

Design in theory

International Baccalaureate · IB Diploma · Design Technology · HL

Scope and prerequisites

This handout covers selected HL topics for the course first assessed in 2027; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

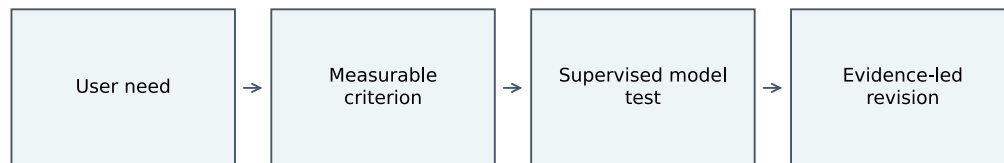
Designing for actual users

■ What would explain this observation?

- A handle that feels comfortable to its designer may exclude another user. Design evidence starts with the people and context of use.

■ Build the model

- Anthropometric data describe body dimensions.
- **Ergonomics** concerns the relationship between people, tasks and products.
- A design **specification** turns a user need into a measurable requirement.
- ergonomics: Designing the fit between people, tasks and products.
- specification: Measurable requirements a proposed solution should meet.



Turn a user need into a measurable criterion, test a model against it, then revise from the evidence

■ Choose evidence that can test it

- Choose data for the target population and task.
- Clearance often needs a larger-user percentile; reach may need a smaller-user percentile.
- A single mean dimension cannot satisfy every design constraint.

In the lab: Observe an approved low-risk task with consent, interview users without leading questions, and record measurable success criteria. Test an early model before committing to expensive materials. Do not collect unnecessary personal measurements.

■ Work from known quantities

- Known: a handle must withstand a 40 N use force with a design safety factor of 2.5.
- Target test load = use force $\times$ factor = $40 \times 2.5 = 100$ N.
- The factor is a design assumption to justify; it is not a substitute for a supervised safety review.

Your turn: A use force is 30 N and selected safety factor 3. Find target load.

■ Check the conclusion and its limits

- A specification is not a list of vague wishes such as nice or strong.
- User testing should evaluate measurable requirements and reveal conflicting needs.

Not true: A population mean dimension always accommodates every user. Designing for the mean fits the middle of a distribution and excludes the tails - often half the users. Ranges and percentiles, not the mean alone, decide accommodation.

Key:

- Anthropometric data describe body dimensions.
- Choose data for the target population and task.
- Watch for: A specification is not a list of vague wishes such as nice or strong.

■ Write from a target load of 80 N

- A handle must withstand a 20 N use force. The selected safety factor is 4.
- Find the target test load. The factor is a design assumption, not a safety review.

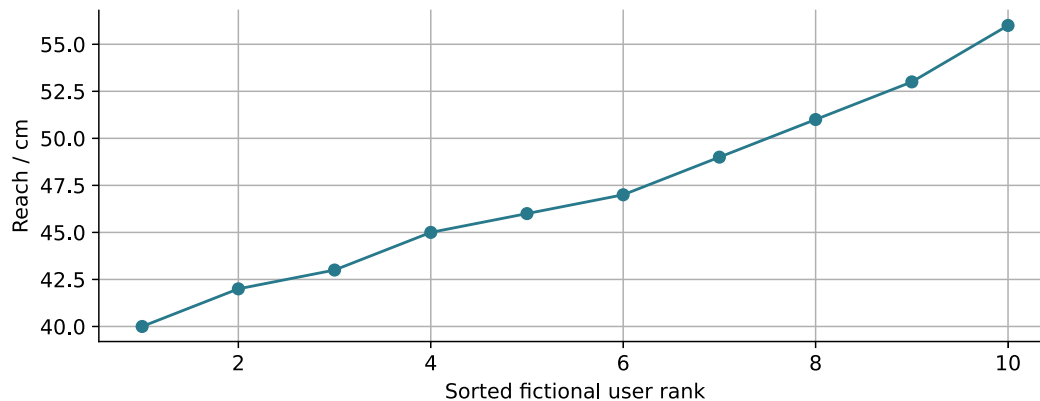
Ergonomics: fit a range of users

■ What would explain this observation?

- A handle sized for the average hand can exclude many intended users. Design decisions need a user range, task and context rather than one average.

■ Build the model

- **Anthropometry** measures body dimensions; **ergonomics** considers interactions between people, tasks and products.
- A percentile locates a value within a specified distribution.
- Choosing a lower or upper percentile depends on whether the dimension concerns reach, clearance or another function.
- Adjustable design may accommodate a broader range than a single fixed dimension.
- anthropometry: Measurement of human body dimensions for a specified population and method.
- ergonomics: Study of interactions between people, tasks and systems to inform design.



Ten sorted reaches from 40 cm to 56 cm: a reach dimension is set near the small end so short users are served

■ Choose evidence that can test it

- A clearance dimension often needs to consider larger relevant body dimensions, while reach can require smaller relevant dimensions.
- Neither principle automatically selects a universal percentile.
- The measured population, posture, clothing, capability and task determine relevance.

- Consider physical, perceptual and cognitive demands together rather than assuming body size explains every usability issue.

In the lab: Define a consenting user group and task. Use attributed data or anonymous teacher-approved measurements, record measurement posture and units, and test safe low-fidelity models before construction. Include users whose access needs differ. Set measurable acceptance criteria and retain qualitative feedback about grip, visibility and comprehension alongside dimensions.

■ Work from known quantities

- Known: sorted fictional reach measurements are 40, 42, 43, 45, 46, 47, 49, 51, 53 and 56 cm.
- Under a stated nearest-rank classroom convention, the 10th percentile uses rank $\text{ceil}(0.10 \times 10) = 1$, giving 40 cm; the 90th uses rank 9, giving 53 cm.
- A 53 cm control distance is beyond the recorded reach of eight users.
- The small fictional sample does not define a product standard.

Your turn: A stated nearest-rank method uses $\text{ceil}(p \times n)$. For $p=0.90$ and $n=20$, find the rank.

■ Check the conclusion and its limits

- Percentile methods differ, especially for small samples.
- A percentile is not a percentage of a body dimension.
- An average dimension and a successful test by one user do not establish accessible design.

Not true: A product dimension based on the mean automatically accommodates every intended user. Half of all users are above or below the mean, so a mean-based dimension excludes a large share by construction. Accommodation is judged across a range - often 5th to 95th percentile - not at the average.

Key:

- Anthropometry measures body dimensions; ergonomics considers interactions between people, tasks and products.
- A clearance dimension often needs to consider larger relevant body dimensions, while reach can require smaller relevant dimensions.
- Watch for: percentile methods differ, especially for small samples.

■ **Write from rank 12**

- A nearest-rank method uses the ceiling of percentile times sample size.
- The percentile is 0.80 and there are 15 sorted fictional measurements.

■ **Write from a percentile range**

- A door handle is placed for the 5th-percentile reach and sized for the 95th-percentile hand.
- The placement serves the shortest adult's reach; the size fits the largest hand – one product serving a RANGE, never the average user only.

■ **Write from an inclusive check**

- A control panel is tested on the design team, who are all right-handed.
- The sample proves nothing about left-handed or gloved users – inclusive design tests the full intended user range, not the designers.