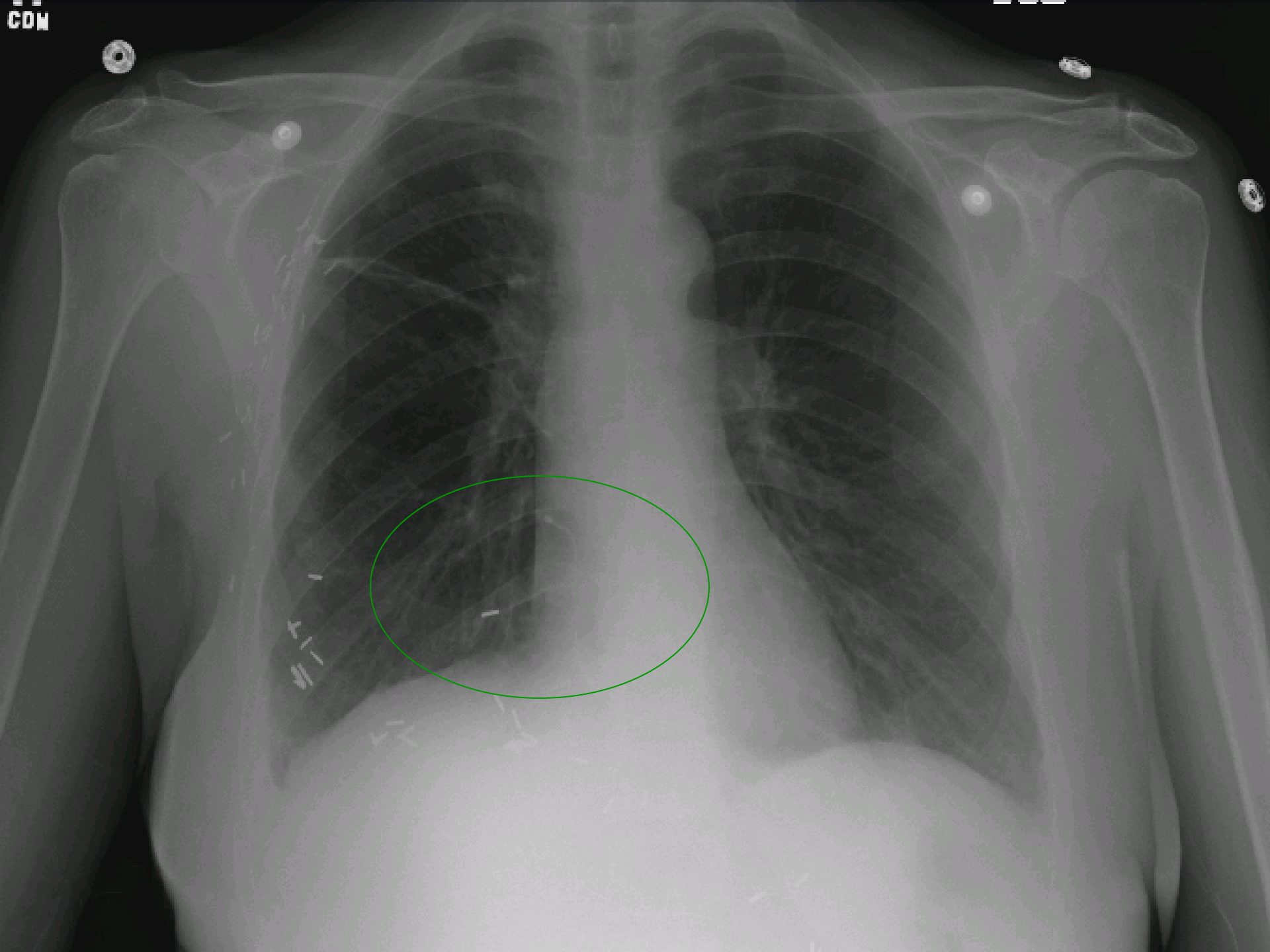
Optimal Viewing

- Dedicated light source
- Darkened environment (like a movie theater)
- Limit distraction

