

# SCINTILLATION COUNTING EQUIPMENT

## LESSON OBJECTIVES:

1. Describe the interactions gamma rays and x-rays have with matter.
2. Recognize the components of a gamma energy spectrum.
3. Draw a schematic diagram of a scintillation detector.
4. Discuss the principle of operation of a scintillation detector.
5. Explain briefly what each component in a scintillation detector is responsible for.
6. Given a gamma ray of a known energy and a scintillation detector, determine if the absorbed photon is counted or rejected.

# **INTERACTIONS OF GAMMA RAYS AND X-RAYS WITH MATTER**

## **A. PHOTOELECTRIC EFFECT**

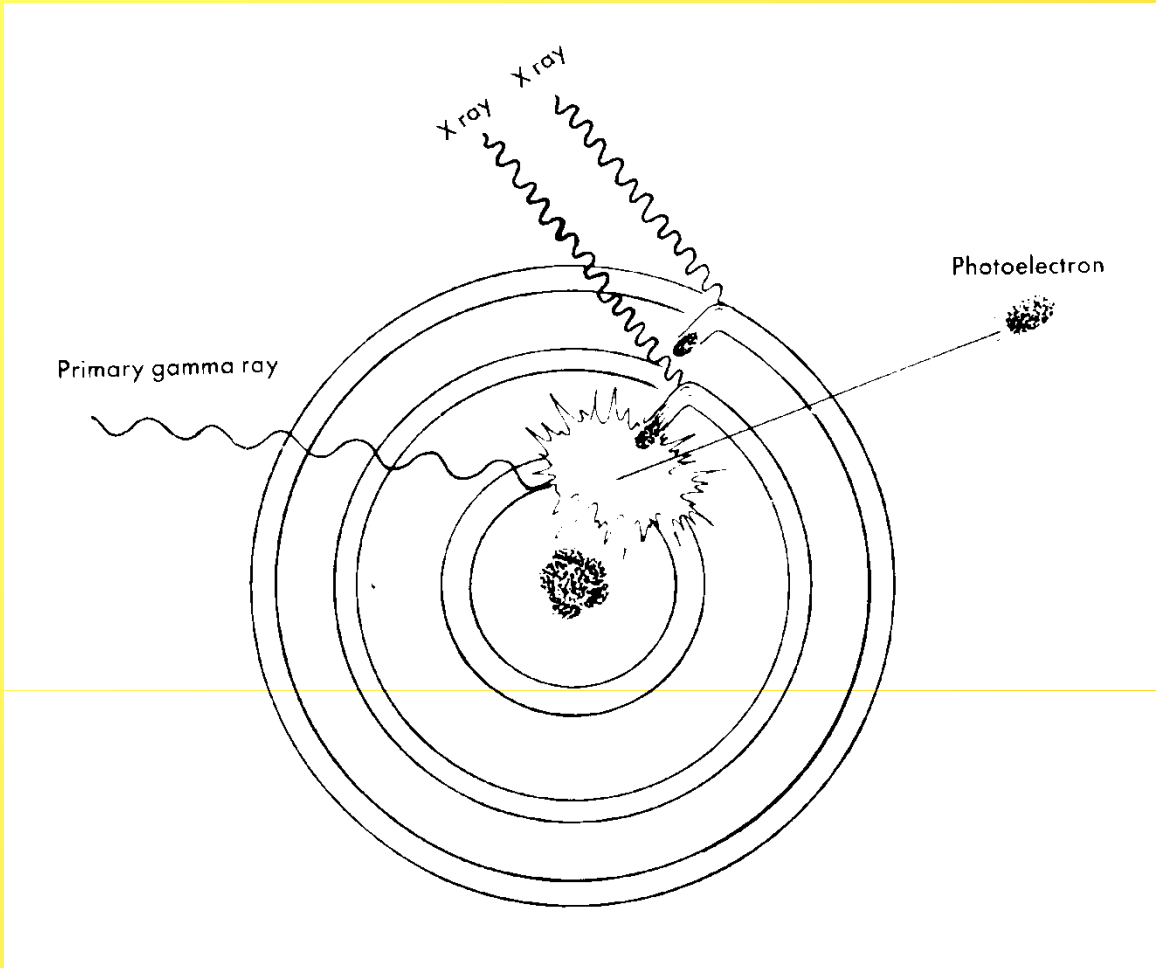
