True North and Magnetic Pole

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True North
The earth’s axis of rotation
Magnetic North
Where your compass points
Magnetic declination, or magnetic variation, is the angle on the horizontal plane between magnetic north (the direction the north end of a compass needle points, corresponding to the direction of the Earth’s magnetic field lines) and true north (the direction along a meridian towards the geographic North Pole). This angle varies depending on position on the Earth's surface and changes over time.
Grid North
Where the UTM grid lines “point” to
The North Reference you choose determines where 0° is when you measure an angle with your protractor or compass.
True v.s. Magnetic North
What is the difference here?

- Fruitvale Ave. is aligned with True North.
- So are the edges of parking lots 4 & 5.
- Let’s go take a bearing along the edge of lot 4 and see what we get…
USA Declination Map

East Declination
True North

Magnetic North

Magnetic North is > True North

West Declination
True North

Magnetic North

Magnetic North is < True North

3/3/2020
Prof. Erande M.R.
High Definition Geomagnetic Model

3/3/2020

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Declination Diagrams

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Declination changes over time

- Here in Northern California it changes by about 1° every 20 years.
- The declination shown on your topo map may be out of date.
- What about declination displayed by my GPS?
  - It probably correct as of the date of manufacture.
Local Anomalies

- May be as much as 90 degrees
  - 3-4 degrees is common

- North of Kingston, Ontario; 90° of anomalous declination.
- Kingston Harbor, Ontario; 16.3° W to 15.5° E of anomalous declination over two kilometers (1.2 miles); magnetite and ilmenite deposits.
- Savoff, Ontario (50.0 N, 85.0 W). Over 60° of anomalous declination.
- Ramapo Mountains, northeastern New Jersey; iron ore; compass rendered useless in some areas.
- Near Grants, New Mexico north of the Gila Wilderness area; Malpais lava flows; compass rendered useless.
Using your GPS & compass to measure current local magnetic declination

- d > 300m
- GPS
  - GOTO WPT001
  - Bearing 214° True
- Compass
  - Bearing to Palm
  - 200° Magnetic
- Current Local Magnetic Declination is
  - 14° East of True North

3/3/2020
Prof. Erande M.R.
Angular Error in GPS Bearing to Waypoint

\[
\tan(\alpha) = \frac{5}{d} = \frac{10}{2d}
\]

\[
\alpha = \tan^{-1}\left(\frac{10}{d}\right)
\]

<table>
<thead>
<tr>
<th>[d]</th>
<th>[\alpha]</th>
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<tr>
<td>100m</td>
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<td>200m</td>
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</tr>
<tr>
<td>300m</td>
<td>2°</td>
</tr>
<tr>
<td>400m</td>
<td>1.4°</td>
</tr>
<tr>
<td>500m</td>
<td>1.1°</td>
</tr>
<tr>
<td>600m</td>
<td>1.0°</td>
</tr>
<tr>
<td>700m</td>
<td>0.8°</td>
</tr>
<tr>
<td>800m</td>
<td>0.7°</td>
</tr>
<tr>
<td>900m</td>
<td>0.6°</td>
</tr>
<tr>
<td>1000m</td>
<td>0.57°</td>
</tr>
</tbody>
</table>
Using your map & compass to measure current local magnetic declination

From the map
Trail Jct -> Peak
68° True

Current local magnetic declination is (68 - 52)
16° E. of True North
Check your compass & sighting technique using these methods and the declination for the area

- Find some place near your home to establish your personal compass testing location.
- Identify several features, at least 1km away, that you can sight on.
- Use a map to determine True bearings to these features. Convert these bearings to Magnetic using the calculated declination for the area.
- Check your compass and technique. Experiment with your gear to see if it influences your compass.
- Keep notes, so you can repeat this in the future.
RIVERS AND ASSOCIATED LANDFORMS

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Presented By: Erande M.R.
Geomorphology

• Study of surface features of the Earth, curved by river; wind or glacial action.