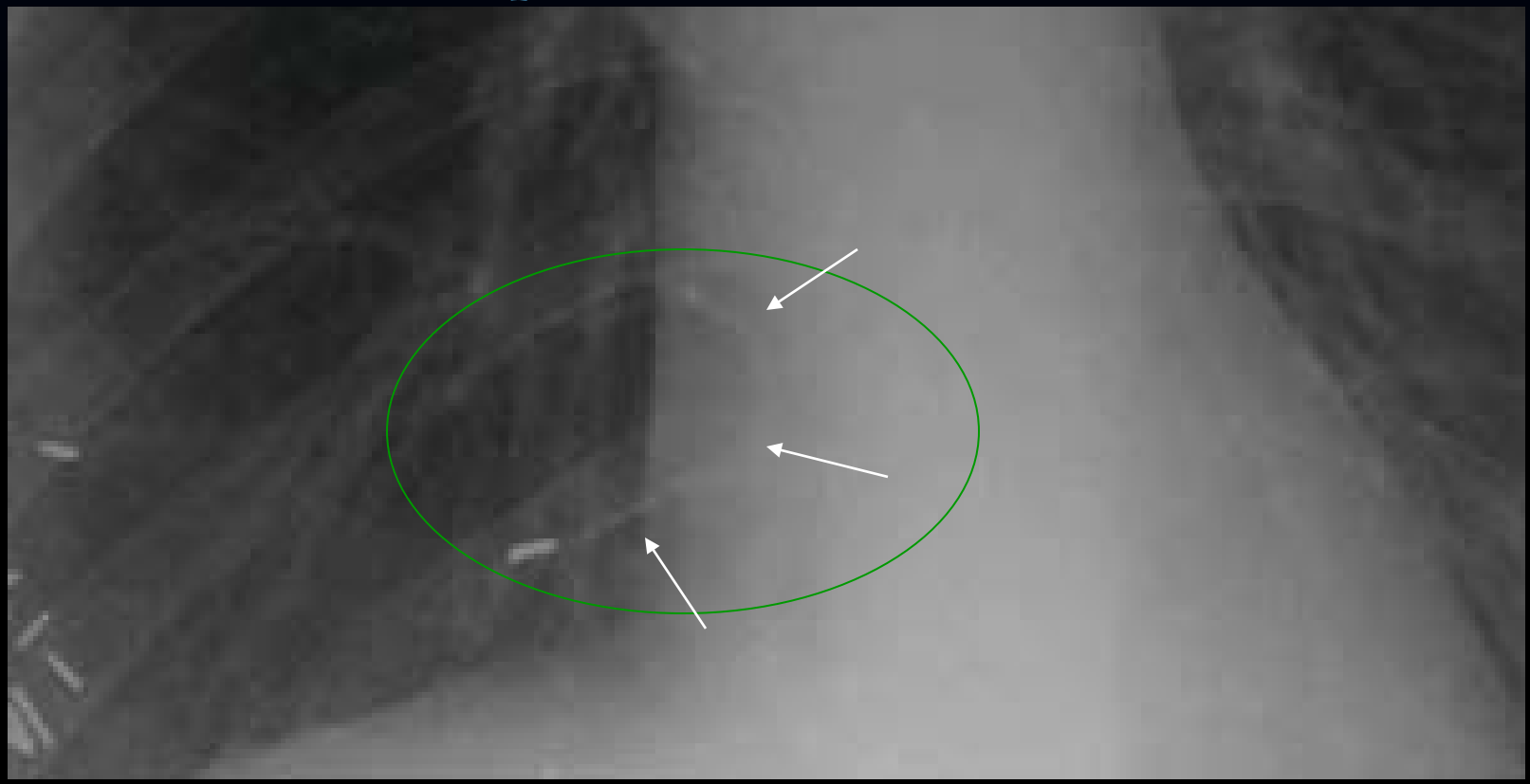


X-ray viewing station


Diagnosis?


CDM

A broken central venous catheter has migrated into the right lower lobe pulmonary artery



Can you recognize shapes and density?

Find the pathology
What clues do you have?

Medical Imaging

- Primary purpose is to identify pathologic conditions.
- Requires recognition of normal anatomy.