- 1. COMPLETE ABSORPTION**
- 2. IONIZATION PROPORTIONAL TO  
ABSORBED PHOTON**

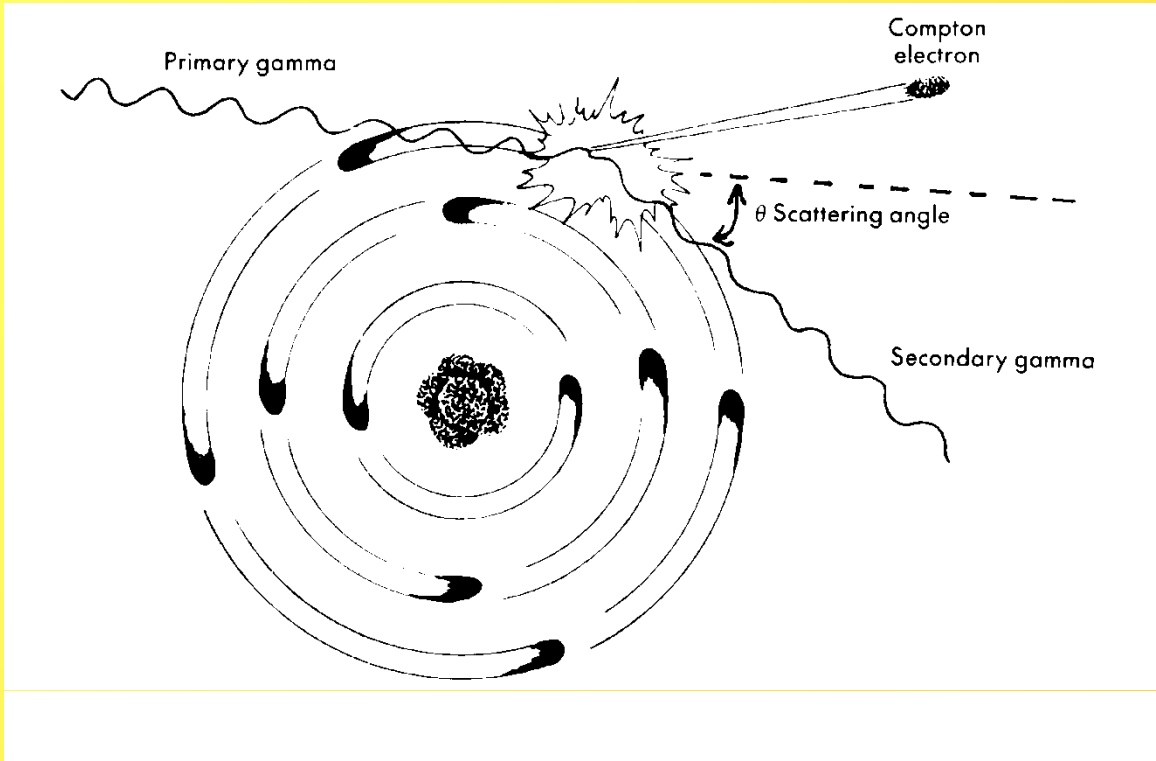
## **B. COMPTON SCATTER**

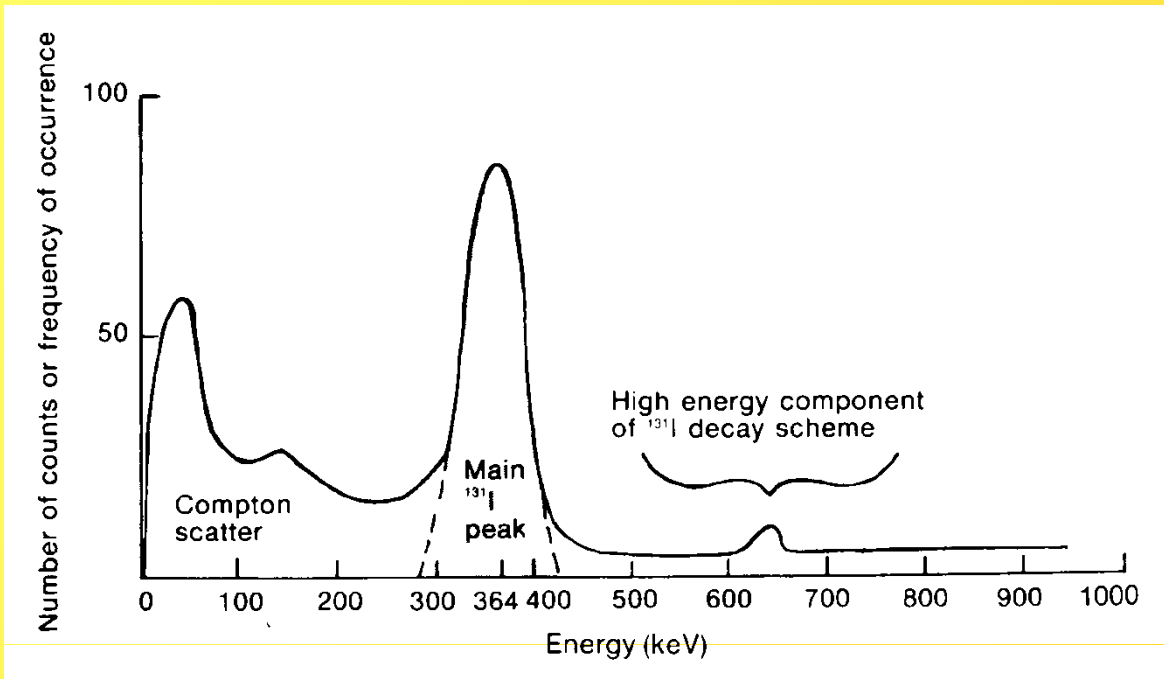
- 1. PARTIAL ABSORPTION**
- 2. IONIZATION DEPENDENT ON COLLISION**
- 3. SCATTERED SECONDARY PHOTON**