• Evolution and structure of various landforms related to mountains, plains, plateaus, valleys and basins are specialized field of study within geomorphology.

• Fluvial Geomorphology
River

- Running water is the most important agent of erosion on the continents and the stream valleys are the most common landforms.

- Rivers flowing to the oceans drain about 68% of the Earth's land surface. The remainder of the land either is covered by ice or drain to closed basins.

- River gradually mould the land by eroding away the material in some place and depositing it in other
• A river system consists of a main channel (trunk stream) and all of the tributaries that flow into it or joining the trunk stream.

• **A RIVER SYSTEM CAN BE DIVIDED INTO THREE SUBSYSTEMS:**

• *collecting system* (branches) -- consisting of a network of tributaries in the headwater region, collects and funnels water and sediment to the main stream

• *transporting system* (trunk) -- the main trunk stream, which functions as a channelway through which water and sediment move from the collecting area toward the ocean. (Erosion and deposition also occur in a river's transporting system)

• *dispersing system* (roots) -- consists of a network of distributaries at the mouth of a river (delta), where sediment and water are dispersed into an ocean, a lake, or a dry basin

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Parts of River

- **tributary**: a stream flowing into or joining a larger stream
- **distributary**: numerous stream branches into which a river divides where it reaches its delta
- **upstream**: moves toward headwater (up the regional slope of erosion)
- **downstream**: moves toward mouth of river (delta)
- **Delta**: a large, roughly triangular body of sediment deposited at the mouth of a river
- **Meander**: a broad, looping bend in a river
- **Braided**: river is divided into multiple channels by alluvial islands. Braided rivers tend to have steeper gradients

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Stream Order

Drainage Basin

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FLUVIAL LANDFORMS

 Presented By: Erande M.R.
• Alluvial fans are fan-shaped deposits of water-transported material (alluvium).

• They typically form at the base of topographic features where there is a marked break in slope.

• Consequently, alluvial fans tend to be coarse-grained, especially at their mouths. At their edges, however, they can be relatively fine-grained.

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• Braided Rivers exhibit numerous channels that split off and rejoin each other to give a braided appearance. They typically carry coarse-grained sediment down a steep gradient.

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Meandering Pattern

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• In contrast to braided rivers, meandering rivers typically contain one channel that winds its way across the floodplain. As it flows, it deposits sediment on banks that lie on the insides of curves (point bar deposits), and erode the banks on the outside of curves.

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• Deltas form wherever rivers encounter standing bodies of water such as lakes or oceans.

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• The Ganges and Brahmaputra Rivers combined have formed one of the largest deltas in the world, comprising approximately 105,640 km².

• The Ganges River originates near the Tibet/India border, and then flows southeast across India to combine with the Brahmaputra in the country of Bangladesh.

• The Brahmaputra River has its source in Tibet along the northern slope of the Himalayas, and flows across Assam into Bangladesh. The drainage basin, approximately 1.6 million km² in area, is geologically young, with large volumes of unconsolidated sediment available for transport.

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Levees

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Oxbow lakes

Presented By: Erande M.R.
River system

Presented By: Erande M.R.
Hazard and Disaster Classification

By
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Major Categories

- Natural Hazards
- Anthropogenic Non-Intentional
- Anthropogenic Intentional
Earth Hazardous to your health?

- 516 active volcanoes, eruption every 15 days (average)
- 2,000 tremors daily
- 2 significant earthquakes daily, severe damage 15-20 times annually
- 1,800 thunderstorms at any given time
Still hazardous?