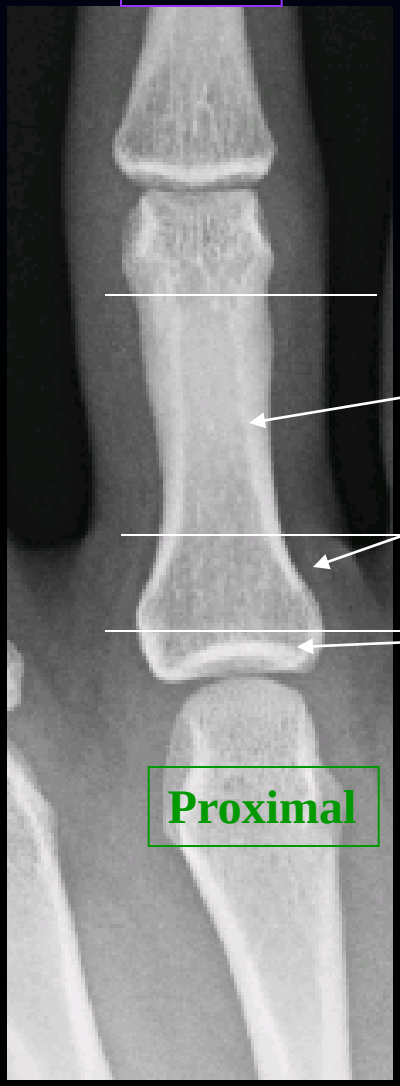
History: 11 y/o twisting injury of the foot

Please name these bones

Word bank:

Cuboid
Navicular
Medial cuneiform
Os naviculare

Naming the parts of a long bone



Word bank: epiphysis, metaphysis, diaphysis, cortex, medullary cavity

Summary: How do x-rays create an image of internal body structures?

- X-rays pass through the body to varying degrees
- Higher atomic number structures block x-rays better, example bone.
- Lower atomic number structures allow x-rays to pass through, example: air in the lungs.

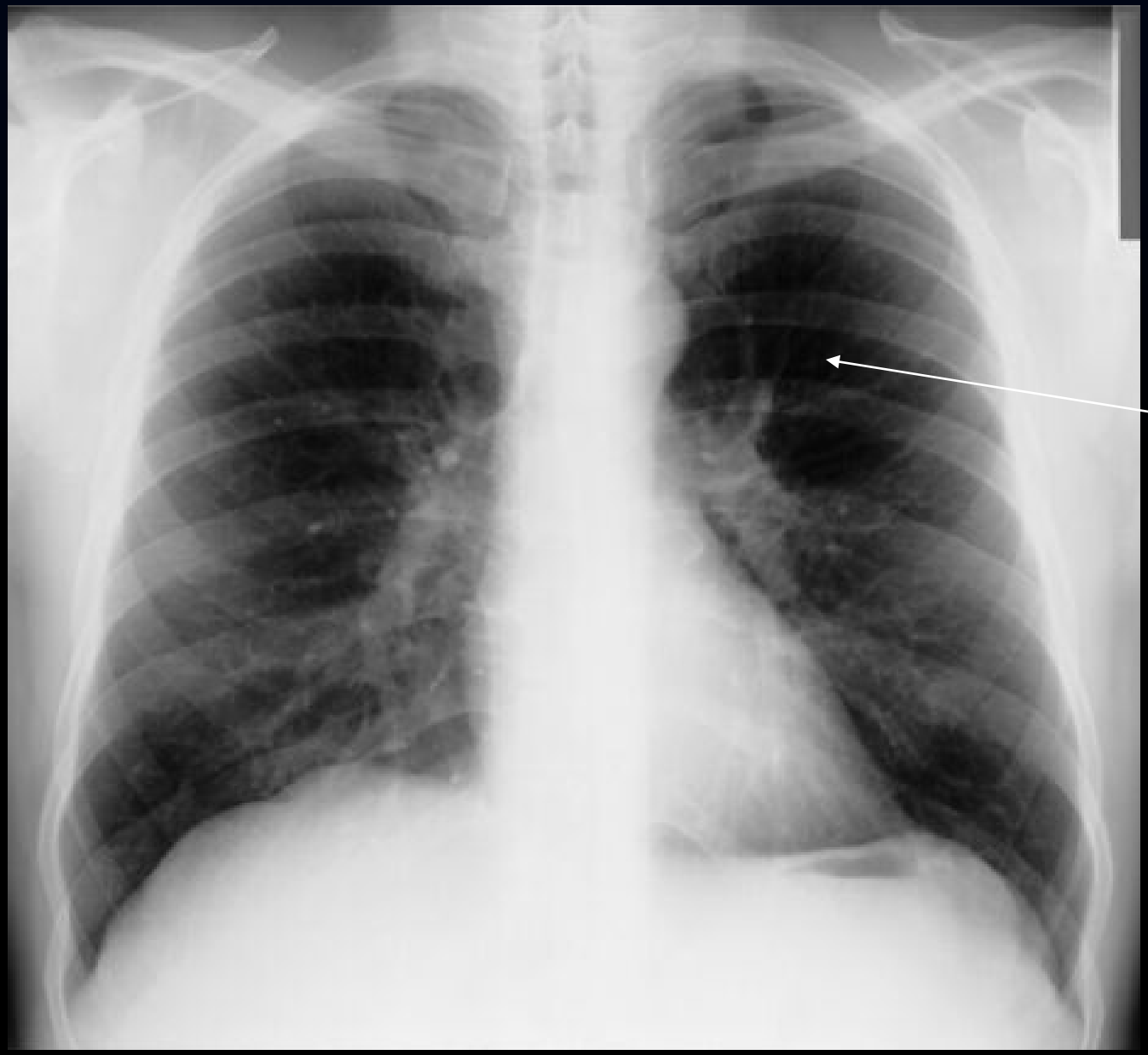
Question: If x-rays were blocked to the same degree by all body structures, could we see the internal parts of the body?

