**Activity 1: Topology Role Play (Human Network Simulation)**

**Objective:**

Students physically act as nodes and simulate different interconnection networks to understand structure and routing.

**Materials:**

* Labels or cards with node IDs
* Strings or yarn (to represent physical links)

**Procedure:**

1. Assign students node numbers (e.g., N0 to N7).
2. Create each topology:
   * **Ring**: Connect each student to two neighbors.
   * **Torus**: Form a grid with wrap-around links.
   * **Hypercube (3D)**: Use binary node labels (000 to 111) and connect nodes differing in one bit.
   * **Completely Connected**: Everyone connects to everyone (can be shown diagrammatically).
3. Simulate message passing from one node to another, showing hop counts and routing paths.
4. Discuss:
   * Bandwidth
   * Latency
   * Scalability
   * Fault tolerance

**Learning Outcome:**

Students visualize routing paths, understand link utilization, and differences in complexity.

**🔹 Activity 2: Network Metrics Comparison Table**

**Objective:**

Compare performance metrics of different network topologies.

**Procedure:**

1. Ask students (individually or in groups) to fill in a table for each topology:

| **Network** | **Diameter** | **Degree** | **Bisection Bandwidth** | **Scalability** | **Cost** |
| --- | --- | --- | --- | --- | --- |
| Ring | ? | ? | ? | ? | ? |
| Torus | ? | ? | ? | ? | ? |
| Hypercube | ? | ? | ? | ? | ? |
| Complete | ? | ? | ? | ? | ? |

1. Then, discuss the answers as a class.

**Learning Outcome:**

Promotes analytical skills and solidifies understanding of network performance metrics.

**🔹 Activity 3: Routing Path Exercises**

**Objective:**

Practice shortest-path routing on different network types.

**Instructions:**

Provide students with small-scale network diagrams (e.g., 4-node ring, 3D hypercube). Then ask:

* From Node A to Node B, list all possible shortest paths.
* What is the number of hops?
* Which topology gives minimum hops for arbitrary nodes?

**Example Prompt:**

"Find the shortest path from node 001 to 110 in a 3D hypercube."

**Learning Outcome:**

Students develop routing algorithms and appreciate differences in routing complexity.

**🔹 Activity 4: Simulation Using Network Simulators or Code**

**Objective:**

Use tools to simulate communication on networks.

**Tools:**

* NS2/NS3
* OMNeT++
* Python/Java custom simulation

**Task:**

Write a simple program that simulates message passing in a torus or hypercube.

Example:

python

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# Simulate 3D hypercube routing between two binary addresses

**Learning Outcome:**

Strengthens programming and simulation skills related to parallel architectures.

**🔹 Activity 5: Case Study Discussion**

**Objective:**

Explore real-world usage of interconnection networks.

**Task:**

Assign students to find examples of where each network is used (e.g., IBM Blue Gene uses 3D torus, Cray systems use hypercube variants).

They present:

* Architecture
* Why that topology was chosen
* Pros and cons in that application

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