- Lightning strikes 100 times per second
- Late summer, an average of 5 hurricanes developing
- 4 tornadoes per day or 600-1000 annually
- 11 blizzards annually in the United States
Categories of Natural Hazards

- Atmospheric (Meteorological)
- Geological (Earth)
- Hydrological (Water)
- Extraterrestrial
- Biological
Atmospheric-Sourced Processes

- Tropical cyclones
- Thunderstorms
- Tornadoes
- Lightning
- Hailstorms
- Windstorms
- Ice storms
- Snowstorms
- Blizzards
- Cold waves
- Heat waves
- Avalanches
- Fog
- Frost
Geological-Sourced Processes

- Earthquakes
- Volcanoes
- Tsunami
- Landslides
- Subsidence
- Mudflows
- Sinkholes
Hydrological-Sourced Processes

- Floods
- Droughts
- Wildfires
Extraterrestrial Processes

- Meteorites
- Asteroids
Biological Processes

- Diseases
- Epidemics
- Pandemics
- Overpopulation
- Famine
Anthropogenic Non-Intentional

- Technological
- Hazardous Materials
- Environmental
- Industrial
- Mining
- Nuclear
- Transportation
- Structural
Technological

- Acts of People
- Technological systems that fail because of complexities and human fallibility (accidents)
Hazardous Materials

- Can classify in different categories
Environmental

- Can classify in different categories
Industrial

- Factories
- Refineries
Mining

- Coal
- Safety Standards
Nuclear

- Power plants
- Industrial use
- Medical use
Transportation

- Aviation
- Highways
- Railroads
- Maritime
Structural

- Fires
- Collapse
Anthropogenic Intentional Hazards

- Mass Shootings
- Civil Disobedience
- Terrorism
- Weapons of Mass Destruction
Mass Shootings

- School shootings
- Workplace violence
- Hate crimes
Civil Disobedience

- Labor riots
- Race riots
- Political riots
Terrorism

- State/State Sponsored
- International Non-state
- Domestic
Weapons of Mass Destruction

- Explosives
- Chemical
- Biological
- Nuclear/Radiological
DISASTER MANAGEMENT:

BY

M.R. Erande,
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### MAJOR DISASTERS IN INDIA : 1990 - 2005

<table>
<thead>
<tr>
<th>YEAR</th>
<th>PLACES &amp; DISASTER</th>
<th>LOSS OF LIVES (APPROX)</th>
<th>LOSS OF PROPERTY (Rs Crore) (APPROX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>Latur Earthquake</td>
<td>9500</td>
<td>6000</td>
</tr>
<tr>
<td>1997</td>
<td>Jabalpur Earthquake</td>
<td>200</td>
<td>5000</td>
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<tr>
<td>1999</td>
<td>Chamoli Earthquake</td>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td>1999</td>
<td>Orissa S Cyclone</td>
<td>9887</td>
<td>10000</td>
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<tr>
<td>2001</td>
<td>Bhuj Earthquake</td>
<td>14000</td>
<td>13400</td>
</tr>
<tr>
<td>2004</td>
<td>SE India Tsunami</td>
<td>15000</td>
<td>10000</td>
</tr>
<tr>
<td>2004</td>
<td>Assam &amp; Bihar Floods</td>
<td>700</td>
<td>5000</td>
</tr>
<tr>
<td>2005</td>
<td>J&amp;K Avalanche</td>
<td>350</td>
<td>100</td>
</tr>
<tr>
<td>2005</td>
<td>Mah, Guj, HP, Karnataka, T’Nadu Floods</td>
<td>1569</td>
<td>10300</td>
</tr>
<tr>
<td>2005</td>
<td>J&amp;K Earthquakes</td>
<td>1336</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>Total Losses of Major Disasters only</td>
<td>56542</td>
<td>64800</td>
</tr>
</tbody>
</table>

1. If Average Annual Lives Lost are Added, Figure Will go to More than 121,500
2. Adding Average Annual Losses, the Figure Will be More than 156,000 Cr
ECONOMIC LOSSES DUE TO DISASTERS

Annual- Impact on People
1. Losses in lives - 4334.
2. People affected - 30 Million.
3. Houses lost - 2.34 Million.

Annual- Financial Losses
Percentage of Central Revenue (for relief) – 12%.