What are the 5 basic radiographic densities from black to bright white?

- Air
- Fat
- Soft tissue/fluid
- Bone/mineral
- Metal

Ways to improve your radiology skills

- The Radiology Handbook
- Learningradioilogy.com
- Auntminnie.com
- Web searches with key words “medical imaging”
- Surf the websites of medical schools



What density are the lungs?

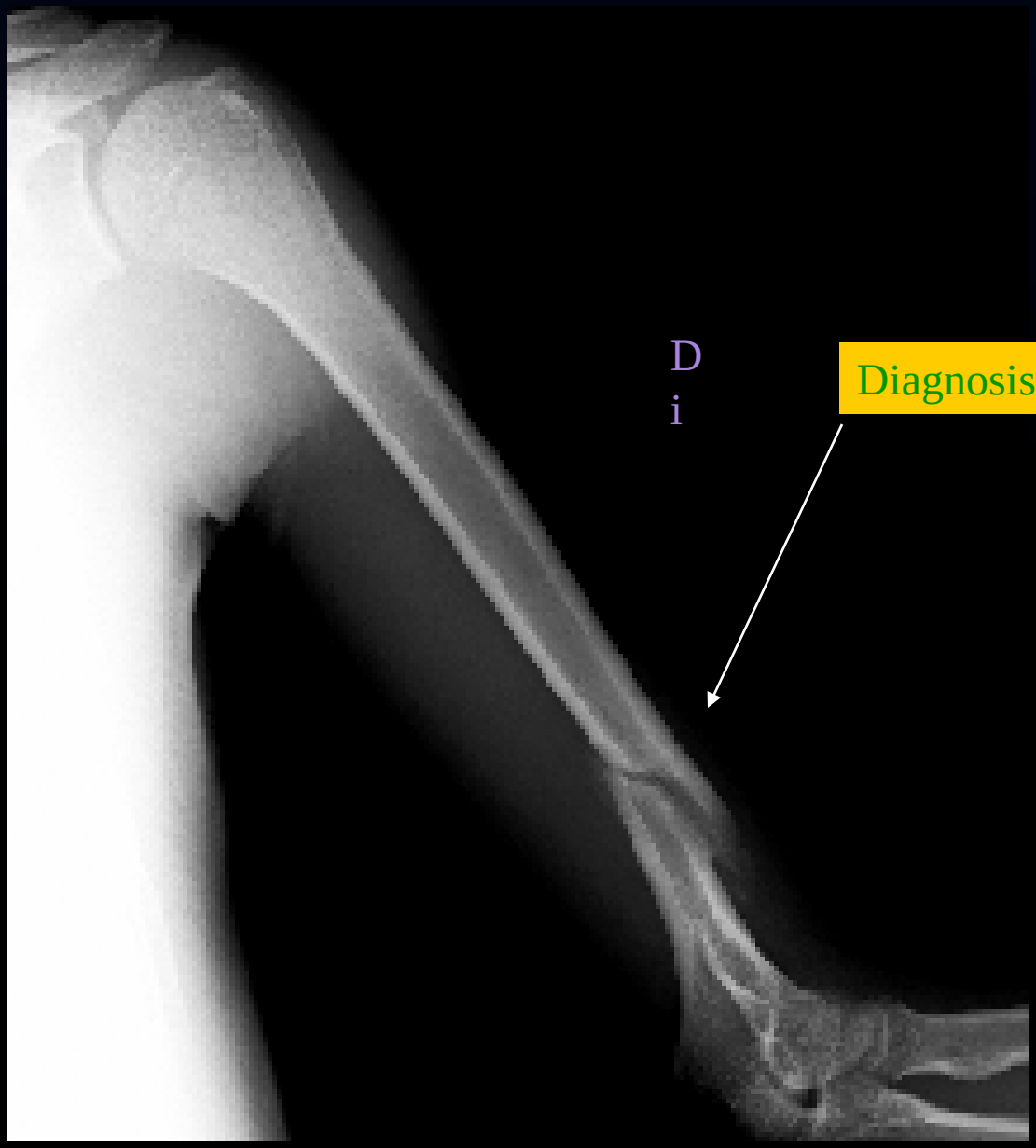
Why?