## **C. BACKSCATTER**

## **D. BACKGROUND RADIATION**







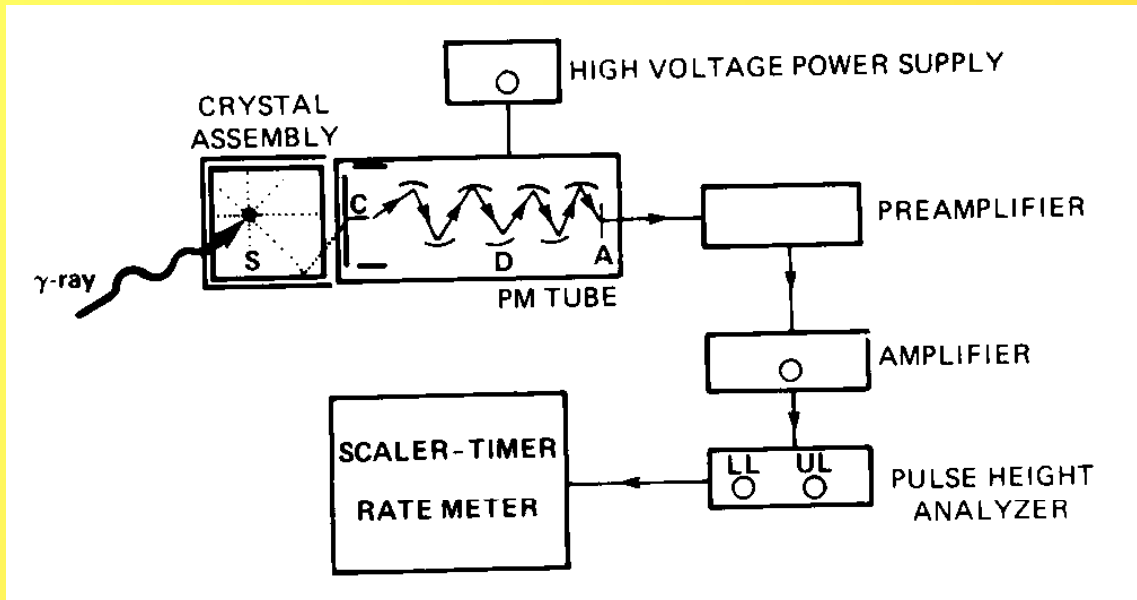
# **SCINTILLATION DETECTOR**

## **PRINCIPLE OF OPERATION**

1. RADIONUCLIDE'S PHOTON
  - A. TOTALLY ABSORBED
  - B. PARTIALLY ABSORBED
  - C. COMPLETELY MISSED
2. ABSORBED PHOTON ENERGY CONVERTED TO LIGHT
3. LIGHT CONVERTED TO AN ELECTRICAL PULSE WHICH IS AMPLIFIED THEN ANALYZED
4. PHOTON COUNTED OR REJECTED

# SCINTILLATION DETECTOR COMPONENTS

1. CRYSTAL
2. PHOTOMULTIPLIER TUBE
3. HIGH VOLTAGE SUPPLY
4. PREAMPLIFIER
5. AMPLIFIER
6. PULSE HEIGHT ANALYZER
7. DISPLAY DEVICE
  - A. SCALER
  - B. RATEMETER





# COMPONENTS OF SYSTEM

1. CRYSTAL - NaI (TI)
  - A. VERY DENSE
  - B. HIGH ATOMIC NUMBER
  - C. HIGH LIGHT YIELD
  - D. SHORT DURATION OF LIGHT YIELD
2. PHOTOMULTIPLIER TUBE: CONVERTS LIGHT INTO AN ELECTRICAL PULSE
3. HIGH VOLTAGE SUPPLY: HIGH VOLTAGE DISTRIBUTED TO THE DYNODES OF THE PMT
4. PREAMPLIFIER: PREVENTS THE PULSE FROM BEING LOST OR DISTORTED

## **COMPONENTS OF SYSTEM (CONT.)**

5. AMPLIFIER: INCREASES THE ELECTRICAL PULSE
6. PULSE HEIGHT ANALYZER: ANALYZES THE ABSORBED PULSE
  - A. LOWER LEVEL DISCRIMINATOR
  - B. SPECTROMETER
7. DISPLAY DEVICE: COUNTS THE ACCEPTED PULSES
  - A. SCALER
  - B. RATEMETER

# **NON-IMAGING COUNTING EQUIPMENT**

## **LESSON OBJECTIVES:**

1. LIST THE DIFFERENT TYPES OF NON-IMAGING SCINTILLATION DETECTORS
2. STATE THE USES OF THE DIFFERENT TYPES OF SCINTILLATION DETECTORS
3. DESCRIBE THE MAKEUP OF THE DIFFERENT TYPES OF SCINTILLATION DETECTORS