Losses in Thousand Crores

<table>
<thead>
<tr>
<th>Period</th>
<th>Losses in Thousand Crores</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>91 - 95</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>96 - 00</td>
<td>54</td>
<td>50%</td>
</tr>
<tr>
<td>'01 - 05</td>
<td>86</td>
<td>139%</td>
</tr>
</tbody>
</table>

86,000 Cr
FACTORS RESPONSIBLE FOR INCREASING NUMBER OF DISASTERS

- Population Growth and Urban Development
- Development Practices
- Climatic changes
- Effect of Environmental degradation
Water: Too little, Too much

Leading cause of natural disasters
POLAR ICE CAPS ARE MELTING FASTER THAN EVER...
MORE AND MORE LAND IS BEING DEVASTATED BY DROUGHT...
RISING WATERS ARE DROWNING LOW-LYING COMMUNITIES...
Now it is very much evident that climate disruptions feed off one another in accelerating spirals of destruction.
MUMBAI FLOODS

1. Plans
   Existed on Paper But, Enforcement Lacking.

2. Police
   Most Crucial Responder - NOT Formally Part of Response Plan.

3. Timely Warning
   Technological Shortfall - Many Lives Could have Been Saved.
NATURAL DISASTERS – LESSONS LEARNT

1. Mitigation Systems Require Manifold Improvement & should be “Technology Driven”.

2. Weakness in “Early Warning Systems” and Dissemination of Information to Far Flung Areas.

3. Decision to Provide Aid:
   (a) Slow because of Procedures.
   (b) Request from States not backed by Proper Assessment.


5. Disaster Response Resources at State Level – Very Inadequate.

7. **Assistance from NGOs NOT Coordinated & Optimised**.

8. **People - Principal Actors** -- Focused Public **Awareness Campaign** a Must.

9. **Post Disaster Relief & Reconstruction - Lot of GAPS**.

10. **Positive Lesson** -- Role of the Armed Forces
DISASTER MANAGEMENT CYCLE

Preparedness → Prevention/Mitigation → Response/Relief → Rehabilitation → Reconstruction → Preparedness

Pre-disaster: risk reduction → Post-disaster: recovery

Emergency Response → Disaster

Preparation → Response → Recovery

Prevention → Mitigation → Rehabilitation
WHAT IS A DISASTER?

DISASTER is an event which is –
- generally unpredictable,
- happens instantly or without giving enough time to react
- affecting a large number of people,
- disrupting normal life and leading to a large scale devastation in terms of loss of life and property
- always finding the administration and affected people struggling to respond in the desired manner and
- leaving deep socio-psychological, political and economic after effects which persist for a long time to come.
CLASSIFICATION OF DISASTERS

- Natural, Man-made & Human-induced

✓ Disasters occur in varied forms
  - Some are predictable in advance
  - Some are annual or seasonal
  - Some are sudden and unpredictable

✓ Factors leading to a Disaster
  - Meteorological, Geological, Ecological or Environmental, Technological Etc.
NATURAL DISASTERS

- Floods
- Earthquakes
- Cyclones
- Droughts
- Landslides, Pest Attacks, Forest Fires, Avalanches etc.
TIME DURATION OF NATURAL DISASTERS

Earthquakes  ->  Seconds/minutes
Cyclones  ->  Days
Floods  ->  Days
Droughts  ->  Months
DISASTER MANAGEMENT CONTINUUM

DISASTER MANAGEMENT

MITIGATION

Risk Analysis
  Vulnerability Analysis
    Hazard Assessment
      Risk Assessment
        Prevention
          Structural Measures
            Warning and Evacuation
              Planning of Disaster Response
                Preparedness
                  Non-Structural Measures

RESPONSE

Rescue
  Relief
    Rehab
      Reconstruct & Recovery

LONG TERM MEASURES

Note

- Being done efficiently
- Needs better Planning
- No Substantial Work done so far
Zone V  MM IX or more
  "  IV  MM VIII
  "  III  MM VII

Zone II  MM VI
  "  I  MM V or less

Together now make

Zone II  MM VI or less

Area under the zones

V  12%
IV  18%
III  ~27%

Total damageable
  ~ 57%
WIND & CYCLONE HAZARD ZONES IN INDIA
FLOOD HAZARD PRONE AREAS OF INDIA
LANDSLIDES ZONATION MAP OF INDIA

- Severe Risk Area
- High Risk Area
- Moderate Risk Area
- Unlikely Occurrence
**Types of Disaster**: Earthquake, Cyclone, Tsunami, Flood, Drought & Landslide.