The list: air, fat, soft tissue, mineral and metal

CT scan of the abdomen

X-rays used

What density is this?

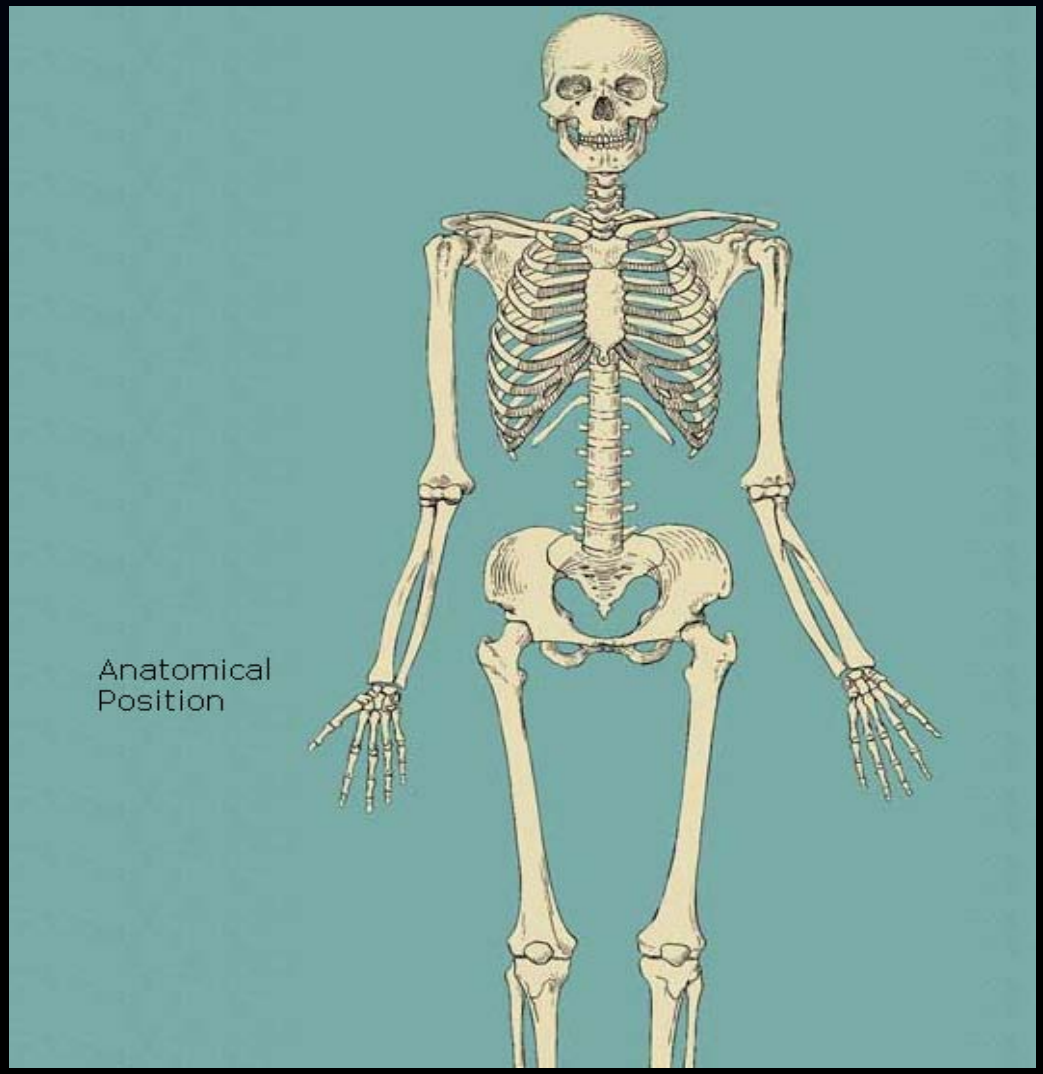

D
i
Diagnosis?