# **JCAHO REQUIRES THAT A QUALITY CONTROL PROGRAM BE IN PLACE TO MAINTAIN ACCREDITATION**

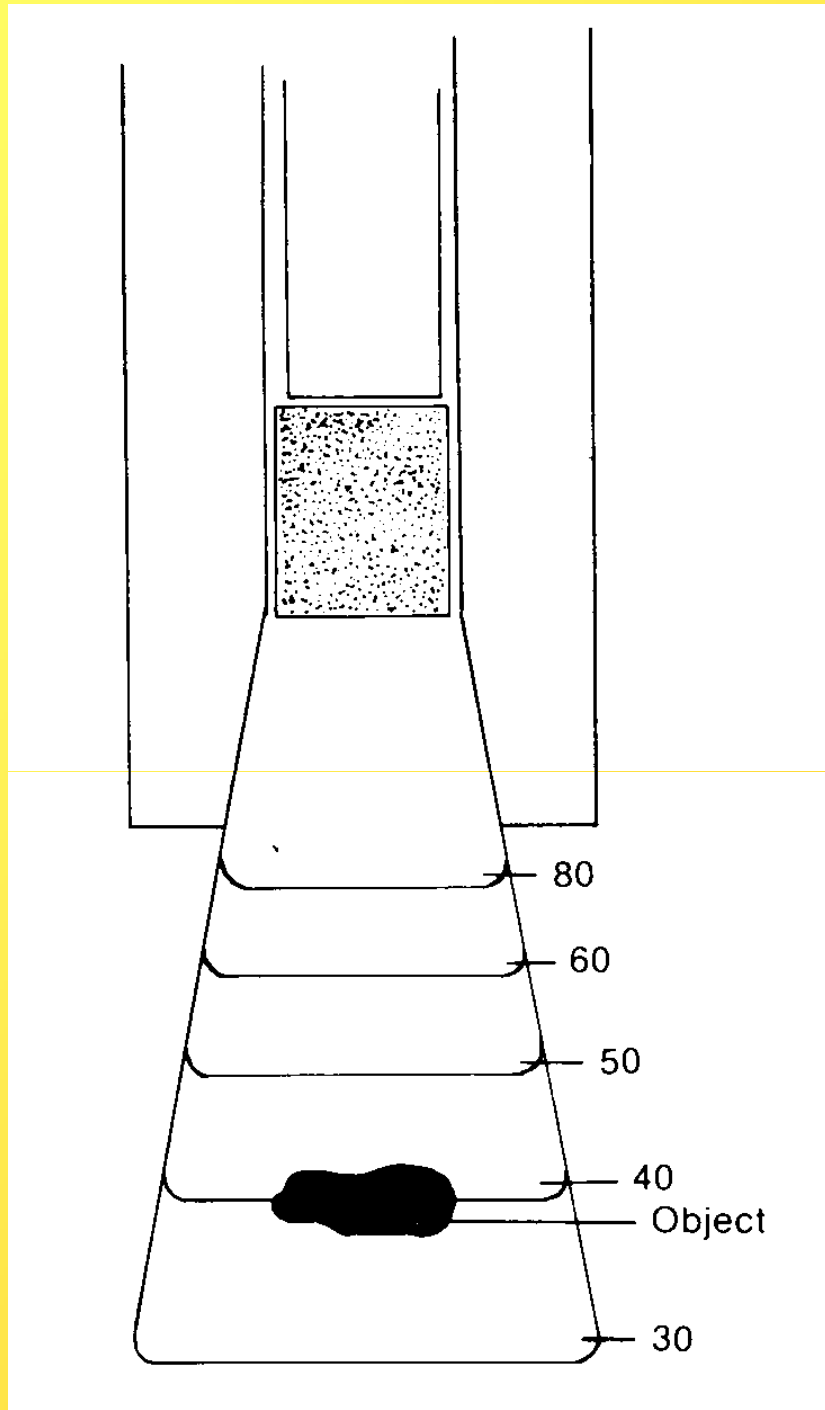
## **NON-IMAGING COUNTING DEVICES**

1. SCINTILLATION PROBE
2. SCINTILLATION WELL COUNTER
3. LIQUID SCINTILLATION DETECTOR

### **SCINTILLATION PROBE**

MAIN USAGE: THYROID UPTAKES

MAKEUP: 1 INCH THICK CRYSTAL  
FLAT-FIELD COLLIMATOR



## **SCINTILLATION WELL COUNTER**

### **MAIN USAGE:**

COUNTS BLOOD AND URINE SAMPLES  
COUNTS CONTAMINATION WIPE TESTS

### **MAKEUP:**

CRYSTAL HAS CENTRAL WELL  
COUNTING SAMPLE ALMOST COMPLETELY  
SURROUNDED

## **LIQUID SCINTILLATION COUNTER**

### **MAIN USAGE:**

COUNTS LOW ACTIVITY LOW ENERGY BETA  
PARTICLES

SCINTILLATION MATERIAL AND SAMPLE TO  
BE COUNTED ARE COMBINED IN LIQUID  
FORM