<table>
<thead>
<tr>
<th>Name &amp; No of States/UTs</th>
<th>1</th>
<th>4</th>
<th>10</th>
<th>17</th>
<th>3</th>
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<tr>
<td>Gujarat</td>
<td></td>
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<td></td>
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<tr>
<td>Maharashtra, AP, Orissa &amp; A&amp;N Islands</td>
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<td></td>
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<tr>
<td>NE States, W Bengal, Bihar, TN</td>
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<tr>
<td>Delhi, UP</td>
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<tr>
<td><em>Rajasthan</em></td>
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</table>

*Even though affected only by Drought but suffers heavy Financial Losses averaging Rs. 3 to 8 Thousand Crores, Annually.*
“In order to Coordinate Central Govt efforts in Preparedness, Prevention, Response, Mitigation, Relief and Rehabilitation and for adoption of a Holistic Pro-active Approach to Disaster Management, a NATIONAL DISASTER MANAGEMENT AUTHORITY has come into being by an Act of Parliament in December 2005 under the Chairmanship of Prime Minister as the NODAL AGENCY for Disaster Management in the Country.”
STRATEGY FOR DISASTER RISK REDUCTION
STRATEGIES FOR DISASTER MANAGEMENT

1. Change of Focus from Relief Centric to Holistic Approach.
2. Mainstreaming Disaster Management into all National Developmental Programmes.
3. Empowerment of the Community to face the Disaster.
5. Key Role of Educational and Professional Institutions for Mass Education and Awareness.
6. Upgradation of the Key Responders.
DISASTER MANAGEMENT:

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HAZARD

A dangerous condition or events that threaten or have the potential for causing injury to life or damage to property or the environment. Hazards are basically grouped in two broad headings:

- **Natural Hazards** (hazards with meteorological, geological or biological origin)
- **Unnatural Hazards** (hazards with human-caused or technological origin)

Natural phenomena are extreme *climatological*, *hydrological*, or *geological*, processes. A massive earthquake in an unpopulated area, is a natural phenomenon, *not a hazard*. But when these natural phenomena interact with the man made habitat, they may cause wide spread damage. Then, they become hazard
VULNERABILITY

Vulnerability is defined as "The extent to which a community, structure, service, or geographic area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrain or a disaster prone area."

- Physical vulnerability – weak buildings, bridges, service lines, lifeline structures, production units etc.
- Social & Economic vulnerability

Human losses in disasters in developing countries are seen to be higher when compared to developed countries.
Risk is a measure of the expected losses (deaths, injuries, property, economic activity etc) due to a hazard of a particular magnitude or Intensity occurring in a given area over a specific time period.

- **Exposure:** the value and importance of the various types of structures and lifeline systems (such as water-supply, communication network, transportation network etc in the community serving the population)
LESSONS LEARNT – HURRICANE KATRINA

“And any time you break that cycle of Preparing, Responding, Recovering and Mitigating, you are doomed to failure. And the policies and decision that were implemented by DHS put FEMA on a path to failure.”

-Michael Brown, Director, FEMA

General

1. The Foremost Lesson - all Facets of Disaster Cycle should be under one Agency and not split among Multi-facet Authorities.

Mitigation & Preparedness

2. State’s Sovereignty be maintained in all Phases of Disaster Cycle.

3. Creating Culture of Preparedness at Community level.


5. Removal of Red Tapism and Bureaucratic Approach. US National Response Plan is elaborate but Failed to Deliver. Need to Rewrite Rationale Response Plan to include, conduct of mock drills periodically, state-of-the-art system in supply chain management of relief supplies and inventory tracking.
6. Training and Equipping of Central Response Force duly backed by trained teams from Armed Forces

7. Safe Houses. Identify shelters, for accommodating evacuees, both in Govt and Private Sector, during Emergencies.


9. Use of Experts to find solutions to disaster related issues.

Communications

10. Failure within the DHS and in Communicating Relevant Information to Public, for Early Warning, resulting in all available Federal Assets not being utilised. Need to develop a more Comprehensive Emergency Communication System, to ensure Survivability, Operability, Inter-Operability and Redundancy.