Radiographic Analysis

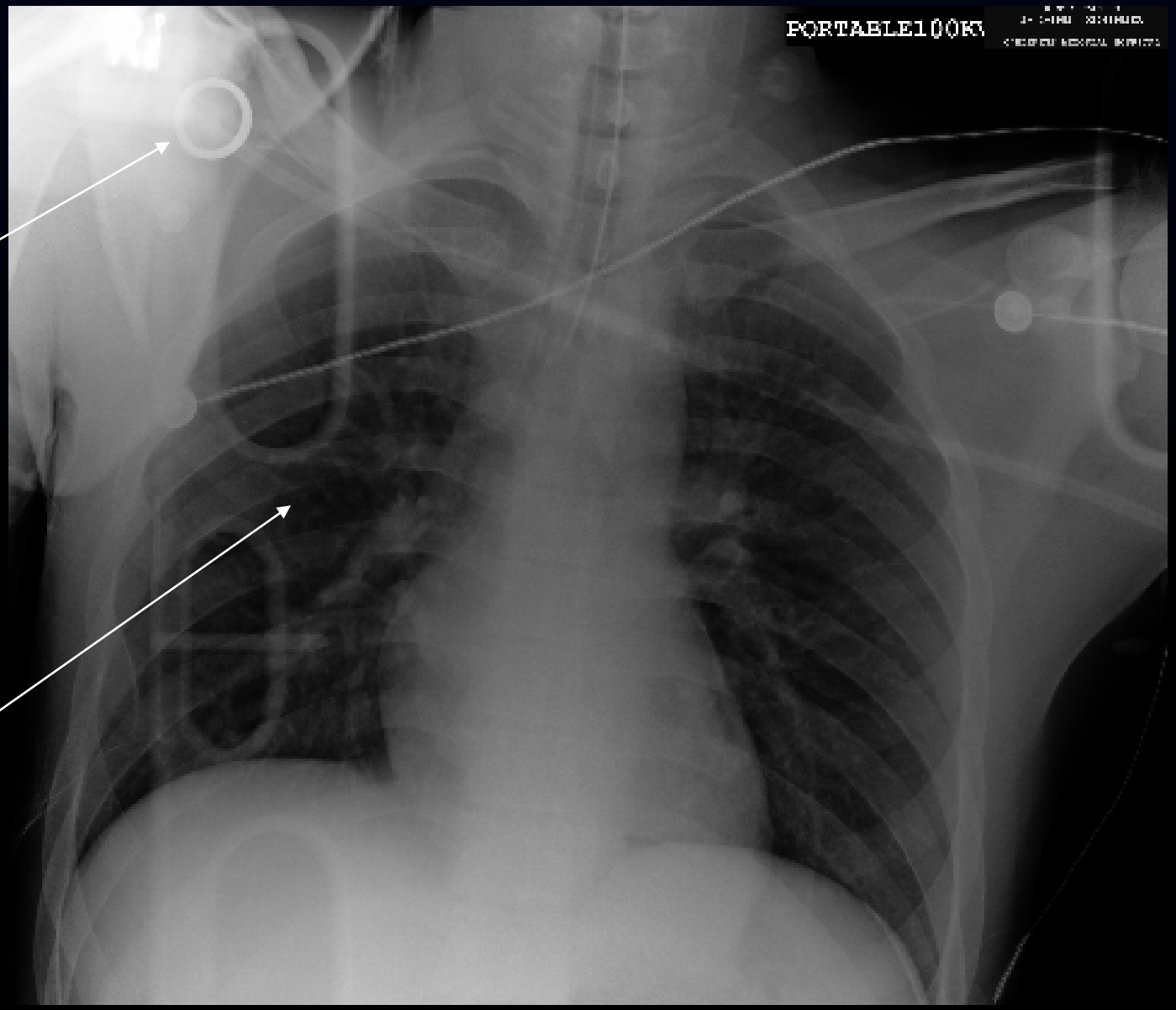
- Any structure, normal or pathologic, should be analyzed for:
  1. Size
  2. Shape and contour
  3. Position
  4. Density (You must know the 5 basic densities)