Response

11. Disaster Response Group at Central level to resolve disagreements on Employment of Resources. This Group should also act as Single Window Assistance Access for public.

13. **Coordination**, between:

(a) Search & Rescue and Medical Teams.

(b) State and Central Response Teams

(c) Local (Distt), State and Central Response Teams, to have inter-operable Communication Network.

(d) At State level, Volunteer Coordinators in State Emergency Operation Centre, for coordinating Volunteer Efforts, like Debris Clearance, etc.

(e) **Integrated Command** at field level – local Response Units (National Guards) and Active Duty Forces (ex Armed Forces) to work in tandem. Mobile Command Field Centre near disaster site (not 80 km away in Baton Rouge like during Katrina).

14. **Need for National Emergency Operation Centre at DHS.** DHS to have a National Emergency Operations Centre, in addition to **White House Situation Room**, regardless of whether President & the Secretary DHS are in same place, to maintain flow of information from one agency.

15. **Integrated Response.** Civil and military assets to be combined and employed as one resource and NOT in a graduated manner.
STRATEGY FOR DISASTER RISK REDUCTION
STRATEGIES FOR DISASTER MANAGEMENT

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The Work of Rivers

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The Work of Rivers

The erosional work of streams/rivers carves and shapes the landscape through which they flow.

3 functions of rivers

a. Erosion

b. Transportation

c. Deposition

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The Work of Rivers

A. Erosion

• A river may erode in 4 ways

1. Abrasion/corrasion

Load carried by a river will grind against its bed and sides.

This process slowly wears the bed and sides away.

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A. Erosion

2. Attrition

When thrown against the sides and bed of rivers, the load gets broken into smaller pieces.
The Work of Rivers

A. Erosion

3. Hydraulic action

The work of turbulence in the water.

Running water causes friction in the joints of rocks in a stream channel.

Joints may be enlarged.

Loosened fragments of rocks get swept away.

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The Work of Rivers

A. Erosion

4. Solution/Corrosion

Certain minerals in rocks like limestone can be dissolved in water.

Rocks are then eroded.

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The Work of Rivers

Relationship of velocity and sediment size to erosion

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The Work of Rivers

B. Transportation (4 ways)

Presented By: Erande M.R.
B. Transportation (4 ways)

1. Traction

Larger and heavier rocks/gravels are dragged or rolled along the bed.
B. Transportation (4 ways)

2. Saltation (*saltim*: by leaps/jumps)

Smaller and lighter rock fragments and sand hop and bounce along the river bed.

*At times, the distinction between traction and saltation may be difficult to determine.*

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The Work of Rivers

B. Transportation (4 ways)

3. Suspension

Some of the load like silt and clay (fine-grained) will float along.

They may only be deposited when stream velocity reaches near 0.

Turbulence in the water is crucial in holding a load of sediments.

Presented By: Erande M.R.
B. Transportation (4 ways)

4. Solution

Some minerals are transported in dissolved form.

Especially chemical solution derived from minerals like limestone or dolomite.
The Work of Rivers

C. Deposition

A river will drop its load when:

a. Volume decreases

b. Speed decreases

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The Work of Rivers

C. Deposition

A river’s volume decreases when

• Dry season
• Dry region with high evaporation
• Presence of permeable rocks
• Receding flood waters

Presented By: Erande M.R.
C. Deposition

A river’s speed decreases when

- It enters a lake
- It enters a calm sea
- It enters a gently sloping plain

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The work of a river depends on its energy

Energy a function of

a. Volume of water

b. Speed of water flow (dependent on gradient)