The anatomical position

right



left


PORTABLE100KV
Absorbed
Passed through

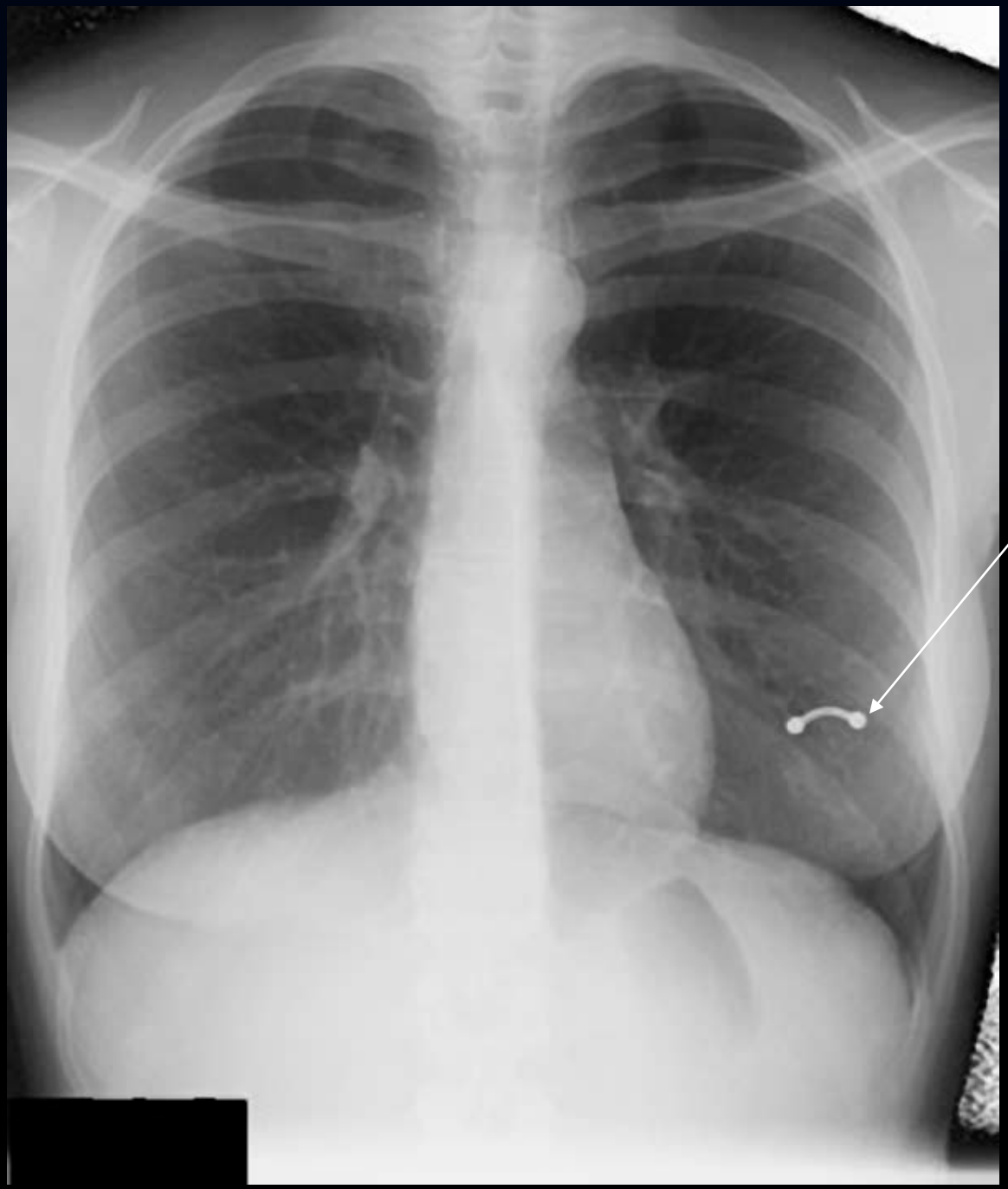
Medullary bone

Soft tissue

Metal

Note:
Right-left marker
Technologist’s initials

Name these densities


What density
is this?

Summary questions

- What 3 things when an x-ray encounters the body?
- How is it possible to see the heart on an x-ray?
- What are the 5 basic radiographic densities?
- What three things can you do to protect yourself from radiation?

Questions for me?